Görg, Holger; Strobl, Eric

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Holger Görg
Eric Strobl

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Forschungsinstitut
zur Zukunft der Arbeit
Institute for the Study
of Labor

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Holger Görg
University of Nottingham, DIW Berlin
and IZA Bonn

Eric Strobl
Université de Paris X-Nanterre
and IZA Bonn

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IZA

P.O. Box 7240
53072 Bonn
Germany

Phone: +49-228-3894-0
Fax: +49-228-3894-180
Email: iza@iza.org

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ABSTRACT

Do Government Subsidies Stimulate Training Expenditure? Microeconometric Evidence from Plant Level Data*

This paper examines whether financial assistance provided by government induces firms to spend more of their own funds on training expenditures, using plant level data for the Republic of Ireland. We pay particular attention to the potential problems in such an evaluation study, namely selectivity and endogeneity, by first identifying a valid counterfactual for grant receiving plants via a matching estimator and then employing a difference-in-differences technique on this matched sample. Our results show that there are differences in causal effects between domestic and foreign owned plants. For the former we find clear evidence that grant receipt stimulates private expenditure, while there are no statistically significant effects for foreign-owned plants based in Ireland.

JEL Classification: J24, H25

Keywords: training, government grants, matching, difference-in-differences

Corresponding author:

Holger Görg
School of Economics
Room B53, The Clive Granger Building
University of Nottingham
University Park
Nottingham NG7 2RD
United Kingdom
Email: holger.gorg@nottingham.ac.uk

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Section I: Introduction

The perceived shortage of skilled labour has been highlighted as a serious problem for firms in many industrialised countries. For example, the UK based web site *Management Issues* reports the results of a company survey undertaken by Lloyds TSB which shows that "[…] more than four out of ten companies have had problems recruiting skilled staff this year [2003]".[1] A study undertaken at WZB Berlin shows that this is not a localised issue, and reports similar findings on skill shortages for the US, Germany, France and other European countries.[2] The Republic of Ireland, the country the data in this paper relate to, is no exception to this trend as, notwithstanding its substantial growth performance over the last decade, skill shortages have also been identified as one of its major problems in the short and medium term.[3, 4]

In order to deal with this issue, governments face a number of policy options. One obvious measure is to use training in order to improve skills of workers in the labour market.[5] In fact, many countries have implemented policies to provide financial assistance for firms to increase their training activities, as, for example, in the US (Holzer et al, 1993), Australia (Dumbrell, 2002), and Ireland. A legitimate question to ask is, of course, whether these programmes of encouraging firms to provide formal training to employees are effective. More specifically, do training subsidies encourage firms to spend more on formal training, or are they just used to finance expenditure that would have occurred even in their absence? Implicitly the support of training relies on the assumption that there is some sort of market failure(s) so that the actual level training provided is lower than its social optimum. In the literature on training,

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[1] "Shortage of skilled labour threatens recovery", 8 October 2003, available at www.management-issues.com
[2] See www.wz-berlin.de/ars/ab/qb/projekte/fachkraeftemangel.en.htm
[3] See www.eiro.eurofound.eu.int/2000/06/feature/ie0006152f.html
[4] One should note the shortage of skill may be the result of profit maximizing behaviour of firms in the face of market failures of training provision, as firms may not want to pay for extra skills through training.
[5] Another possibility is of course to encourage immigration of skilled workers. While this has received much attention in the popular press recently, we do not concern ourselves with this issue herein.

two imperfections have been pointed out as the potential cause of such under-provision – labour market and capital market imperfections; see Stevens (1999) for a review. Thus, evidence regarding a link between training subsidies and training provision can be interpreted as indirect evidence regarding the role of such market failures in the under-provision of training.

Importantly, as far as we are aware, the link between firm expenditure on training and government support has as of yet not been directly empirically addressed in the literature. [6] Rather there are a number of related papers that use data on training expenditure to analyse the effects on productivity of the training provided. For example, Holzer et al. (1993) find for a sample of manufacturing firms in Michigan that firm-sponsored training helps to reduce a firm's scrap rate. Black and Lynch (1996) estimate an augmented Cobb-Douglas production function using data from a US employers' survey for 1993 and find that firms' investment in human capital is positively related to productivity.[7]

One should note that if one is interested in whether training subsidies may be alleviating some sort of market failure in training provision, it is important to examine directly the impact on training rather than productivity. More precisely, evidence of a positive link between training grants and productivity may not necessarily be due to increasing training provision, but instead due to the possibility that firms that would have undertaken the training expenditure even in the absence of a subsidy simply use the extra funds to finance some other productivity enhancing activity. Additionally, a lack of finding of a relationship between productivity and training grant

[6] A similar question is, however, addressed in terms of examining the effect of R&D subsidies on private R&D expenditure. See, for example, Lach (2002) for a recent example and Garcia-Quevedo (2004) for a review of this literature.

[7] Other papers have focused on the effects of training on the individual. For example, Bassi (1984) using data from the US Continuous Longitudinal Manpower Survey for 1977 and 1978 finds that women benefiting from training tend to earn higher wages, while no such effect is found for men. Booth (1991) undertakes a similar study with data from the British Social Attitudes Survey of 1987 and finds evidence that some forms of training tend to increase wages.

provision may not mean that the policy was ineffective, but rather be a reflection of the firm's inability to retain trained workers.

In the current paper we thus explicitly address the issue of whether training subsidies encourage or discourage firms to increase their own private expenditure on formal training. Our empirical analysis is carried out using a large and extensive panel of manufacturing plants in the Republic of Ireland. This data set is generated by linking a rich plant level survey including information on production and expenditure with exhaustive information on plants' receipts of grants for formal training purposes. One particular feature of Ireland's industrial structure is the importance of foreign multinational companies, which accounted for roughly one half of manufacturing employment in 2000. Hence, we make a point of focusing on differences across nationality of ownership in our analysis, an aspect that similarly remains as of yet unexplored.

One crucial issue for the empirical estimation is how to deal with the problem of what privately financed training activity would have been without government support. Ideally, the researcher would want to observe what would have happened to training activity in the firm if it had not received a subsidy. Clearly, however, this is unobservable; one only observes a funded firm's actual expenditure and not what it would have spent without a subsidy. This leaves as control group only those firms that were not subsidised. The use of non-recipients as a comparison group, however, would only be justified if the provision of grants were a completely random process, otherwise the analysis would suffer from selection bias. In reality, of course, this is unlikely to be the case as authorities will select recipients among the pool of candidates according to some selection criteria.[8] Thus, properly identifying the effects of public funding on privately financed training activity requires generating the appropriate counterfactual in order to deal with the selection issue.

[8] Moreover, awareness of these criteria may mean that plants will self select themselves into the application process.

In order to determine a set of non-grant receiving plants that can act as a valid counterfactual for the grant beneficiaries we use the propensity score matching estimator, a technique that has been prominent in the evaluation of labour market programmes (e.g., Dehejia and Wahba, 2002, Heckman et al., 1997). We then employ a difference-in-differences (DID) estimation on this matched sample in order to identify the causal effect of grant receipt on private expenditure on formal training. This combination of matching and DID is motivated by recent studies which argue that standard matching estimators are usually unsatisfactory, but in combination with DID methodology can have the potential to "...improve the quality of non-experimental evaluation results significantly" (Blundell and Costa Dias, 2000, p. 438).

The remainder of the paper is organised as follows. In the following section we provide some background discussion on training, market failures and government intervention. In Section III we outline grant provision in Ireland. Section IV describes our data set. We outline the matching process and the difference-in-differences estimator in Section V. Section VI contains our results and we conclude in the final section.

Section II: Training and the Role for Government Intervention

Current thinking about the role of government intervention in training provision is shaped by the seminal work of Becker (1962). In particular, in contrast to the earlier literature Becker (1962) made the crucial distinction between general versus firm specific training, where the former refers to those skills that are also useful to all or some other employers and the latter concerns the specific skills that increase the productivity of a worker only in the current firm. In competitive labour markets where workers are paid their marginal product, firms never invest in general training as they could not guarantee that the trained worker will not be poached by competitors. However, workers themselves may have an incentive to invest in general training

since they are the sole beneficiaries of such investment. This could be done, for instance, if workers accept lower wages (than their productivity) during training. In contrast, firms may be willing to finance at least part of firm specific training since they can recoup at least part of their cost.

Within this context there are two main reasons why there may be a market failure in training; see Stevens (1999, 2001). First, there may be capital market imperfections so that workers cannot borrow against future increases in productivity in order to finance current lower wages during training. Related to this, in the face of capital market imperfections firms themselves may be unable to invest in firm specific training of their workers. It has been shown, however, that even where capital market imperfections exist, certain imperfections in the labour market could still lead firms to invest in general training. Specifically, this occurs when there is wage compression for more skilled workers, which may be caused by such factors as minimum wages, unions, search costs, monopsony power, asymmetric information, efficiency wages, and complementarity with firm specific human capital, see, for instance, Stevens (1994) and Acemoglu (1997) amongst others. However, as noted by Acemoglu and Pischke (1998) even in this case there are incentives for workers to move to another firm where they would be paid a wage below their marginal product, thus leading to an under-investment in general training.

Acemoglu and Pischke (1998) argue that for the case when labour markets are perfectly competitive and capital market imperfect, government intervention is better limited to improving loan markets. In most of the other cases under labour market imperfections, the provision of subsidies could, in contrast, be beneficial in bringing the amount of investment in training closer to its optimum, although their effectiveness can be dampened by monitoring problems at the workplace.

It is also of interest to consider for which firms such problems of market failure are most relevant. In this regard, Casas-Arce (2004) remarks that in industries with faster technological change there will be greater depreciation of human capital, and hence these will require more aggressive training programs. Additionally, training may serve to reduce the costs of worker turnover.

One particular focus of the current paper is the distinction between foreign multinational and domestic plants, and it is thus important to consider the above discussion in terms of this. First of all it is generally assumed that foreign multinationals are generally more technology intensive than domestic firms, due to their having access to some sort of firm specific asset (e.g., Barba Navaretti and Venables, 2004). They thus may have relatively greater need for training. However, foreign multinationals are also generally assumed to be less financially constrained than domestic firms, given that they are part of a multinational corporation. After all, they have many means of financing their operations, not least foreign direct investment, i.e., capital transfers from the parent company. Hence, they are less likely to be reliant on the domestic capital market for funds for funding of training. In this respect, Harrison and McMillan (2003) have recently provided evidence that in Cote d'Ivoire only domestic firms face financial constraints.

Section III: Grant Provision in Ireland

Grants for industrial development were first offered in Ireland 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.[9] In the late 1950s, however, there was an 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. This, in conjunction with the already existent export tax relief, 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.[10] The range of grants that have been available to firms included capital grants, research and development grants, rent subsidies, employment grants, feasibility study grants, technology acquisition grants, loan guarantees and interest subsidies, and, most importantly from the standpoint of this paper, training grants. 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) until 1994,[11] after which it was split into IDA Ireland and Forbairt. The former is now responsible for the grant provision to foreign owned firms while the latter resides over assisting indigenous plants.[12] The official specifics for training grants are spelled out in the Industrial Development Act 1986:

(1) A training grant may be made for the training of persons for positions of supervision or management in an industrial undertaking or for the engagement of instructors, technical advisers or consultants to train (or assist in the training of) persons for such positions.

(2) The amount of training grants made in respect of a particular industrial undertaking shall not exceed the sum of the amount of wages or salaries paid by the undertaking during the period of training to the persons being

[9] See Meyler and Strobl (2000) for details.

[10] 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.

[11] 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.

trained, the amount of expenses paid to those persons by the undertaking for travel and subsistence and the amount paid by the undertaking in respect of fees (including fees and remuneration of instructors, advisers and consultants) and similar expenses connected with the training.
(3) The Authority shall not, without the prior permission of the Government, give in respect of a particular industrial undertaking training grants exceeding in the aggregate £2,000,000.[13]

In practice, projects suitable for assistance had to either involve the production of goods primarily for export, be of an advanced technological nature for supply to international trading or skilled self supply firms within Ireland, and/or be in sectors of the Irish market that are subject to international competition. Moreover, it was often viewed upon favourably if they could demonstrate back-ward linkages to the Irish economy, particularly for foreign applicants. 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 and those of a more entrepreneurial nature. 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.

Section IV: Data

For the empirical analysis in this paper we utilise information from two data sources collected by Forfás, the Irish policy and advisory board with responsibility for enterprise, trade, science, and technology in Ireland. Our first data set is the Annual Business Survey, collected

[12] After 1998 Forbairt become Enterprise Ireland as a consequence of a merger with the Irish Trade board.
[13] In Euros this amounts to around 2,539,476.

from 1999 until 2002. This is an annual survey of plants in Irish manufacturing with at least 10 employees, although a plant, once it is included, is generally still surveyed even if its employment level falls below the 10 employee cut-off point. Over its four year existence the survey has covered around 50 per cent of all manufacturing plants with 10 or more employees. The information available from this source that is relevant to the current paper are the nationality of ownership, sector of production, the start-up year, output, employment, exports, wages, total and domestically purchased inputs, and total expenditure on formal training.[14]

It is important to emphasize a number of drawbacks of using total expenditure as an indicator of training taking place in a firm. First of all, as became apparent from the discussion in Section II, ideally one would be able to distinguish between expenditure on general versus firm specific training. Unfortunately our data is only on total expenditure. Secondly, some training in the firm may be informal in the sense that it may entail being trained by already existing workers whose primary task is not training provision, and this is unlikely to be captured in total training expenditure. Again, we do not have any information in this regard. Finally, if, as discussed earlier, there are no capital market imperfections, workers may finance part of the training themselves.

Importantly, Forfás also 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 can thus isolate training grants from all other grant payments made to the firm. In terms of using these two 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

[14] All nominal variables are appropriately deflated by the consumer price index.

data for classifying plants as grant recipients, and the ABS for all other plant level variables used in the analysis.

One should 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 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).

By linking information across data sources our sample consists of plants of generally at least 10 employees. We calculate a measure of private training expenditure in any year as the value of total training expenditure net of training grant payments made to that plant in that year. Using only observations with non-missing values for all variables in our empirical analysis left us with a total amount of 1837 observations on 569 foreign plants, 89 per cent of which spend money on training workers, and of these 13 per cent received a training grant. Similarly, we have 4445 observations on 1479 domestic plants, 71 per cent of which are training spenders, and of these 26 per cent received support for such. One should also note that for both the foreign and domestic sector, larger training spenders are more likely to be supported. More specifically, if we divide plants into those less than 50, those between 50 and 100, and those over 100 employees, then for the foreign sector 8, 11, and 15 per cent of these receive grant support. Similarly the corresponding figures are 13, 28, and 33 per cent for domestic establishments.

We provide some basic summary statistics with regard to total training expenditure and grant payments in Table 1. As can be seen, the total expenditure on training as a proportion of wages is relatively low in Irish manufacturing for both foreign and domestic plants– standing at about 1.9 and 2.5 per cent, respectively. There are also sectoral differences in the expenditures on training for domestic and foreign plants. For example, spending is highest in the food sector

for foreign plants, while domestic plants operating in the miscellaneous sectors are the top spenders. In contrast, the lowest expenditure on training occurs in the furniture sector for plants of foreign nationality, while the domestic plants spend the least in the paper and printing industry. For both nationality groups, small firms (less than 50 employees) have the highest expenditure on training relative to their labour cost outlay. While there is little difference between medium (between 50 and 100 employees) and large (greater than 100 employees) sized plants in the foreign sector, domestic large producers spend slightly more on training than their medium sized counterparts.

Examining the proportion of total training expenditure that is due to grant payments, we find that this constitutes about 11.0 and 23.3 per cent for foreign and domestic plants, respectively. Foreign plants located in the metals & engineering, paper & printing, and textiles are the most heavily subsidised (measured as a percentage of total training outlay), while those in furniture, and wood & wood products are the least. For domestic plants, highly subsidised industries are plastics & rubber, food, and furniture, while those that receive the least amount of support are textiles and wood & wood products. Decomposing the subsidisation measure by nationality of ownership one discovers that for both the foreign and domestic industry the medium sized firms are the most subsidised. In contrast, while there is little difference in the degree of support between small and large plants on average if they are domestic, smaller foreign plants are more subsidised than their large counterparts.

[Table 1 here]

Section V: Econometric Methodology

This section briefly outlines the econometric methodology employed to investigate the impact of grant receipt on private expenditure on formal training. The general modelling

problem is the evaluation of the causal effect of training grant receipt on private training expenditure y. Let $GRT_{it} \in \{0,1\}$ be an indicator of whether or not a plant received a training subsidy at time period *t*, y_{it}^1 be private expenditure on training if plant i received a grant at time *t* and y_{it}^0 be the spending on training if the plant *had not received any grant at time t.* The causal effect of the receipt of a training grant for plant *i* at time period t is then defined as $y_{it}^1 - y_{it}^0$. The fundamental problem of causal inference is that the quantity y_{it}^0 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

$$E\{y_t^1 - y_t^0 \mid GRT_{it} = 1\} = E\{y_t^1 \mid GRT_{it} = 1\} - E\{y_t^0 \mid GRT_{it} = 1\} \quad (1)$$

Causal inference relies on the construction of the counterfactual for the last term in equation (1), which is the outcome the grants-receiving plants would have experienced, on average, in the absence of grants. This is estimated by the expenditure on training of plants that did received any training grant payment grants at time *t*, i.e.,

$$E\{y_{it}^0 \mid GRT_{it} = 0\} \quad (2)$$

One should note, however, that (2) is not necessarily equal to the last term in (1). Such would only be the case where grant receipt was randomised. Instead, as discussed in Section II, the distribution process of training subsidies by the Irish government has, at least officially, been selective. Thus, the receipt of grants is likely to be correlated with observable plant characteristics, so that using (2) in terms of the average for all non-grants receiving plants would produce biased estimates of the effect of grant receipt on private training spending. An important feature in our 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 pattern of private expenditure on training can be studied to generate the counterfactual for the grant-receiving plants.

Since such matching ideally involves comparing training grants and non-training-grant plants across a number of observable characteristics, it would be difficult to determine along which dimension to match the plants, or what type of weighting scheme to use. To overcome this dimensionality problem we employ the propensity score matching method due to Rosenbaum and Rubin (1983), which suggests the use of the probability of receiving training grants conditional on plant specific characteristics as a single comprehensive index.

Accordingly, we first identify the probability of training grant receipt (or 'propensity score') conditional on a set of observables $\boldsymbol{X}$ using the following probit model:

$$P(GRT_{it}=1) = F(\boldsymbol{X}) \qquad (3)$$

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. More formally, *at each point in time*[15] and for each grants plant *i*, a non-grants plant *j* is selected such that for the predicted probability, P_{it}, of receiving an training grant at time *t* of grant recepient plant *i* and the predicted probability, P_{jt}, of receiving a training grant at time *t* for grant non-recipient plant *j*.

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

where λ is a pre-specified scalar.

We then use this matched data set, which includes grant receiving plants as well as a valid control group for the subsequent econometric analysis. In order to identify the causal effect of

[15] Note that the matching strategy is only appropriate on a cross-section by cross-section basis

grant receipt on plants' private expenditure on training we then employ a difference-in-differences (DID) estimator on the matched plants. This combination of a matched sample and DID analysis arguably improves the accuracy of the evaluation study (Blundell and Costa Dias, 2000).[16]

The version of the DID estimator used can be described as follows. Firstly, the difference in private training spending between before and after receiving a training grant ($\Delta^g y$) is calculated. Then this difference is further differenced with respect to the before and after differences for the comparison control group (Δy^c), to obtain the difference-in-differences estimator $\delta = \Delta^g y - \Delta^c y$ (see Meyer, 1995). Defining *GRANT* as a dummy variable equal to one if the plant receives a training grant at time *t*, the regression

$$y_{it} = \phi + \delta GRANT_{it} + u_{it} \tag{5}$$

produces a coefficient δ that can be interpreted as the average change in privately financed training expenditures, *y*, due to the receipt of a training grant. In this regard, given that our dependent variable is training expenditure net of government training grants, one should note that there are three possible distinct results. Firstly, one may find that the coefficient is significantly negative suggesting that government financing simply crowds out private expenditure on training. One could also find that that one cannot reject the hypothesis that support does not affect private training, thus indicating that government solely acts to increase spending on training but this does not crowd out private expenditure. Finally, a significantly positive coefficient would suggest that not only do training grants not crowd out private

[16] For example, compared to the matching estimator on its own, this combination avoids the problems associated with the assumption of conditional independence between the error term in the outcome equation and treatment status. Compared to the difference-in-difference estimator on its own, it allows one, under certain assumptions, to overcome the lack of control for unobservable temporary unit-specific components that may influence the treatment decision. In contrast, the Heckman selection estimator or the IV estimator would require at least one additional

spending but they act to increase expenditure on training (over and above the direct effect of the grant). This may be because there are large fixed costs to starting or expanding on existing training programs, after which marginal costs are relatively small. Another explanation might be that training programmes bring complementary benefits to other already existent programmes, thus making it worthwhile to expand these other ones as well.

Section VI: Empirical Results

Propensity Score Matching Results

In implementing (3) to create our treatment and control groups one would ideally like to use a set of covariates $\boldsymbol{X}$ that capture, or are correlated with, the factors that the IDA may take into account when deciding on handouts of grants and that plants will consider when making the decision to apply for support. In terms of the information that our data sets provide us with, we identified a number of factors that may be important, as determined by data availability: As noted in Section II, the IDA was keen on supporting firms that were export oriented, innovative and technology intensive, linked to the local economy, and likely to be financially constrained. To capture this we include measures of export intensity (exports as a proportion of total output), R&D intensity (R&D expenditure as a proportion of total output), locally sourced inputs (as a proportion of total inputs), and size (in terms of employment), respectively. Given that it is well known that Irish policy makers were keen on building up the more modern sectors, we also interacted these variables with a dummy for high-tech plants, defined as those operating in the chemicals and metals & engineering industries.

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variable that affects treatment receipt but not the outcome of interest – to find one of convincing nature is, of course, difficult in practise.

In terms of considering what factors might be important in terms of plants applying for grants, it becomes apparent that many of these coincide with those that were viewed as more favourable characteristics by grant providing authorities. For instance, more financially constrained firms are also those more likely to apply and size can serve as a proxy for this. Additionally, one would expect that those firms that are more skill intensive have a greater need for training, which would in part be captured by the export and R&D intensity variables. Nevertheless we also include the average wage rate and labour productivity to capture the skill level in a plant. It is also likely that younger firms are more in need of training workers since on average their workers are likely to be younger and have lower tenure and since such firms have less experience. Finally, we included a set of industry dummies to capture industry difference in training necessity.

The results of the individual probits for foreign and domestic firms separately, from which the propensity scores are generated, are reported as marginal effects in Table 2. First of all one should note that the pseudo r-squared values in conjunction with the predicted positive outcomes suggest that for both samples we explain a reasonable amount of the variation in the grant provision. As can be seen, one finds that, in terms of statistical significance, important factors of predicting grant receipt for foreign plants are export intensity, local linkages, size, and whether the plant is operating in the chemicals, drink & tobacoo, and metals & engineering sectors – all of which act positively on the probability of grant receipt. With regard to the size variable, one may take note that the coefficient is contrary to expectations, in that if it truly were a good proxy for financial constraints it would suggest that less of such constraints is more likely to lead policy makers to provide support and/or for firms to seek support. Our interaction terms only indicate that there is a different high tech industry effect for the linkages effect.

For domestic plants we find those more export intensive, larger, and located in the drink & tobacco or the non-metallic minerals industries are more likely to receive a grant. One also discovers that younger plants are more likely to receive support for training. Peculiarly, we, however, also discover that the more labour productive plants are less likely to receive a subsidy.

[Table 2 here]

We then used the calculated propensity scores and the matching estimator outlined to create our control and treatment groups as in (4) for foreign and domestic plants separately. For domestic plants we were able to match a total amount of 235 grant recipients, covering 324 observations, with a total amount of 284 non-recipients, covering 284 observations.[17] For the case of foreign plants, were matched a total of 58 grant recipients, covering 75 observations, with 67 non-recipients covering 74 observations.

In order to assess the accuracy of our matching procedure graphically we display the distribution of the propensity scores of our matched treatment group, our matched control group, and the unmatched observations pooled across all years for domestic and foreign plants in Figures 1 and 2, respectively. As can be seen, the distribution of propensity scores across our two matched groups is fairly similarly for both foreign and domestic plants. One should also note that using a simple Kolmogorov-Smirnov test, we were not able to reject the equality of the distribution of the matched control and treatment group for either nationality group. In contrast, clearly the distribution of propensity scores of the unmatched group differs markedly from the other two for both samples. As a matter of fact, comparing these to both the matched treatment and control group spearately, the Kolmogorov-Smirnov test suggested that their equality could be rejected for both nationality groups.

[Figure 1 here]

We also provide summary statistics for these three groups for our two samples in Table 3. From these the differences in the groups in terms of our covariates are also readily apparent. In particular, the unmatched group tends on average to be older, smaller, more productive, more R&D intensive, and less export intensive for both foreign and domestic plants. In terms of the sectoral distribution, we find that the unmatched sample is less likely to be in Metals and Engineering and Food sectors, but more likely to be producing Clothing, Footwear, and Leather and Furniture products. One should note that in comparing the matched treatment and control groups one, in contrast, finds strong similarities in terms of the means of all the variables used to generate the propensity scores, except perhaps the probability of receiving other types of grants. In terms of sectoral distribution one notices that the unmatched groups is for foreign plants much less likely to be locatd in the metals & engineering and drink & tobacco sectors. In contrast, in the domestic sample the unmatched group is more likely to be producing in the clothing, leather & footwear and textiles industries, but less likely to be part of the furniture sector.

[Table 3 here]

Difference-in-Difference Estimator Results

Since the matching controls for the impact of observables on the probability of receiving grants (i.e., pre-treatment), we also take account of other possible observable factors that may be correlated with changes in private expenditure on training after receipt of the treatment. Specifically, the size of the plant has been identified as an important determinant of training expenditure in the empirical literature (e.g., Barry et al, 2004). We therefore, include plant size (measured as employment) as an additional covariate in equation (5). Since our dependent

[17] This smaller number of recipient observations is due to the fact that some recipient observations were matched

variable and explanatory variable of interest are measured in levels this control also allows us to take account of differences in spending and grant receipt due to different sizes across plants. Moreover, we allowed for NACE Rev. 1 two-digit industry and year effects by including appropriate sets of dummies. Given the potentially bounded nature of our dependent variable, private training spending, and the fact that we want to control for time invariant plant specific effects, our choice of econometric tool was the random effects tobit estimator. In terms of our main variables of interest we use the level of training privately sourced, i.e., total expenditure net of training subsidies, as the dependent variable and a dummy for training grant receipt to gauge the impact of government support.

We first report results for our total foreign and domestic samples without dropping the unmatched observations as the benchmark case in Table 4. As can be seen, while there appears to be a positive impact of grant receipt for foreign plants in the first column, results from including employment as in the second column show that this is due to not controlling for the fact that larger firms spend more of their own finances on training. Thus, while total private expenditure in this specification does increase in response to a grant, per employee private expenditure does not. In contrast, for domestic sample, the positive impact of grant support is robust to including a size measure, although the coefficient does change.

[Table 4 here]

The results for our matched samples are given in Table 5. Accordingly, public support does not increase the private expenditure on training in foreign plants, regardless if we control for their size or not. (However, one should note that there is also no evidence of crowding out, in which case there would be a significantly negative coefficient.) In contrast, and in line with the total sample, one discovers that domestic firms increase their private expenditure on training in

twice to a non-recipient observations if they were closest in terms of propensity score.

response to a training subsidy. Notably, the size of the coefficient is substantially larger than for the total sample in the specification with and the one without the employment variable. Thus, not controlling for selection and endogeneity appears to lead to an underestimation of the causal effect of grant receipt on private training expenditure.[18]

[Table 5 here]

In order to verify that our results are not due to our choice of the particular matching method (calliper) in Table 4, we also experimented with using kernel matching methods, including restricting our matches to those with a common support; see Leuven and Sianesi (2003).[19] The results shown in Table 5 reveal that this results in little qualitative differences. However, noteworthy is that the size of the coefficients is much more in line with the total samples, although this may be due to the larger matched samples under the kernel matching method.

[Table 6 here]

Section VII: Concluding Remarks

This paper examines whether financial assistance provided by governments induce firms to spend more of their own funds on training expenditures. In doing so we use plant level data from two rich data sources from the Republic of Ireland for our empirical analysis and pay particular attention in our econometric analysis to the potential problems inherent in such an evaluation study, namely selectivity and endogeneity.

[18] A simple t-test confirms that the difference between the two estimates for both the dummy and levels variable are statistically significant.
[19] The bandwidth was set to the default of 0.06

Our results show that there are differences in effects between domestic and foreign owned plants. For the former we find clear evidence that grant receipt stimulates private expenditure on training. In contrast, we find no such private spending enhancing effects of training subsidies for foreign-owned plants based in Ireland. Nevertheless, there is also no evidence of crowding out for foreign multinationals, where grants are simply used to finance training that would have been sponsored privately anyway. One possible explanation for the lack of such a relationship between grants and private training expenditure is that these plants are part of a multinational company and, hence, are not subject to financial constraints. Another possibility may be that domestic firms have a greater need for general training, for which there is more likely to be market failure.

More generally, returning to the debate on skill shortages, our paper suggests that training grants may be an effective way of combating these through increased training activities at the level of the plant, at least for domestic owned establishments. Also, although there may not be such additionality effects for foreign multinationals, the fact that subsidies can increase total expenditure on training in these may generate further technology spillover effects to the host country through labour mobility; see, for example, Fosfuri et al. (2001) and Görg and Strobl (2005).

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Table 1: Training Summary Statistics by Ownership, Sector, and Size

SECTOR	TR/W	GR/TR	TR/W	GR/TR
	FOREIGN		DOMESTIC	
Chemicals	0.019	0.081	0.014	0.178
Clothing, Footwear & Leather	0.004	0.008	0.014	0.117
Drink & Tobacco	0.017	0.015	0.019	0.300
Food	0.103	0.023	0.020	0.323
Furniture	0.000	0.000	0.016	0.349
Metals & Engineering	0.016	0.262	0.028	0.295
Miscellaneous Manufacturing	0.010	0.196	0.127	0.169
Non-Metallic Minerals	0.010	0.007	0.017	0.184
Paper & Printing	0.011	0.007	0.013	0.137
Plastics & Rubber	0.012	0.203	0.018	0.499
Textiles	0.014	0.231	0.016	0.050
Wood & Wood Products	0.006	0.000	0.011	0.074
<50 emp.	0.030	0.233	0.026	0.261
50-100 emp.	0.015	0.258	0.016	0.299
100+ empl	0.014	0.132	0.019	0.258
TOTAL	0.019	0.110	0.025	0.233

Note: Authors' own calculations using data sources described in Section III. TR: Training, W: Wages, GR: Grants.

Table 2: Probit Estimation of Training Grant Receipt

	(1)	(2)
	FOREIGN	**DOMESTIC**
EXPORT INTENSITY	0.90*	0.40***
	(0.47)	(0.09)
RD INTENSITY	8.52	-0.26
	(6.73)	(0.58)
LINKAGE	1.55***	-0.08
	(0.52)	(0.16)
WAGE	-0.00	0.00
	(0.01)	(0.00)
LABOUR PRODUCTIVITY	0.00	-0.00***
	(0.00)	(0.00)
AGE	-0.00	-0.00***
	(0.00)	(0.00)
EMPLOYMENT	0.14***	0.24***
	(0.05)	(0.03)
HIGH*rd	-8.53	0.24
	(6.73)	(0.58)
HIGH*LINKAGES	-1.44**	-0.11
	(0.58)	(0.25)
HIGH*WAGES	-0.01	0.00
	(0.01)	(0.00)
HIGH*WAGES	-0.00	0.00
	(0.00)	(0.00)
Chemicals	1.74**	0.13
	(0.82)	(0.38)
Cloth., Foot. & Leath.	-0.32	0.08
	(0.68)	(0.33)
Drink & Tobacco	0.91*	1.26***
	(0.52)	(0.35)
Food	-0.89	0.47
	(0.58)	(0.29)
Furniture	---	0.37
		(0.30)
Metals & Engineering	1.78**	0.15
	(0.79)	(0.34)
Non-Metallic Minerals	-0.14	0.53*
	(0.66)	(0.32)
Paper & Printing	0.73	0.22
	(0.53)	(0.30)
Plastics & Rubber	-0.05	0.48
	(0.43)	(0.30)
Textiles	-0.16	-0.35
	(0.52)	(0.36)
Wood & Wood Pr.	---	0.36
		(0.33)
Observations	1404	3148
LOG LIKELIHOOD	-275.84	-980.89
PSEUDO R-SQUARED	0.08	0.08
Actual Grant Receipt (%)	0.0548	0.1055
Predicted Outcome (%)	0.0407	0.0877

Notes: (1) Standard errors in parantheses.
(2) ***, **, and * indicate 1, 5, and 10 per cent significance levels.
(3) All regressions include industry dummies.

Table 3: Summary Statistics for Matched and Unmatched Samples

	MCG	MTG	UG	MCG	MTG	UG
	FOREIGN			DOMESTIC		
Export Int.	0.80	0.80	0.77	0.39	0.38	0.28
R&D Int.	0.03	0.03	0.10	0.05	0.03	0.13
Domestic Inputs	0.45	0.47	0.43	0.62	0.64	0.64
Average Wage	33.68	32.40	38.62	27.93	25.35	27.20
Labour Prod.	335.39	247.88	395.77	119.42	111.74	134.37
Age	20.01	21.31	25.49	21.36	20.65	40.69
Employment	247.40	336.16	192.85	93.41	81.86	61.97
Chemicals	0.12	0.08	0.14	0.03	0.04	0.04
Cloth., Foot. & Leath.	0.01	0.04	0.05	0.03	0.05	0.08
Drink & Tobacco	0.09	0.07	0.03	0.03	0.02	0.01
Food	0.01	0.03	0.07	0.22	0.24	0.21
Furniture	0.00	0.00	0.00	0.08	0.09	0.05
Metals & Engineering	0.60	0.59	0.49	0.34	0.30	0.31
Misc. Manufacturing	0.03	0.05	0.02	0.01	0.00	0.03
Non-Metallic Minerals	0.01	0.03	0.02	0.06	0.05	0.05
Paper & Printing	0.03	0.03	0.03	0.07	0.08	0.09
Plastics & Rubber	0.07	0.05	0.09	0.08	0.07	0.05
Textiles	0.03	0.03	0.05	0.01	0.01	0.04
Wood & Wood Pr.	0.00	0.00	0.01	0.03	0.03	0.04

Notes: MCG: Matched control group
MTG: Matched treatment group
UG: Unmatched group

Table 4: Total Sample

	(1)	(2)	(3)	(4)
	FOREIGN	FOREIGN	DOMESTIC	DOMESTIC
GRANT DUMMY	144.44*	75.32	23.33***	18.14***
	(80.57)	(80.51)	(5.11)	(5.01)
EMPLOYMENT		126.32***		24.57***
		(10.55)		(1.43)
Observations	1837	1837	4445	4445
Plants	569	569	1479	1479
LOG LIKE.	-14249.19	-14136.92	-25682.95	-25502.88
WALD TEST	14.7	158.3***	71.6***	385.7***

Notes: (1) Standard errors in parantheses.
(2) ***, **, and * indicate 1, 5, and 10 per cent significance levels.
(3) All regressions include time and industry dummies.
(4) Wald test examines the null hypothesis of whether coefficients are jointly equal to zero.

Table 5: The Effect of Training Grants on Own Training Expenditure – Matched Sample – Caliper Method

	(1)	(2)	(3)	(4)
	FOREIGN	**FOREIGN**	**DOMESTIC**	**DOMESTIC**
GRANT DUMMY	111.22	125.41	48.78***	36.45***
	(136.77)	(93.92)	(11.82)	(10.69)
EMPLOYMENT		173.15***		39.62***
		(21.87)		(3.52)
Observations	149	149	608	608
Plants	125	125	489	489
LOG LIKE.	-995.47	-975.20	-3173.35	-3115.30
WALD TEST	5.5	77.1***	50.9***	186.4***

Notes: (1) Standard errors in parantheses.
(2) ***, **, and * indicate 1, 5, and 10 per cent significance levels.
(3) All regressions include time and industry dummies.
(4) Wald test examines the null hypothesis of whether coefficients are jointly equal to zero.

Table 6: The Effect of Training Grants on Own Training Expenditure – Matched Sample – Kernel Method

	(1)	(2)	(3)	(4)
	FOREIGN	**FOREIGN**	**DOMESTIC**	**DOMESTIC**
GRANT DUMMY	171.65	94.38	16.67**	11.96*
	(122.38)	(116.83)	(6.93)	(6.77)
EMPLOYMENT		156.49***		25.71***
		(15.06)		(1.78)
Observations	1348	1348	2996	2996
Plants	540	540	1260	1260
LOG LIKE.	-10731.51	-10686.07	-17733.84	-17640.91
WALD TEST	11.1	121.3***	59.9***	274.6***

Notes: (1) Standard errors in parantheses.
(2) ***, **, and * indicate 1, 5, and 10 per cent significance levels.
(3) All regressions include time and industry dummies.
(4) Wald test examines the null hypothesis of whether coefficients are jointly equal to zero.

Figure 1: Distribution of Propensity Scores of Matched and Unmatched Samples of Domestic Plants

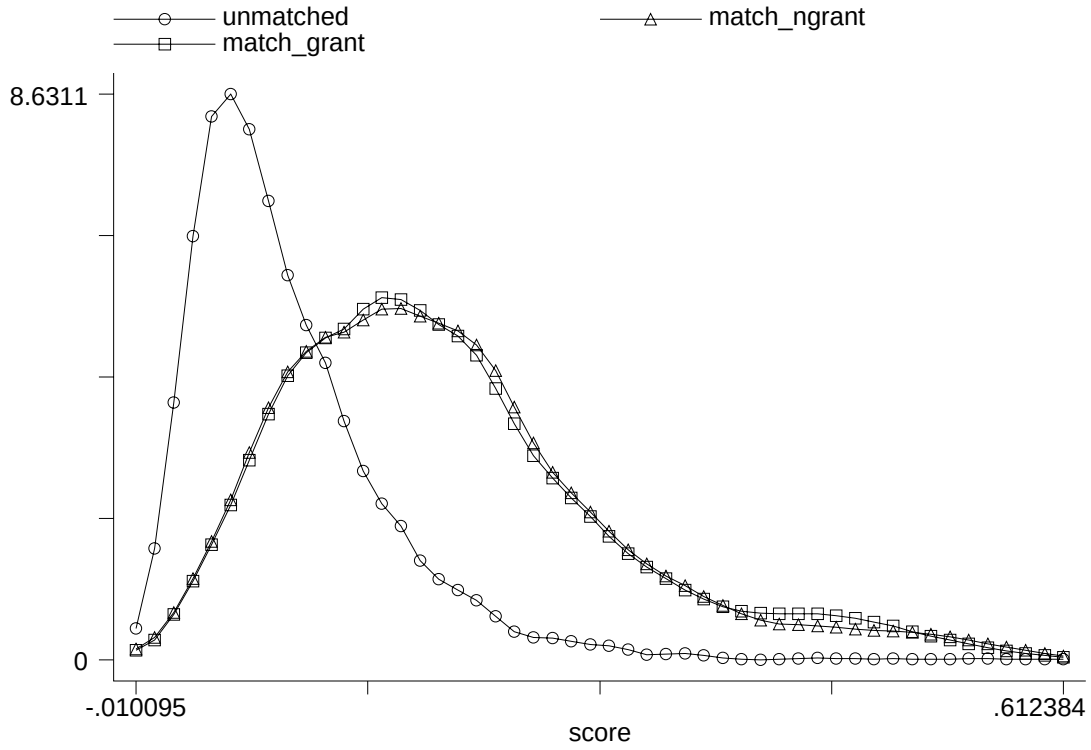

Figure 2: Distribution of Propensity Scores of Matched and Unmatched Samples of Foreign Plants