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ABSTRACT

Government Grants, Plant Survival and Employment Growth: A Micro-Econometric Analysis*

In this paper we analyse the impact of governmental grant provision on plant performance. To this end we utilise rich information derived from three data sources for the manufacturing sector in Ireland, where grant provision has been an important part of the industrial policy. We use a matching technique combined with a difference-in-differences estimator in the empirical analysis. Our results indicate that particularly capital related, but also other types of grants can provide an important impetus to plant survival and employment growth. We also discover some differences in terms of the effectiveness of grants between foreign multinationals and domestic plants. Specifically, while grants have helped to stimulate employment creation in multinationals, they may not always be an effective way of ensuring that these remain in the host country. In contrast, grants have in general been successful in not only helping domestic plants to survive longer, but also to create more jobs.

JEL Classification: J2, L2, H2

Keywords: government assistance, grants, employment, survival, matching, difference-indifferences

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1 Introduction

It is well known that many governments around the world provide financial assistance, sometimes very generous, to manufacturing firms in some form or other. Such assistance is often justified in a number of ways. For instance, it has been argued that new and small firms face financial constraints (Hubbard, 1998) and governments may, hence, provide assistance in the form of low-interest rate loans or cash grants in order to help these overcome such constraints. Examples include the low interest loans of the *Japan Development Bank* (Beason and Weinstein, 1996) and the similar programme by the *Deutsche Ausgleichsbank* for Germany (Almus and Prantl, 2002). Also, government assistance may be aimed at improving the adoption of new technologies in targeted firms, as for example the *Manufacturing Extension Partnership* or the *Small Business Innovation Program* in the US (Jarmin, 1999, Jarmin and Jensen, 1997, Wallsten, 2000). Furthermore, government assistance may be aimed at firms in order to promote the industrial development of particular regions, such as the *Regional Selective Assistance* (RSA) in the UK (Harris and Robinson, 2001) or the regional policy subsidies administered by *NUTEK* in Sweden (Bergström, 2000).[1]

Given the extent of financial assistance globally it is, of course, important to also evaluate its effectiveness. In the empirical literature focusing on this issue 'effectiveness' is defined in a number of ways; for example, in terms of improved technology use (Wallsten, 2000), higher productivity (Harris and Robinson, 2001, Bergström, 2000, Beaston and Weinstein, 1996), or improved survival probabilities (Almus and Prantl, 2002, Jarmin, 1999). The evidence on effectiveness is, however, mixed. Using micro-level data, Almus and Prantl

[1] Of course, an argument against government assistance is that it does not allow market forces to work. If entry and exit is a way of reallocating resources to "best" uses (e.g., Jovanovic, 1982) then encouraging entry of sub-standard new firms or preventing exit of unproductive firms may lead to deadweight in the economy. In this

(2002), Jarmin (1999) and Bergström (2000) show that the receipt of financial assistance can improve the survival and growth prospects of the beneficiary firms, while Harris and Robinson (2001) find that RSA receiving firms are able to improve their productivity. In contrast, Bergström (2000) does not find that assisted firms are able to boost their productivity. Similarly Beason and Weinstein (1996) use industry level data to evaluate the effect of assistance in Japan and find no evidence of productivity enhancements as a result of the industrial policy measures.

The present paper contributes to the literature on evaluating the effectiveness of government grants given to industry. Specifically, we examine the impact of government assistance in the form of grants being paid to manufacturing plants in the Republic of Ireland. Ireland is a particularly interesting case study in this regard as grants have not only been used to improve the performance of domestic firms, but also (and some observers would argue much more importantly) in order to attract foreign firms to locate production facilities in the country (e.g., KPMG, 2003). We investigate whether grants impacted on the performance of grant receiving plants in terms of their survival prospects and employment performance.

There are a number of novelties in our paper compared to the previous literature. In contrast to earlier papers, which aim at evaluating one particular programme, we have information on all different forms of government grant assistance, since these are meticulously recorded by Forfás, the government agency responsible for industrial development, science and technology in Ireland. We can therefore evaluate the effectiveness of total grants and distinguish the effects of different types of grants on plants' performance. Furthermore, given Ireland's peculiar industrial structure, which relies heavily on foreign

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paper we do not attempt to justify theoretically the use of government assistance but start from the premise that it is widely used in practice.

multinational firms, in particular in high-tech sectors (e.g., Görg and Strobl, 2002), we are able to analyse the different effects of grants on domestic and foreign plants separately. As we show below, this unearths some surprising differences across these two groups.

In conducting our analysis we link information obtained from three rich plant level data sets collected by Forfás. First, we have access to unique plant level data on the population of grants being paid to all manufacturing plants located in Ireland. Second, we have data on the employment history of virtually the entire population of manufacturing plants which allow us to determine their entry and exit. These two data sets are further linked with data on plant level variables for a large sample of manufacturing plants.

A major concern in the analysis of the impact of government assistance programmes on the performance of beneficiaries relative to non-beneficiaries is the issue of selectivity and endogeneity. If the receipt of grants is related to some covariates that are correlated with performance but are not taken into account in the evaluation, then any potential effect being picked up in the evaluation may not necessarily reflect the true causal relationship between grants and performance. In order to take account of this issue we use the propensity score matching technique commonly used in the evaluation of labour market programmes (e.g., Dehejia and Wahba, 2002, Heckman et al., 1997), and we combine this technique with a difference-in-differences analysis. This is motivated by recent studies which argue that standard matching estimators are usually unsatisfactory, but in combination with difference-in-differences methodology can have the potential to "...improve the quality of non-experimental evaluation results significantly" (Blundell and Costa Dias, 2000, p. 438).

Our results show that grant provision, in particular capital, technology and research related, but also other types of grants, can provide an important impetus to plant performance, both in terms of plant survival and employment growth. Differentiating effects across nationality of ownership, we find that plant survival of domestic plants is receptive to the provision of capital, technology and research, as well as employment grants. The time a foreign plant spends in the host country, in contrast, is not necessarily extended by employment grants. Employment in both domestic and foreign plants is receptive to all different types of grant provision.

The rest of the paper is organised as follows. In the next section we outline the history and system of grant provision in Ireland. Section III describes our data sets used in the empirical analysis. The matching technology which creates are comparable (across grant provision) sample is discussed in the subsequent section. Empirical results of the effect of grant provision on plant survival and employment growth are presented in Sections IV and V, respectively. Concluding remarks are provided in the final section.

2 Government assistance to industry [2]

The provision of grants for industrial development has played an important part in most of the history of Irish industrial policy since the inception of the Irish republic in 1922. After an initial protectionist phase, characterised by near autarky protecting the Irish large agricultural and a very small domestic industrial base, stagflation and huge emigration in the late 1940s and early 1950s made it clear that there was a need for a new approach to industrial policy in Ireland. Grants for industrial development were first offered under the Underdeveloped Areas Act of 1952, which was enacted to assist the provision of an alternative source of employment to replace declining agricultural employment in rural sectors, specfically by providing cash grants of up to 50 per cent of the cost of machinery and equipment and up to 100 per cent of the cost of land and buildings and for the training of workers in certain underdeveloped areas of Ireland.[3] Additionally considerable explicit efforts were made to attract foreign direct investment, for example through export tax relief.

In the late 1950s further concern with the deteriorating national economic situation led to the erosion of the regional emphasis in favour of a more nationally oriented approach based on export-led growth. Subsequently the Anglo-Irish Free Trade Agreement was signed in 1965, which paved way for Ireland's eventual membership of the EEC in 1973. In conjunction with the existent export tax relief, access to European markets made Ireland an attractive location for multinationals. At the same time the industrial grant system was expanded, increasingly trying to develop the virtually non-existent technology intensive sectors.[4] The essence of this industrial strategy has remained an integral part of Irish industrial policy until today.

The agency primarily responsible for the provision of grant assistance in manufacturing in the modern era was the Industrial Development Agency (IDA) [5] until 1994[6], after which it was split into IDA Ireland and Forbairt - where the former is now responsible for the grant provision to foreign owned firms while the latter resides over assisting indigenous plants.[7] While there have been some changes in the provision of grants over time, provision within the time period examined in our empirical analysis can be safely summarised as follows (see KPMG, 2003). Projects suitable for assistance had to either involve the production of goods primarily for export, be of an advanced technological nature for supply to

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[2] This summary of the grant provision in Ireland is based on information in Cassidy (2002), Kennedy et al (1988), and Meyler and Strobl (2000).
[3] See Meyler and Strobl (2000) for details.
[4] While regional concerns still dominated in the 1970s, by the early 1980s a strategic industry approach, encouraging the attraction of multinationals and the development of an indigenous sector in technology intensive sectors became the primary concern. Nevertheless regions always remained of at least some concern.
[5] This is also the principal organisation for promoting industrial development in Ireland
[6] In the very early years, grant provision was under the authority of the Underdeveloped Areas Board before this responsibility was taken over by the IDA.

international trading or skilled self supply firms within Ireland, and/or be in sectors of the Irish market that are subject to international competition. In order to be eligible the applicant has to generally show that the project required financial assistance, is viable, has an adequate equity capital base, and, through financial assistance, will be able to generate new employment or maintain existing employment in Ireland, thereby increasing output and value added within the Irish economy.

Additionally, there is also a generally more favourable view of more technology intensive projects, those of firms located in (or planning to locate in) certain designated regions, and those of a more entrepreneurial nature. The range of grants that have been available to firms include capital grants, training grants, research and development grants, rent subsidies, employment grants, feasibility study grants, technology acquisition grants, and loan guarantees and interest subsidies. The actual grant level is generally very project specific and subjected to a cost-benefit analysis. Additionally, total grant levels can generally not exceed certain capital cost thresholds, usually between 45 and 60 per cent. Grants are usually paid in pre-specified instalments such that further payment is often subject to periodic reviews.

3 Description of the data

We utilise information from three data sources collected by Forfás, the Irish policy and advisory board with responsibility for enterprise, trade, science, and technology in Ireland. The first is the Forfás employment survey which is an annual plant level survey, conducted since 1972, with information on the nationality of ownership, sector of production, the start-up year and the level of employment each year. The response rate to this survey is

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[7] After 1998Forbairt become Enterprise Ireland as a consequence of a merger with the Irish Trade board.

argued by Forfás to be essentially 100 per cent so that the data can be seen to cover the entire population of manufacturing plants. This allows us to follow the life cycle of each plant as far as this falls within our sample period. More precisely a plant is considered to be a `start up' in its first year of positive employment, and to have exited once its employment level reaches zero.[8] One should also note that Forfás defines foreign plants as plants that are majority-owned by foreign shareholders, i.e., where there is at least 50 per cent foreign ownership. While, arguably, plants with lower foreign ownership should still possibly considered to be foreign owned, this is not necessarily a problem for the case of Ireland since almost all inward foreign direct investment has been greenfield investment rather than acquisition of local firms (see Barry and Bradley, 1997).

Our second data source is the Irish Economy Expenditure (IEE) Survey, collected from 1983 until 1998. This is an annual survey of larger plants in Irish manufacturing with at least 20 employees, although a plant, once it is included, is generally still surveyed even if its employment level falls below the 20 employee cut-off point.[9] The response rate to this survey has varied between 60 and 80 per cent. The information available from this source that is relevant to the current paper are the level of output, the level of employment, and total wages.

Finally, Forfás has an exhaustive annual database on all grant payments that have been made to plants in Irish manufacturing since 1972. Specifically, there is information on the level of payment, the year of payment and the (aforementioned) explicit scheme under which it was paid. For our empirical analysis we group schemes into three main categories, namely: Capital, Technology and Research Related (capital, research and development, and

[8] For plants where the first year of employment does not fall within our sample period frame we use information on the start-up year to determine the length of its existence.
[9] As discussed below, a unique plant identifier allows us to link data across information sources and hence we are able to distinguish non-responses from actual plant exits from the market.

technology acquisition grants), Employment Related (employment and training grants), and Other Types (feasibility study grants, rent subsidies, loan guarantees and interest subsidies).

In terms of using these three data sources in conjunction with each other one should note that Forfás provides each plant with a unique numerical identifier, which allows one to link information across plants and years. For the analysis here we use the grant data for classifying plants as grant recipients and the group of scheme, the IEE for all other plant level variables used in the analysis, and the employment survey to determine plant entry and exit. One should note that by linking information across data sources our sample consists of plants of a mostly larger nature, that is generally of at least 20 employees.

While the matched data set used in the econometric analysis below covers the period 1983 to 1998 due to the nature of the IEE data, we can use the grant data from 1972 onwards to chart the development of grant provision over this longer period. We have graphed total grant provision, decomposed into the three types, in Figure 1. As can be seen, grant provision was lower in the 1970s, peaking in the early 1980s, but has been fairly stable since the late 1980s. While capital, technology and research related and other types of grants played a much greater role in the earlier era, employment related grants have since the mid 1990s been the most important component of the Irish grant provision system. In Figure 2 we number plants and their proportion receiving grants. Accordingly, while the number of plants in Irish manufacturing has increased, in any year about 10 – 20 per cent of plants are supported by a grant payment. While Figure 3 reveals that on average the amount received was much higher in the 1970s and the first half of the 1980s, one discovers from Figure 4 that once one adjusts for the size of the firm, this difference is not as stark.

[Figures 1 - 4 here]

4 Matching and difference-in-differences methodology

The modelling problem is the evaluation of the causal effect of grant receipt on y, where y represents either plants' probability of survival or level of employment. Let $GRT_{it} \in \{0,1\}$ be an indicator of whether or not a plant received grants at time period *t*, and let y^1_{it+s} be the (log) hazard of exiting / level of employment at time t+s, $s \geq 0$. Also denote by y^0_{it+s} the employment (or exit hazard) of the plant *had it not received any grants.* The causal effect of the receipt of grants for plant *i* at time period t + s is then defined as

$$y^1_{it+s} - y^0_{it+s} \ . \qquad (1)$$

The fundamental problem of causal inference is that the quantity y^0_{it+s} is unobservable. Thus the analysis can be viewed as confronting a missing-data problem. Following the microeconometric evaluation literature (e.g. Dehejia and Wahba, 2002, Heckman et al, 1997), we define the *average* effect of grants on the plants receiving grants as

$$E\{y^1_{t+s} - y^0_{t+s} \mid GRT_{it} = 1\} = E\{y^1_{t+s} \mid GRT_{it} = 1\} - E\{y^0_{t+s} \mid GRT_{it} = 1\} \qquad (2)$$

Causal inference relies on the construction of the counterfactual for the last term in equation (2), which is the outcome the grants-receiving plants would have experienced, on average, in the absence of grants. This is estimated by the exit hazard / average employment of the plants that never received grants, i.e.,

$$E\{y^0_{it+s} \mid GRT_{it} = 0\} \qquad (3)$$

The calculation of (3) raises the problem of selectivity. If the receipt of grants is correlated with a number of observable plant characteristics but (3) were calculated as the average for all non-grants receiving plants then we would obtain a biased estimate. An important feature in the analysis is therefore the construction of a valid counterfactual, i.e., the selection of a valid control group that avoids the problem of selectivity. One way of doing so is by employing matching techniques. The purpose of matching is to pair each grant-receiving plant at each point in time with a non-grant plant in such a way that the latter's employment dynamics (or hazard pattern) can be studied to generate the counterfactual for the grant-receiving plants.

Since matching involves comparing grants and non-grants plants across a number of observable characteristics (e.g. productivity, employment, wages and industry characteristics), it would be difficult to determine along which dimension to match the plants, or what type of weighting scheme to use.[10] It is therefore desirable to perform the matching on the basis of a single index that captures all the information from those variables. We adopt the method of propensity score matching due to Rosenbaum and Rubin (1983) which suggests the use of the probability of receiving grants conditional on plant specific characteristics, to reduce the dimensionality problem.

Accordingly, we first identify the probability of receiving grants (or 'propensity score') using the following probit model

$$\begin{aligned} P(GRT_{it}=1) = F(&GRT_{it-1}, size_{it-1}, wages_{it-1}, \ labprod_{it-1}, age_{it}, \\ &foreign \ dummy, regional \ dummy, industry \ dummies) \end{aligned} \quad (4)$$

where *size* is measured in terms of log employment, *wages* are wages per worker, *labprod* is output per worker in firm i relative to average output per worker in the industry, *age* is plant age. Dummies are equal to one if the plant is foreign owned and if the firm locates in a non-designated region, respectively. Furthermore, the model includes a full set of four digit industry dummies. The choice of covariates attempts to capture, or be correlated with, some

[10] This is usually referred to selection on observables.

of the factors that the IDA may take into account when deciding on handouts of grants as discussed above.[11]

Now let P_{it} denote the predicted probability of receiving grants at time t for plant i (which is an actual grant receiver). A non-grants plant j, which is 'closest' in terms of its 'propensity score' to a grants plant, is then selected as a match for the latter using the 'caliper' matching method.[12] More formally, *at each point in time*[13] and for each grants plant i, a non-grants plant j is selected such that

$$l > \left|P_{it} - P_{jt}\right| = \min_{j \in \{no\ grants\}} \{| P_{it} - P_{jt} |\} \qquad (5)$$

where λ ?is a pre-specified scalar. This type of matching procedure is preferable to randomly or indiscriminately choosing the comparison group, because it is less likely to induce estimation bias by picking plants with markedly different characteristics.

This paper then employs a difference-in-differences estimator on the matched plants to isolate the role of grants in the employment dynamics (exit hazard) of plants.[14] This combination of matching and difference-in-differences analysis arguably improves the accuracy of the evaluation study (Blundell and Costa Dias, 2000).

The version of the combined matching and difference-in-differences estimator used can be described as follows. Firstly, the difference between the (log) hazard of exiting (or average employment) before and after the receipt of grants, say $\Delta^g y$, is calculated. Then this

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[11] For illustration, a probit of this form on the pooled data is reported in Appendix 1. Note that the coefficients are broadly as we would expect.
[12] The matching is performed in Stata Version 7 using the software provided by Sianesi (2001).
[13] Note that the matching strategy is only appropriate on a cross-section by cross-section basis. Once the matched plants are identified, we pool all observations on them to form a panel of matched plants. This panel is used in subsequent analyses.

difference is further differenced with respect to the before and after differences for the comparison control group, say Δy^c, to obtain the difference-in-differences estimator $d = \Delta^g y - \Delta^c y$.[15] Defining *GRANT* as a dummy variable equal to one if the plant receives a grant in time *t*, the regression

$$y_{it} = f + dGRANT_{it} + u_{it} \qquad (6)$$

should produce a coefficient *d* that can be interpreted as the average change in *y* due to the receipt of grants. In order to control for possible observable factors that may be correlated with changes in exit hazard or employment, we extend this basic framework by a vector of regressors which consists of different variables depending on whether we are examining the hazard model or the employment equation.

We implement the matching methodology on our linked data. Table 4.1 details the number of grant receiving plans and matched plants by year. Table 4.2 provides summary statistics for the matched and unmatched samples. As can be seen, in terms of grant recipients versus non-recipients, the matched firms show more (relative) homogeneity with regard to labour productivity, the incidence of foreign ownership, and age, while they are not too different, at least on average, in terms of the other control variables. As a matter of fact, using a simple t-test on the equality of means for each variable for each year, the hypothesis that that these are equal across the two groups could not be rejected in almost all cases.[16] In terms of disentangling differences within our matched group, which we will use for our subsequent

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[14] Having constructed the comparison group (say C) of plants that are similar to the grants plants (say G), a standard matching estimator of the causal effect of grants can be written as $d = \sum_{i \in G} (y_i - \sum_{j \in C} w_{ij}\, y_i)$ where the w_{ij} are the weights placed on the comparison plant *j*, which are generated by the matching algorithm.

[15] See Meyer (1994) for an excellent exposition of this methodology.

[16] Detailed results are available from the authors.

econometric analysis, one discovers that those firms that receive grants tend on average to be larger, younger, less productive, and pay higher wages than those that do not receive grants. The incidence of foreign ownership and the location of plants in the designated areas within Ireland is, in contrast, fairly similar.

[Tables 4.1 – 4.2 here]

5 The Hazard Model

Following the related empirical literature (for example, Disney et al., 2003, Agarwal and Audretsch, 2001, Audretsch and Mahmood, 1995) we utilise a Cox proportional hazard model for the empirical analysis of the effect of grants on the hazard of exiting. This model specifies the hazard function *h*(*t*) to be the following:

$$h(t) = h_0(t)e^{(bX + dGRANT + D_t)} \qquad (7)$$

where $h(t)$ is the rate at which plants exit at time t given that they have survived in t-1, h_0 is the baseline hazard function when all of the covariates are set to zero, X is a vector of plant and industry characteristics postulated to impact on a plant's hazard rate and D is a full set of time dummies to capture economy wide shocks.[17]

In line with the empirical literature (see Geroski, 1995) we include current plant size (measured in terms of employment) as independent variable in the vector X as it appears to be a stylised fact that large plants have better survival prospects than small ones, ceteris paribus. Further plant level controls used are plant labour productivity (relative to the three digit industry mean) and a nationality dummy which is equal to one if the plant is foreign owned. As Görg and Strobl (2003) find, foreign-owned plants in Ireland are more likely to exit the

[17] The Cox model is particularly suited since it does not require any restrictive assumptions regarding the baseline hazard, such as for instance a Weibull or lognormal specification. As pointed out in the literature on

industry than are domestic plants, all other things being equal. Also, industry growth (measured as employment growth in the three digit industry) is included since one would expect that plants in a growing industry will have higher survival rates as the competitive pressure in a growing industry may be alleviated (Audretsch, 1991).

We calculate a number of alternative measures of grants received in order to capture the effect of grants on plant survival. The first is a dummy variable equal to one if the plant received any grant payments at time *t*. This variable amalgamates the effects of a number of different grant types, as discussed above. In order to allow the potential effect on survival to differ by grant type, we calculate, second, three different grant type dummies which take on values of one if the plant received any employment related grants, capital, technology and research related grants, or other grants at time *t*. Third, we also investigate whether the amount of grants matters by including the log values of these three different grant types received by plant *i* in time *t*. These three groups of variables capture any contemporaneous effect of grants on plant survival. Arguably, one may also expect more long term effects. In order to capture these we re-calculate the three types of variables not only for time *t* but for the three year period *t*-2 to *t*. We decided on a three year period since we found when experimenting with longer lags that after three years the effect of grants on survival largely disappeared. Given that Görg and Strobl (2003) find different survival and employment adjustment patterns for domestic and foreign plants in the Irish manufacturing sector we allow the effect of grants to vary across the two nationality groups of plants.

By way of preliminary analysis we compare the survival of plants which receive any type of grants with those in the control group, calculating Kaplan-Meier (K-M) survival

survival analysis, the semi-parametric modelling approach of the Cox proportional hazard model is advantageous if the parametric form of the underlying baseline hazard function is not known with certainty.

functions separately for plants of these two groups.[18] The functions are plotted in Figure 1. Inspection shows that the survival function of plants that have received grants appears to be below that of the control group. For example, the probability of a plant surviving up to the age of 20 is 96 percent for control group plants compared with 94 percent for grant-receiving. However, a log-rank test which tests for equality of the survival functions across the two groups does not allow us to reject the null hypothesis that the two functions are not statistically different (c^2 = 1.56). Of course, the K-M functions do not allow us to control for any other confounding effects. In order to do so we turn to the estimation of the hazard model.

[Figure 5 here]

The results of estimating different specifications of equation (7) for the total sample of plants are presented in Table 5. All estimations are stratified by sector. This allows for equal coefficients of the covariates across strata (sectors), but baseline hazards unique to each stratum (sector). They also include time dummies to control for any common macroeconomic effects on plants' survival prospects. The tables report hazard ratios, which allow a fairly straightforward interpretation of the magnitude of the effect of the covariate on the hazard of exiting.

First of all, one should note that the coefficients on the control variables turn out largely as expected. Large plants and plants located in growing industries have higher probabilities of survival, ceteris paribus. The coefficients on the foreign dummy and the

[18] A K-M function gives the probability of surviving up to time *t* or beyond and is calculated as $\hat{S}(t) = \prod_{j|t_j \le t} \left([n_j - d_j]/n_j \right)$, where n_t is the population alive and d_t is the number of failures respectively at time *t*.

labour productivity variable are not statistically significantly different from zero, implying that there is no effect on the hazard of exiting from these variables.

Turning to the effect of total grants on survival of domestic plants we find that the receipt of grants has a positive effect at time *t*, although there does not appear to be a more long term effect from total grant payments (columns 1 and 2). Dividing total grants into the three separate components we find evidence that both employment and capital, technology and research grants positively affect survival of domestic plants. For example, in column (3) where we consider the short term effect of grants we find that domestic plants that received employment or capital, technology and research grants in *t* face hazards of about only one-third (0.26 and 0.42, respectively) of domestic plants that did not receive such grants. Column (4) indicates, however, that only capital, technology and research grants have a positive effect when considering grant receipts between *t* and *t*-2. We are not able to discern any statistically significant effects of other types of grants on survival probabilities of domestic plants.

[Table 5 here]

The coefficients for the effect of grant receipts for foreign plants highlights further the importance of capital, technology and research grants. From column (3) we find that plants that receive capital, technology and research grants have exit hazards of only about 48 percent of those plants that do not. Quite surprising, however, is that there is some evidence (although only statistically significant in one case) that the receipt of employment grants is positively correlated with the hazard of exiting. In other words, foreign plants that receive employment grants may be more likely to exit, ceteris paribus, than foreign plants that do not receive such financial assistance. One possible explanation is that employment related grants in foreign plants were mainly used to maintain current employment levels, that is were provided to firms that may have already been in difficulty.

6 Employment equations

We now turn to the analysis of the effects of government assistance on employment adjustment at the level of the plant. We extend equation (6) in order to control for possible observable factors that may be correlated with changes in employment,

$$y_{it} = bX_{it} + dGRANT_{it} + f_i + D_t + e_{it} \qquad (8)$$

where y is log employment in plant i at time t, X includes the log average wage in the plant, f_i is a fixed effect to account for unobservable plant-specific characteristics and D_t is a full set of time dummies to capture economy-wide shocks.

Equation (8) is an *unconditional* labour demand model in the sense that the employment function is not conditioned on the output of the plant. The coefficient on the grant dummy variable (d) can be interpreted as the average employment effect of grants. For example, $d > 0$ would suggest that grants help create jobs. A number of studies that seek to identify the labour market consequences of ownership change have employed variants of this unconditional labour demand model (see, inter alia, Brown and Medoff, 1988 and McGuckin et al., 1995).

The concept of unconditional labour demand is distinct from the argument that underpins the idea of *conditional* (derived) labour demand schedules (see, for example, Nickell, 1986 and Bresson et al., 1996). Such demand schedules condition labour demand on the output produced by the plant (or to be more precise on expected product demand). Hence, in the estimation of such a model we also include log output by plant i in the vector X in equation 8. In a conditional labour demand framework, $d > 0$ can be taken as evidence that plants in receipts of grants require more labour input to produce a given level of output. In other words, δ captures the labour efficiency/ inefficiency effects of grants. The estimation of both conditional and unconditional labour demand models helps distinguish between labour efficiency-enhancing effect and pure job creation/destruction effect of grants.

We estimate both unconditional and conditional labour demand equations via fixed effects techniques to control for the potential endogeneity of wages and output.[19] Given that the hazard estimations above suggested that there are substantial differences between foreign and domestic owned plants in their responses to grant receipts we also estimate the employment equations separately by allowing for the impact of grants to vary across these two groups of firms. Also, we focus only on the "long term" effects of grants by including the variables for grant receipts at any time between *t* and *t*-2. The estimation results are reported in Table 6. Note that, for both estimations, the coefficients on wages and output are as expected. Wage increase causes statistically significant decrease in the level of labour demand while an increase in output is associated with an increase in labour input.

Turning our discussion to the impact of grants on employment, Table 6 shows that capital, technology and research grants represent the most important components of grants as far as unconditional labour demand is concerned. For foreign plants, receipt of such grants in the last three years leads on average to a 15.7% increase in labour demand, and a 1% increase in the amount of these grants received causes a 2.3 % employment growth. It is interesting to note that receipt of employment grants is not associated with as economically significant effects, with a 10% increase in employment grants leading to less than one percent change in employment. Finally receipt of "other" types of grants does not appear to have any effect on

[19] In all specifications, Hausman tests comparing the fixed versus random effects models indicate that the former is appropriate.

foreign plants' unconditional labour demand trajectory when the model is estimated with grant dummies, while a small negative effect is detected when the log of grants size is used instead.

For domestic plants capital, technology and research grants have similarly the more pronounced effects on unconditional labour demand, although the effects are smaller compared to foreign plants. As can seen from Table 6, employment grants and other types of grants have also discernible positive employment effects. Overall our difference-in-differences estimates of the impacts of government grants point to the conclusion that receipt of such grants is conducive to economically as well statistically significant job creation.

The estimates[20] from the conditional labour demand show that, conditioning on output, the receipt of other grants reduces employment for foreign plants (we find positive effects amongst domestic plants). This indicates that some (modest) rationalisation in the use of labour has occurred for foreign plants in receipt of other grants and, for given levels of output, less labour is employed. By contrast receipt of capital, technology and research and employment grants, which are positively associated with conditional labour demand for both foreign and domestic plants, seems to lead to some inefficiency in the use of labour in both foreign and domestic plants. For example, for a foreign plant in receipts of 10 percent more capital, technology and research grants than otherwise equivalent (in terms of wages and outputs) plant, employs 1% more workers. This finding is consistent with the interpretation that plants are hoarding workers they may not need (given their expected output), at least in the short run.

[Tables 6 here]

[20] Here we are referring to the estimates based on the actual amount of grants received, rather than the model with dummy variables.

7 Conclusions

While many governments provide financial assistance to their firms, the evidence on the effectiveness of this `strategy' is not only fairly sparse but also mixed. In this paper we set out to investigate whether the grant provision system in the Irish manufacturing sector has succeeded in enhancing plant performance. Our results indicate that in general grant payments have helped plants to survive longer in Ireland. This result is particularly clear-cut for domestic plants, for which grants of all types have provided an important impetus. In contrast, not all grant types have successfully aided multinational plant survival. We also find that most grant provision has been a positive determinant of employment creation in domestic and foreign plants.

In terms of policy relevance these empirical findings imply that grant provision can be an effective means to enhance firm performance. For one, it can serve as an instrument of employment creation. While it can also be an important impetus in plant survival, particularly for domestic plants, policy makers may want to take note that it may not always ensure that multinationals remain in the host country.

References

Agarwal, R. and Audretsch, D.B. (2001) "Does entry size matter? The impact of the life cycle and technology on firm survival", *Journal of Industrial Economics*, Vol. 49, pp. 21-43.

Almus, M. and S. Prantl (2002) "Die Auswirkungen öffentlicher Gründungsförderung auf das Überleben und Wachstum junger Unternehmen", *Jahrbücher für Nationalökonomie und Statistik*, vol. 222, pp. 161-85.

Audretsch, D.B. (1991) "New-Firm Survival and the Technological Regime", *Review of Economics and Statistics*, Vol. 60, pp. 441-450.

Audretsch, D.B., and Mahmood, T. (1995) "New-Firm Survival: New Results using a Hazard Function", *Review of Economics and Statistics*, Vol. 77, pp. 97-103.

Barry, F. and Bradley, J. (1997) "FDI and Trade: The Irish Host-Country Experience", *Economic Journal*, Vol. 107, pp. 1798-1811.

Beason, R. and D.E. Weinstein (1996) "Growth, economies of scale, and targeting in Japan (1955-1990), *Review of Economics and Statistics*, Vol. 78, pp. 286-295.

Bergström, F. (2000) "Capital subsidies and the performance of firms", *Small Business Economics*, Vol. 14, pp. 183-193.

Blundell, R. and Costa Dias, M (2000) 'Evaluation methods for non-experimental data', *Fiscal Studies*, Vol. 21, pp. 427-468.

Bresson G, Kramarz F and Sevestre P (1996) Dynamic Labour Demand Models. Chapter 9 in: Matyas, L. and P. Sevestre (Eds.) *The Econometrics of Panel Data: Handbook of Theory and Applications*. Kluwer Academic Publishers: Dordrecht.

Brown C. and Medoff J.L. (1988) The impact of plant acquisition on labor. In A.J. Auerbach (ed.) *Corporate Take-overs: Causes and Consequences*. University of Chicago Press: London and Chicago, 9-25.

Cassidy, Mark (2002), "The Irish Economy: Recent Experience and Prospects", in R. Aronson, V. Munley and R. Thornton (eds.), *The Irish Economy in Transition: Successes, Problems and Prospects*, Amsterdam: Elsevier Science, pp 5-30.

Dehejia, Rajeev H. and Sadek Wahba (2002), "Propensity score matching methods for nonexperimental causal studies", *Review of Economics and Statistics*, Vol. 84, pp. 151-161.

Disney, R., Haskel, J. and Heden, Y. (2003) "Entry, exit and establishment survival in UK manufacturing", *Journal of Industrial Economics*, Vol. 51, pp. 91-112.

Geroski, P.A. (1995) "What do we know about entry?", *International Journal of Industrial Organization*, Vol. 13, pp. 421-440.

Görg, H. and Strobl, E. (2002) "Multinational companies and indigenous development: An empirical analysis", *European Economic Review*, Vol. 46, pp. 1305-1322.

Görg, H. and Strobl, E. (2003) "Footloose Multinationals?", *The Manchester School*, Vol. 71, pp. 1-19.

Harris, R. and C. Robinson (2001) "The impact of regional selective assistance on UK manufacturing total factor productivity, 1990-98", paper presented at CEPR/ESRC Workshop, London, October 2001.

Heckman, J., Ichimura, H., Smith, J. and Todd, P. (1997) 'Matching as an Econometric Evaluation Estimator: Evidence from Evaluating a Job Training Programme', *Review of Economic Studies*, vol. 64, pp.605-654.

Hubbard, R.G. (1998) "Capital market imperfections and investment", *Journal of Economic Literature*, Vol. 36, pp. 193-225.

Jarmin, R.S. (1999) "Government technical assistance programs and plant survival: The role of plant ownership type", Center for Economic Studies Discussion Paper 99-2, US Bureau of the Census, Washington DC.

Jarmin, R.S. and Jensen, J.B. (1997), "Evaluating government technology programs: The case of manufacturing extension", in *Policy Evaluation in Innovation and Technology: Towards Best Practices*, OECD, Paris.

KPMG (2003), *Investment in Ireland*, KPMG Publications Limited, Dublin (available at http://www.kpmg.ie/inv_irl/Pubs/Investment.pdf)

Kennedy, K., Giblin, T. and McHugh, D. (1988), *The Economic Development of Ireland in the Twentieth Century*, London: Routledge.

McGuckin R.H., Nguyen S.V. and Reznek A.P., (1995) 'The impact of ownership change on employment, wages and labor productivity in US manufacturing 1977-1987', Center for Economic Studies Discussion Paper 95-8, US Bureau of the Census, Washington DC.

Meyer, B. (1994): "Natural and quasi-experiments in economics", NBER Technical Working Paper No. 170.

Meyler, A. and Strobl, E. (2000), "Regional industrial policy and job generation in Ireland", *Economic and Social Review*, Vol. 31, pp. 111-128.

Nickell S. (1986) Dynamic models of labour demand. In: O.Ashenfelter and R.Layard (Eds.) *Handbook of labour economics, Vol. 1,* Amsterdam, North Holland.

Rosenbaum, P. and Rubin, D.B (1983) 'The central role of the propensity score in observational studies for causal effects', *Biometrika*, vol. 70, pp.41-55.

Sianesi, Barbara (2001) 'Implementing propensity score matching estimators with Stata', program available at http://fmwww.bc.edu/RePEc/usug2001/psmatch.pdf

Wallsten, S.J. (2000) "The effects of government-industry R&D programs on private R&D: The case of the Small Business Innovation Research Program", *RAND Journal of Economics*, vol. 31, pp. 82-100.

Figure 1: Total Grant Provision

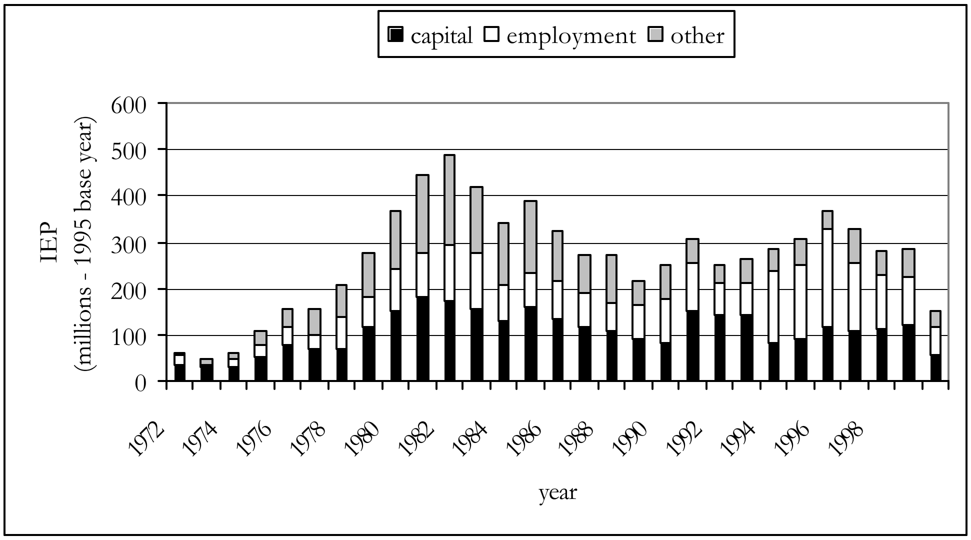

Figure 2: Number of Plants – Grant versus non-Grant Recipient

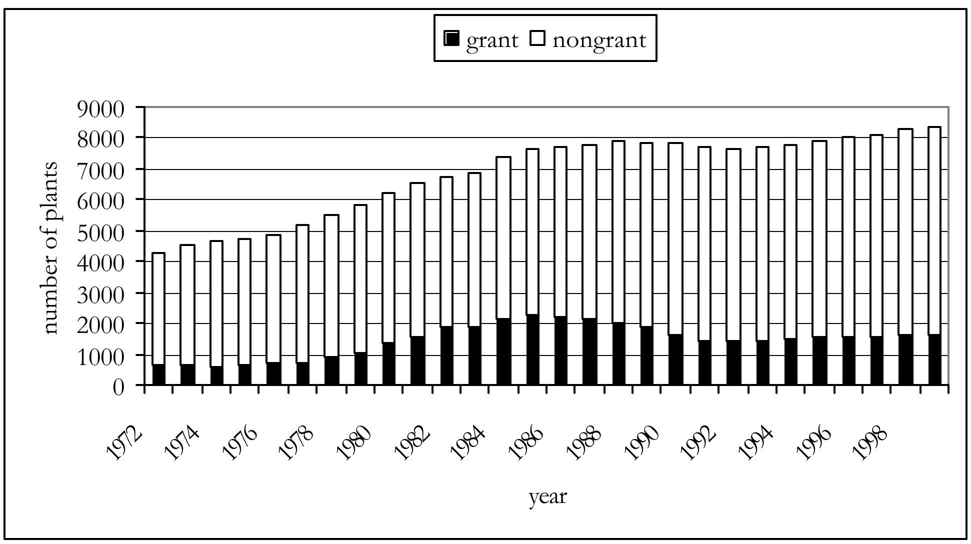

Figure 3: Average Grant Amount per Recipient

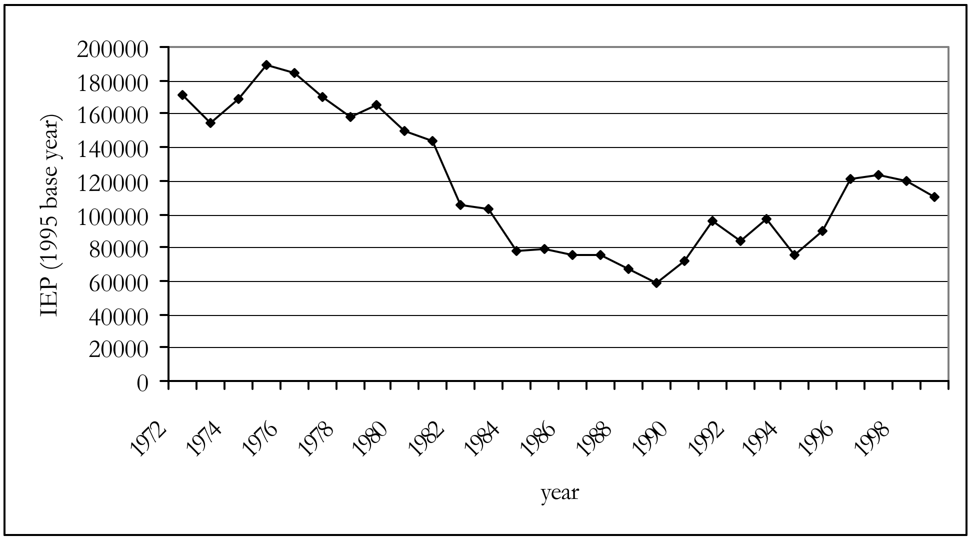

Figure 4: Average Grant Amount by Employment Size of Recipient

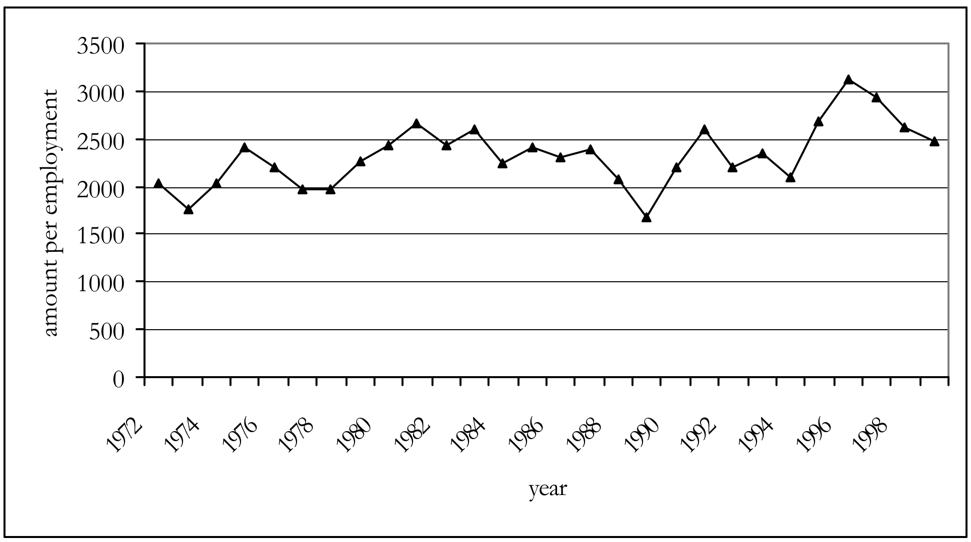

Figure 5:

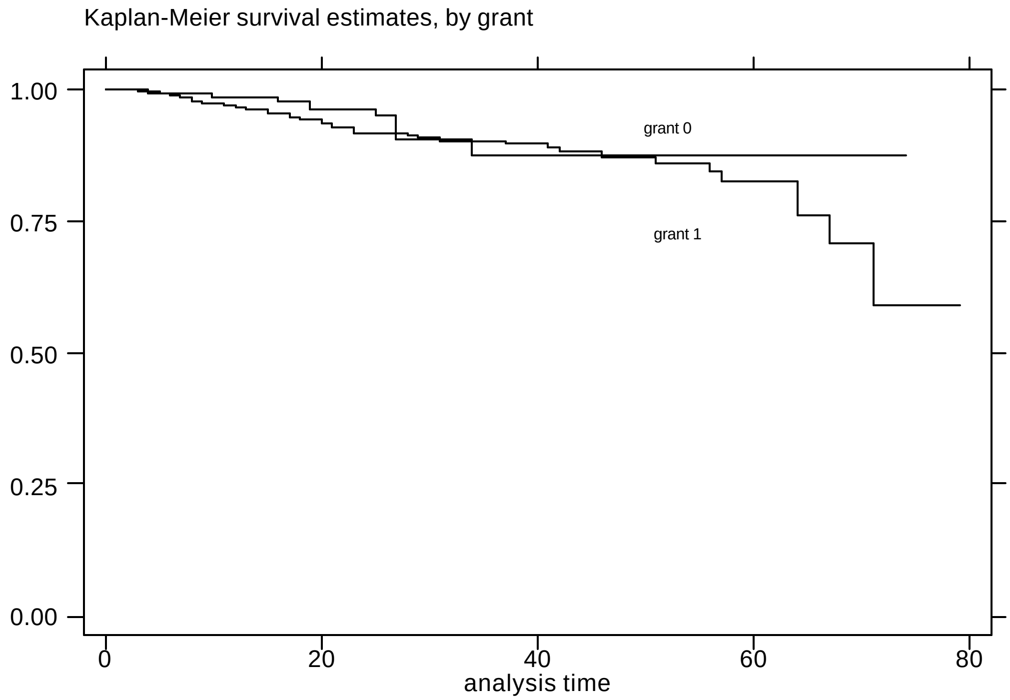
Kaplan-Meier survival estimates, by grant
1.00
0.75
0.50
0.25
0.00
grant 0
grant 1
0
20
40
60
80
analysis time

Table 4.1: Number of matches by year

Year	grants	control
1983	388	108
1984	421	117
1985	483	119
1986	510	101
1987	540	105
1988	571	117
1989	615	130
1990	649	140
1991	811	241
1992	835	243
1993	838	227
1994	785	212
1995	856	228
1996	825	221
1997	767	195
1998	756	189

Table 4.2: Summary Statistics (Mean)

	Grant	**Employ.**	**Wage Rate**	**Lab. Prod.**	**Foreign**	**DA**	**Age**
Unmatched Group	No	86.47 (181.6)	14.47 (9.6)	51.64 (342.5)	0.30 (0.46)	0.29 (0.45)	20.02 (15.0)
Unmatched Group	Yes	99.66 (182.4)	11.78 (7.0)	32.88 (342.5)	0.39 (0.49)	0.31 (0.46)	12.18 (12.5)
Matched Group	No	138.68 (162.5)	16.65 (29.3)	40.05 (123.4)	0.46 (0.50)	0.30 (0.46)	22.62 (14.0)
Matched Group	Yes	155.76 (207.1)	13.83 (18.8)	32.05 (76.1)	0.45 (0.50)	0.30 (0.46)	17.06 (12.8)

Table 5: Cox proportional hazard model (hazard rates reported)

	(1)	(2)	(3)	(4)	(5)	(6)
	Specification with grant dummy	Specification with grant dummy	Specification with grant dummies	Specification with grant dummy	Specification with log of grant amount	Specification with log of grant amount
Foreign dummy	0.915	1.158	0.941	1.293	1.140	1.395
	(0.24)	(0.33)	(0.17)	(0.61)	(0.36)	(0.80)
Ln employment size	0.767	0.728	0.774	0.775	0.761	0.773
	(1.91)*	(2.24)**	(1.87)*	(1.78)*	(2.01)**	(1.72)*
Relative labour productivity	1.005	1.004	0.993	1.001	0.995	0.998
	(0.15)	(0.15)	(0.29)	(0.03)	(0.24)	(0.07)
Industry growth	0.412	0.379	0.342	0.351	0.344	0.334
	(1.56)	(1.63)	(1.87)*	(1.73)*	(1.83)*	(1.78)*
Foreign plants						
Grant dummy t	0.635					
	(1.19)					
Grant dummy t to t-2		0.939				
		(0.18)				
Employment grant t			1.617		1.072	
			(1.20)		(1.68)*	
Capital grant t			0.474		0.933	
			(1.99)**		(2.16)**	
Other grant t			0.565		0.914	
			(1.07)		(1.23)	
Employment grant t to t-2				1.287		1.047
				(0.70)		(0.93)
Capital grant t to t-2				0.513		0.903
				(2.08)**		(2.65)***
Other grant t to t-2				0.978		0.997
				(0.06)		(0.06)
Domestic plants						
Grant dummy t	0.256					
	(3.47)***					
Grant dummy t to t-2		0.656				
		(1.23)				
Employment grant t			0.264		0.841	
			(2.45)**		(2.31)**	
Capital grant t			0.418		0.934	
			(1.70)*		(1.27)	
Other grant t			0.674		1.002	
			(0.74)		(0.02)	
Employment grant t to t-2				0.752		0.953

				(0.76)		(0.77)
Capital grant t to t-2				0.371		0.876
				(2.37)**		(2.07)**
Other grant t to t-2				1.797		1.109
				(1.45)		(1.60)
Observations	11748	11748	11748	11748	11729	11713

Robust z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
Estimations are stratified by sector and include time dummies

**Table 6: GRANT receipts and employment dynamics:
Is there a foreign/domestic differential effect?
(fix_all2)**

	Unconditional labour demand		Conditional labour demand	
	Specification with grants dummies	Specification with log of grants size	Specification with grants dummies	Specification with log of grants size
Wages	-0.162	-0.161	-0.515	-0.512
	(16.21)***	(16.21)***	(71.04)***	(70.79)***
Output			0.580	0.577
			(121.47)***	(120.64)***
Foreign plants				
Employment grant t to t-2	0.038	0.007	0.012	0.003
	(3.27)***	(4.35)***	(1.55)	(3.02)***
Capital grant t to t-2	0.157	0.023	0.065	0.010
	(14.24)***	(16.18)***	(8.77)***	(10.10)***
Other grant t to t-2	-0.008	-0.004	-0.009	-0.003
	(0.62)	(2.61)***	(1.06)	(2.76)***
Domestic plants				
Employment grant t to t-2	0.048	0.009	0.025	0.005
	(4.40)***	(5.19)***	(3.37)***	(4.06)***
Capital grant t to t-2	0.117	0.020	0.050	0.009
	(11.21)***	(12.55)***	(7.26)***	(8.29)***
Other grant t to t-2	0.043	0.008	0.021	0.004
	(3.92)***	(4.55)***	(2.85)***	(3.53)***
p-value from test for the endogeneity of wages and output	0	0	0	0
Observations	13219	13185	13219	13185
Number of plants	1567	1567	1567	1567

Note:
(i) Time dummies are included in all specifications
(ii) Absolute value of t-statistics in parentheses
(iii) Significant at 10%; ** significant at 5%; *** significant at 1%
(iv) The tests for the endogeneity of wages and output was conducted via Hausman tests by comparing the fixed effects estimates with the random effects one. In all case output and wages were found to be endogenous, vindicating the use of the fixed effects specification.

Appendix 1: Pooled probit for matching

Independent variable	Coefficient (standard error)
Grant_dummyl1	1.248
	(0.026)***
templ1	0.4e-03
	(0.1e-03)***
labprol1	-0.2e-03
	(0.1e-03)
wageratel1	-0.002
	(0.001)***
age	-0.012
	(0.001)***
foreign	-0.164
	(0.032)***
Non-designated area	-0.033
	(0.029)
Constant	-0.402
	(0.816)
Log-likelihood	-6657.53
Observations	12795

Standard errors in parentheses
Regression includes four digit sector dummies
* significant at 10%; ** significant at 5%; *** significant at 1%

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