**Data-Linking and Impact Evaluation in Northern Ireland**

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Of course, the usual disclaimer applies and all errors are the responsibility of the authors.

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**Executive Summary**

* **The aim of this ‘Case Study’ on data-linking in Northern Ireland is to add to the pool of good practice in the area of evaluation by demonstrating the efficient way policy makers can access results on the impact of public policy interventions using existing data derived from official business surveys.**
* **A new firm-level panel dataset for Northern Ireland for the period 2001 to 2008 has been constructed from Department of Enterprise, Trade and Investment (DETI) Northern Ireland official business surveys and Invest Northern Ireland (INI) client records to assess the impact of public sector financial assistance to firms in the private sector.**
* **Invest NI clients are different from non-assisted firms in Northern Ireland in the following ways: they are more innovative (in that they are statistically more likely to engage in product and process innovation) and more likely to export (both in terms of sales outside the UK and sales outside NI). They are also larger: Invest NI clients have a median turnover of £5m compared to £3m for non-assisted firms; they also have on average almost twice as many employees.**
* **Estimates (using appropriate econometric modelling techniques) of the impact of Invest NI assistance on employment, sales and GVA growth have been generated and we conclude that, controlling for firm size and sector and also the very different profile of Invest NI firms, financial assistance provided by Invest NI has had:**
* **a positive and significant effect on GVA growth**
* **a positive and significant effect on sales growth**
* **no effect on employment growth**
* **The effects of innovation and export activity is present in the turnover and employment growth models respectively but NOT in the GVA modes**
* **Alternative econometric approaches were introduced – Difference-in-Difference (DID) and Propensity Score Matching (PSM) – both of which were unable to produce the same outcomes observed from the 2-stage Heckman modelling due to the lack of relevance of the DID approach in this case and the difficulty of the matching process with existing data in the PSM method.**

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**Chapter 1: Project Overview**

**1.1 Background**

This report evolved out of discussions with the Evaluation Unit in DG REGIO concerning the development of impact frameworks beyond 2013. An informal workshop organised by the Evaluation Unit in June 2010 raised the potential of accessing case studies of good practice in order to contribute to methodological discussions on evaluation. In particular, the use of official survey and administrative datasets was discussed and how a data-linking methodology harnessed to econometric modelling techniques could be shown to be an effective way of developing impact assessments.

It was agreed that an initial first step would be to obtain an example from a former Objective 1 region (i.e., Northern Ireland in the UK) to illustrate how conclusions may be drawn about the impact of European funding used to support the business support products and services delivered by Invest NI. In brief, the overall objective of this report is to document work currently underway preparing and linking various datasets in Northern Ireland, as well as to perform an impact evaluation using these datasets. This will form the basis of the ‘Case Study’.

**1.2 Rationale**

Invest NI’s priority over the years has been to improve the competitive position of its client business, thereby contributing towards an increase in regional productivity. They have been able to develop a suite of business support products and services (including direct state aid) using support obtained under EU subventions to lagging regions and especially Objective 1 regions[[1]](#footnote-1). Northern Ireland retained its Objective 1 status in the 2000-06 funding cycle but only on a transitional basis.

However, the evidence as to whether assistance has a positive effect on the productivity of NI firms is mixed.[[2]](#footnote-2) Theory suggests that assistance should allow firms to allocate resources more efficiently and hence become more productive but in many cases policies are targeted wrongly resulting in the aiding and protection of declining sectors and unproductive industries[[3]](#footnote-3).

A project commenced in 2007, led by Professor Mark Hart, and was designed to examine whether Invest NI assistance has had an impact on the productivity growth of its clients and will also update the evidence on its impact on employment and turnover growth.

**1.3 Method**

The methodology adopted for this project embraced the principles of data-linking and the analysis was undertaken using a specially constructed panel dataset for the period 2001-2008 and contains a range of variables drawn from official data supplied by the Department of Enterprise Trade and Investment (DETI). These survey datasets were the Census of Employment (CoE), the Annual Business Inquiry (ABI), the Manufacturing and Services Export Survey (MSES), Business Expenditure on Research & Development Survey (BERD) and the Community Innovation Survey (CIS). In addition, information on all assisted firms and the grants they had received has been added to the panel to enable the effect of assistance to be estimated.

In assessing the impact of grant assistance on firm performance and productivity one must deal with the fundamental problem, associated with the effects of programmes or treatments, that the counterfactual outcome for individual firms had they not received the assistance, is unobservable. There are a number of techniques which can be used to detect the true effect of a program/treatment on an outcome variable when the programme users differ (in other ways than program use) from the non-users. Econometric techniques were, therefore, utilised in order to detect the true effect of the assistance. This involved controlling for the selection bias that arises (whereby better firms may be selected to receive assistance) and also endogeneity problems (whereby improvements in performance may have been a condition of the assistance).

**1.4 Structure of the Report**

The structure of the report is as follows:

* Chapter 2 will set out the policy context in which Invest NI operates and provide a case for business support.
* Chapter 3 describes in some detail the data-linking techniques and the databases used for this study in Northern Ireland. It also outlines some of the common problems with this type of work and provides a commentary on the econometric techniques that are appropriate.
* Chapter 4 sets out the results of the data-linking work and provides and assessment of the impact of Invest NI interventions in terms of job creation, sales and productivity (GVA). A range of econometric techniques are presented to understand the way in which the outcome varies depending on the choice of estimation method.

**Chapter 2: Public Policy and Firm Performance**

**2.1 Introduction**

This report thus seeks to make a contribution to the empirical literature by demonstrating the value of using firm-level data to examine how government financial assistance impacts on firm performance and productivity. The research reported here is unique in that it considers the impact of financial intervention along with export and innovative behaviour. The literature on exporting and innovation has not yet captured the effects of individual grant data, while empirical work on grant assistance tends to look at it in isolation and ignore the wider context. The aim of the report is, thus, to merge the two; the study will fill a knowledge gap on these issues at the firm level whilst the use of uniquely linked datasets incorporating financial data on grant payments will be used to construct a panel dataset for Northern Ireland which can be utilised for further research. The study will seek to determine whether the theoretical arguments which suggest that intervention enhances performance and productivity growth have any basis in empirics, and whether the much heralded drivers of productivity i.e. exporting and innovation, do in fact raise the productive efforts of firms.

Northern Ireland represents an interesting and useful case study for examining these issues in that manufacturing firms in Northern Ireland have enjoyed a higher level of subsidy from government than firms in any other UK region since the mid-1960s (Roper, 1996). This, therefore, provides an opportunity to apply data-linking and econometric modelling techniques to understand more clearly the effects of these subsidies.

BY way of context, the region performs poorly on most of the aggregate performance indicators compared to other UK regions:

* Northern Ireland’s productivity has lagged behind the rest of the UK with GVA per employee of around 80% of the UK average for the last thirty years (Oxford Economics, 2009).
* Northern Ireland has one of the lowest gross domestic expenditures on R&D of the UK regions, at 1.2% of GVA in 2007 (Notley and Clary, 2010)[[4]](#footnote-4).
* The value of exports of goods per employee job in Northern Ireland in 2009 is £7,245 which is around 15 per cent lower than the UK average.
* In addition the value of goods exported is less than 20% of GVA (Notley and Clary, 2010), which is just above the UK average but well below other regions including the North East and Wales[[5]](#footnote-5).

These figures suggest that firm performance in Northern Ireland is somehow different to or inferior to other regions and its output is of a lower value added nature, despite being heavily assisted by government. Peripherality may in part explain these findings; however the underlying nature of firms, the industrial structure and/or the nature of industrial policy may also play a part.

The research summarised in this report will, therefore, contribute to the understanding of the complex relationships behind these activities, and can be addressed by the availability of detailed firm-level data. The questions are important from a policy perspective in that in order to set appropriate policy goals it is necessary to understand the nature of firms; how they expand into new business areas such as R&D and exporting, and how this impacts on their performance. This understanding helps to target assistance more specifically; identify the potential impacts of such policies and avoid setting targets for activities which potentially have no impact on the ultimate policy goals.

Innovation, trade and productivity growth have been highlighted as central tenets of economic growth. Endogenous growth theories in particular suggest that improvements in productivity can be linked to a faster pace of innovation and extra investment in human capital, whilst the international trade branch of endogenous growth theory (Romer, 1990; Grossman and Helpman, 1994) suggests that the development and production of goods for export has externality effects which foster economic growth. Whilst the importance of these activities has been recognised in the growth literature, research into the specific areas, particularly at the level at which they largely occur i.e., at the firm level, is still being developed and has only become feasible with the increasing availability of micro-level data, and suitable software and techniques to enable its manipulation. In fact the impact of grant assistance on productivity growth is still an area of research that is underdeveloped due to suitable data being largely unavailable, with a recent paper (Girma et al., 2007) suggesting that, to date, due to lack of such data, the empirical evidence of the effect of grant assistance on productivity has been based largely on whether a firm participated in a government scheme or not rather than examining the effects of the actual payments. The report provides a unique attempt to address these deficiencies in the literature and provide policymakers with methodologies to connect business support interventions with outcomes that may impact directly on drivers of economic growth.

### 2.2 The Case for State Intervention

There are several reasons for offering government assistance to private sector companies. For externally owned companies the chief reason is to attract new investments to Northern Ireland. For companies with no existing operation in Northern Ireland the logic is clear. Few companies based outside Northern Ireland would normally locate here and most are likely to need some financial inducement to be persuaded to do so. For externally owned companies with existing operations within Northern Ireland the argument is similar. These companies often have the opportunity to locate new or expansion projects at other locations within their UK or global operations and require some inducement to locate this investment at their existing Northern Ireland site or elsewhere in Northern Ireland. For Northern Ireland owned companies a similar case can sometimes be made, but the logic more usually is different. Only viable projects should be supported but only those requiring financial assistance to bring them to fruition. Under the Industrial Development (NI) Order:

“*Assistance may be given on a discretionary basis to viable projects in industries or firms to:*

* *Promote development or modernisation*
* *Promote efficiency*
* *Create, expand or sustain productive capacity*

*An important aspect of the legislation is the stipulation that projects must be additional to what would have occurred in the absence of assistance. Companies must be able to ‘demonstrate convincingly that without assistance that the project would either not go ahead at all in Northern Ireland, or would go ahead on a smaller scale or within a longer timeframe’. A general rule is that SFA is provided as assistance of last resort.”*

Hence assistance can be, and usually is, given to firms to bring projects forward in time or to expand the size of a project. Some projects are also rendered financially viable through grants by reducing the cost of capital and thus increasing the expected return on capital. These approaches are also sometimes used as reasons for assisting externally owned companies. The case for reducing the cost of capital is accepted in practice although it might be viewed as circumventing the legal requirement that the project should be viable. The normal situation seems to be that viability is defined as profitable operation rather than meeting any particular expected rate of return required by capital markets at any given time.

There is considered to be a strong positive relationship between export expansion and the economic growth of a country or region. The basic argument is that as exports rise they inject additional income into the domestic economy and increase total demand for domestically-produced output. As a result governments worldwide have pursued, as part of their industrialisation strategies, export-promotion policies, in the belief that sustainable GDP growth can be attained through policies aimed at increasing the growth rate of exports.

Within Northern Ireland industrial policy was historically concerned with promoting new employment. Export assistance was available to firms however export promotion was not a key policy initiative, and in fact it was acknowledged by government that whilst export assistance was comprehensive, export performance was a key weakness of the economy (DED, 1987). As a result policy in the 1990s was refocused, with the new aim of promoting higher levels of growth, through which the promotion of exports, particularly from indigenous firms, was a key element (DED, 1990).

Acting under the remit of the Department of Economic Development (DED), the Industrial Development Board (IDB) and Local Enterprise Development Unit (LEDU) were responsible for delivering the export promotion policies under this new economic strategy, the latter taking responsibility for small local firms. Their central strategies were focussed on helping firms with their marketing, design and quality practices to enhance export potential, as well as organising trade missions and providing improved market intelligence. Invest NI took over the responsibilities of both IDB and LEDU in 2002; the promotion of exports remained a particular focus, with Invest NI citing “being international” as one of three economic drivers for its client companies (Invest NI, 2005).

Despite the various policy initiatives and growth challenges to promote **exports**, there have been few empirical studies examining the Northern Ireland position. Roper and Love (2001) examine the determinants of export performance for manufacturing plants in Northern Ireland and the Republic of Ireland over the 1996-99 period. They find a strong positive effect from the strength of plants’ internal resource base, suggesting that those with a high proportion of graduate employees and those with an in-house R&D capability have higher export propensity. Plant size and external ownership is found to be an important determinant, whilst younger firms are also found to have a higher export intensity. In a follow-up study covering 1998-2002, Bonner et al. (2006) find that the characteristics that influence the type of firms that export are not the same as those that influence export intensity, therefore export promotion policies should make a clear distinction between those designed to promote non-exporters to participate in export markets and those aimed at increasing the export share of current exporters. In terms of the actual influences on the likelihood of being an exporter firm size, productivity and undertaking R&D are all deemed important. The determinants of export performance, in this case export intensity, are shown to be linked to superior firm characteristics; there appears to be a greater sectoral influence, whilst export intensity is also found to be higher amongst the externally-owned group of firms. Those with high labour costs are found to export lower shares of total sales suggesting that firms are using their low cost basis as a means of being competitive.

**Innovation** has been defined by Porter and Stern (1999) as the “transformation of knowledge into new wealth-creating products, processes and services”, and is widely considered, particularly by endogenous growth theorists, to be a long–term driver of economic growth. As a result, the measurement of innovation activities has become more widespread over recent years and has been facilitated by the introduction of the Community Innovation Survey (CIS) which was initiated in European countries to investigate firms’ innovation activities. The survey has now been conducted six times (each survey spanning a three year period) and has spawned various research (for example, Camacho and Rodriguez, 2005; Cefis and Marsili, 2005; Criscuolo and Haskel, 2003; Harris and Li, 2006; Roper and Hewitt-Dundas, 2006; Roper and Love, 2002).

Within NI there have been several Innovation Strategies, dating back to the start of the decade, which aimed ultimately to create an R&D and innovation infrastructure; enhance the use of R&D and innovation by the business sector and, develop a culture of innovation and enterprise (DETI, 2003, 2005, 2008). The most recent of these, the third action plan, has been developed in “in recognition of the contribution that innovation can make to Northern Ireland’s productivity growth”(DETI, 2008); and as such sets out four “imperatives” and a number of associated objectives which seek to, amongst other things, increase innovation and R&D. However despite the continued policy focus on innovation there is to date, particularly in NI, scarce empirical evidence on the positive impact of innovation on productivity. Roper et al. (2006), analyzing manufacturing plants, find insignificant process innovation effects on productivity and negative product innovation effects. The latter findings are explained as either a ‘disruption’ effect whereby the introduction of new products to a plant may disrupt production and hence reduce productivity, or as a product-lifecycle type effect whereby newly introduced products are initially produced inefficiently with negative productivity consequences before becoming established and the focus of process innovations to improve productive efficiency. In a later study concentrating on the service sector in Northern Ireland Roper et al. (2007) find innovators to be more likely to be exporting than non-innovating services firms; to have higher labour productivity and sales per employee as that of non-innovators and to have faster sales and employment growth than their non-innovating counterparts. However, they find that innovation in itself has no direct impact on productivity and its effect is actually an indirect effect through its impact on exporting.

**2.3 Impact of Exporting, Innovation and Government Financial Assistance on Firm Performance and Productivity**

The provision of Government assistance to firms is a feature of most industrial policies around the world. Typically the argument for government intervention is to overcome some type of market failure or address specific business need, for example SMEs and start-ups are often viewed as most in need of assistance due to their limited internal resources and perceived vulnerability to external competition (Holm-Pedersen et al., 2009). However, despite the prominence of these policies, research analysing the impact of the value of financial assistance on firm performance is limited. To date the empirical studies have not had the required data, and where they have, they have estimated the impact in isolation. The unique element of this study is to consider, not only the impact of the value of financial assistance on productivity, but also to include the key variables of exporting and innovation, which to date has not been undertaken.

Within Northern Ireland Government support has progressed over the last fifty years from being strongly interventionist towards a more focussed role in helping industry overcome market failure. The nature of assistance to firms has evolved from direct forms of support for capital investment to a more targeted approach at the underlying obstacles to firm growth. Traditionally, the policies to emerge under the industrial structure heading were aimed largely at promoting new employment to compensate for the loss of jobs in older, declining industries, and hence reduce unemployment. However since the 1990s policy has shifted towards achieving higher levels of growth for the Northern Ireland economy, to be attained through measures to improve the competitiveness of the economy and to be facilitated through the private manufacturing and tradeable services sectors. In keeping with this policy the most recent Programme for Government aims to halve Northern Ireland’s private sector productivity gap with the UK average (excluding the Greater South East) by 2015 (NI Executive, 2008). Whilst the region’s economic development agency’s ultimate objective is to “improve the competitive position of our client business, thereby contributing towards an increase in regional productivity, as measured by Gross Value Added per head” (Invest NI, 2008).

To date most of the evaluation work on the effect of government assistance in Northern Ireland has tended to focus on the impact on employment and/or turnover growth (see Gudgin et al, 1989, Hart and Hanvey, 1995, Hart and Scott, 1994, Roper and Hewitt-Dundas, 1998, Hart and Gudgin, 1997; 1999, Hart et al., 1998) and there has been less work focusing on the productivity impact. Early studies tended to look at the productivity effects of grant assistance on small firms only (Hart et al., 2000, Hart and McGuinness, 2003) however these again found mainly employment impacts but little or no effect on productivity growth. Two subsequent evaluations, covering both large and small firms, looking explicitly at the effect of Selective Financial Assistance (SFA) on productivity came to differing conclusions about its impact. Harris et al, 2002, estimating a policy-on/policy-off model, found that total manufacturing output would have been between 7-10 per cent lower throughout 1984-97 if SFA had not been in operation. Whilst the later study, Hart et al., 2007, using a two-step model, found no significant observable impact of SFA on productivity. One of the reasons highlighted for this latter finding was that the impact period may have been too short, in that they examined the effect of assistance received between 1998-04 on the performance in 2004-06. The research reported here, therefore, seeks to build on this work and help provide a more definitive answer on whether financial assistance impacts on productivity growth. In addition, this study will improve on the latter work by using GVA per employee as a measure of labour productivity rather than sales per employee.

There are a number of theoretical arguments for the link between government assistance and productivity growth. Beason and Weinsten, 1996, summarise these into three categories, namely, Schumpeterian, Marshallian and strategic trade arguments. Schumpeterian theories suggest that through protection and subsidies innovators can take monopoly rents, thus giving them greater incentives to invest in new technologies and processes; these innovations then lead to increases in productivity growth. Marshallian theories promote infant industry protection for those sectors or industries that exhibit local externalities which increase with the size of the industry, hence giving rise to economies of scale, network effects and agglomeration economies which raise productivity. Finally strategic trade theories argue that in order for productivity to increase, domestic firms must be protected from foreign firms (for example by import protection policies) if they are not as efficient or because of market failure they are unable to grow.

Whilst the theoretical arguments can be made in terms of justifying government intervention[[6]](#footnote-6) the empirical evidence of its success, in terms of increasing productivity growth, is mixed and in may cases relies on whether a firm took part in a program rather than analysing the impact of the actual payments received (Girma et al., 2007). Beason and Weinstein (1996) use aggregated data to examine the impact of industrial policy tools on Japanese mining and manufacturing firms between 1955-90. They explore how tariffs, loans, subsidies and corporate tax breaks have been used to target sectors and the impact this had had on total factor productivity. Overall they find little evidence that these policies positively affected productivity growth, and in fact they suggest that this occurred because policies were targeted wrongly in that they sought to aid declining sectors and protect large unproductive industries. Bergstrom (2000) examines the effects of government capital subsidies on firm level productivity in Sweden over the 1987-93 period. Using panel data on both subsidised and non-subsidised manufacturing firms he finds that subsidisation is positively correlated with productivity growth but only for the first year after subsidies were granted. After that, the more subsidies a firm gets, the worse its total factor productivity growth. He therefore suggests that although there may be market failure arguments for subsidies that it is not certain that resources will be efficiently allocated upon their receipt. Harris and Robinson (2004) examine the effects of two UK government industrial support schemes (Regional Selective Assistance (RSA) and the Small Firm Merit Awards for Research and Development (SMART)) on the total factor productivity of British manufacturing plants between 1990-98. They find that when comparisons are made between RSA-assisted plants and those in the whole of Great Britain that assistance does improve productivity compared to average levels. However, when the comparison group is restricted to only include other plants within assisted areas then RSA assistance does not significantly improve plant productivity (although it does in certain sectors and in Scotland). Additionally firms in receipt of SMART support do not experience any improvement in performance, although the authors argue that this may be due to the fact that the benefits from this scheme would be expected over a longer time frame than was analysed. Girma et al. (2007) investigate whether government subsidies stimulate productivity growth in manufacturing plants in the Republic of Ireland over the period 1992-98. Their paper is unique in that they have data on all grant payments that were made to plants and thus are confident that their results are not biased due to other unobserved financial assistance payments. Their results show that when all the grant payments are added together as a total in any year they have no significant impact on total factor productivity growth. However, when the grants are categorised into whether they are likely to affect productivity directly or not, it is only those that are likely to be directly productivity enhancing that have a significant positive impact. The effects of productivity enhancing grants are also found to be higher in those plants that are most financially constrained, up to a certain point.

**2.4 Summary**

Overall, to date the empirical evidence on the productivity effects of public assistance is mixed. In addition, there has been little work carried out using data at the firm level in conjunction with individual data on payments, the Girma et al. (2007) paper being novel in this respect. The research reported in the remainder of this report seeks to adopt a similar framework, analysing the impact of grant assistance paid to Northern Ireland firms on their GVA growth, whilst controlling for other firm and sectoral effects. Innovation and exporting activities will be included in the model to examine their impact, with measures being taken to control for the endogeneity problem that arises with their inclusion[[7]](#footnote-7). The rehearsal of the literature on the role of innovation and exporting above serves to underline the importance of the inclusion of these variables in any model seeking to establish the impact of government support to business.

The study will adopt techniques to properly identify the true effects of policy support, as highlighted by Storey (1998) in his “Six Steps to Heaven” paper, in which he emphasises the need to control for selection bias. Technically, this approach involves estimating a relatively standard selection model, where the probit and the outcome equation are estimated simultaneously, but the second stage (the productivity growth model) is only performed on the selected firms (i.e. the assisted firms). This tests, and subsequently allows for, sample selection bias but then only estimates the growth effects on the selected firms. This approach is potentially important in allowing for sample selection bias, in that if one simply runs an OLS regression on this, the selectivity question is ignored, and the effect of financial assistance in productivity growth is likely to be overstated (Hart et al., 2008). The technique utilised will thus identify whether any selection into receipt of assistance has occurred, and if so on what basis. Furthermore the hypotheses will be grounded in the theoretical literature that suggests that firm subsidisation increases productivity by advancing the technological development of firms and, by helping firms maximise economies of scale. However, as stated above, alternative econometric techniques will be presented to serve as a sensitivity analysis on the preferred approach to provide reassurance to policy makers on the impact results.

**Chapter 3: Data-Linking: Data and Impact Assessment Methodology**

**3.1 Introduction: Data-linking – Basic Principles**

* Decide on relevant official business surveys and administrative data and check what level they have been collected/constructed at (plant vs firm); and whether they have a common referencing number.
* If there is a mix of plant and firm level survey data then you need to either aggregate up to firm level or apportion the firm level data to its plants – the purpose of the analysis should guide this. For example, if you want to look at local or regional area data then its usually better to work at plant level as the firm level postcode could be that of the headquarters and the accompanying data may include data from various areas[[8]](#footnote-8)
* If aggregating upwards from plant to firm level, it is important to decide how to create variables that cannot be summed, e.g. if plants have various SIC/NACE codes, which one should be used, likewise with address
* Typically common practice is to allocate the firm the SIC/NACE code/address of its largest plant (in terms of employment or turnover)
* If there is a common reference number across surveys/datasets then start to link by creating annual cross-sections. This is easier than creating longitudinal panels of individual datasets and then linking them together with other longitudinal panels particularly when reference numbers quite often change over time.
* It is helpful to have names and addresses wherever possible to help with the matching process. When reference numbers do not match you need to start checking for name/address/postcode matches. This can be done using software packages, however the proposed matches still have to be checked manually to ensure it is the correct firm. If the number of non-matches by reference number is large then you can decide to only check the largest non-matches by name, address etc. Also need to watch out for slight variations in names e.g. Smith Brothers versus Smith Bros versus The Smith Bros etc.
* If the surveys are a mixture of compulsory/census and voluntary then you need to decide what to do about the missing data in the voluntary surveys - i.e. whether you want to estimate or impute missing data. If doing this you need to be careful and check firstly the reason why the data is missing for example it could be missing due to not being included in the sample, due to non-response or it could be closed – do not want to estimate data for closed firms.
* When you have data matched it is helpful to tabulate certain variables that are common to both to see if any large differences arise. This can be due to the structure of firms being recorded differently on surveys. For example, the whole enterprise may be recorded as one reference number in one survey whereas the individual firms in the enterprise can be recorded as separate firms in another dataset. You need to decide how to deal with these irregular firms.
* Also when you have common variables, you should identify which one you will report on. For example, if there are two separate surveys which record employment you must decide which you shall use as you employment measure.
* If you are linking in any data on financial aid then you should keep in mind that only part of the business may have been aided and so adjust your data accordingly to reflect this. For example, a particular plant of a multi-plant

**3.2 Data-linking in Northern Ireland**

Having set out some basic principle of data-linking we now engage with a case study of Invest NI interventions in the region. One of the key aims of the project is to create a panel dataset which is constructed by linking together various official government survey data for Northern Ireland, namely, the Annual Business Inquiry (ABI), the Manufacturing Sales and Export Survey (MSES), the Business Expenditure on R&D Survey (BERD), the Census of Employment (CoE) and the Community Innovation Survey (CIS).

Each of these surveys has its sampling frame drawn from the Inter-Departmental Business Register (IDBR) which is a business register that contains information on all businesses in the UK which are VAT registered or operating a PAYE scheme. The IDBR holds a unique identifying reference number for each individual firm. Actual returns from these surveys spanning the period 1998-2008 will thus be linked together using this reporting unit reference number as the unique identifier. The resulting panel dataset will then be merged with financial data from Invest NI in order to both identify which firms received assistance and also to quantify the amount of grant assistance received.

The ABI is a statutory survey, conducted by DETI (and its predecessors), that has been conducted annually since 1998. It provides information on the value of the economic activity that businesses generate and associated expenditure, costs, and incomes. The survey includes data on turnover, gross value added, employment levels, employment costs and purchases. In Northern Ireland the survey is undertaken on a sample of firms; until 2007 typically all businesses in the Production industries employing twenty or more employees were selected to contribute to the survey, within the Construction sector all businesses employing fifty or more employees were selected and within Services, an employment threshold of one hundred employees was applied, with businesses falling below the threshold of complete enumeration selected on a random stratified basis. For the 2008 survey all businesses with 50+ employees, or 20+ employees and more than one local unit, were fully enumerated. Businesses falling below the threshold of complete enumeration were once again selected on a random stratified basis. The data provided for the purpose of creating the panel dataset was obtained from actual returns; on average, data was provided for around 2,000-4,000 firms per ABI survey between 1998-2008.

The MSES is a voluntary survey that has been carried out annually in Northern Ireland since 1991/92. The Northern Ireland Economic Research Centre conducted the survey until 2003, it has since been conducted by DETI (and its predecessors). The survey provides information on total sales, external sales and exports by Standard Industrial Classification (SIC) Division and destination of goods. Currently the sample for the survey is all manufacturing firms with 5 or more employees, although this is then boosted to ensure all assisted firms (both in manufacturing and business services are included). Previously, until 2001/02, all firms with 20 or more employees were surveyed (and usually a sample of 500 firms with employment less than 20). The data provided for the purpose of creating the panel dataset was obtained from actual returns; on average; data was provided for around 1,500 to 2,500 firms per MSES survey between 1998-2008.

The BERD survey is a voluntary survey, conducted by DETI (and its predecessors), that has been carried out triennially in Northern Ireland between 1993-99; and collected annually since 2001. The survey contains a range of data including types of R&D expenditure; type of research undertaken; sources of funding and types of R&D employment. The survey is undertaken on a sample of firms however it includes all those known to be engaged in R&D and thus represents a census of all known R&D performers in Northern Ireland[[9]](#footnote-9). The data provided for the purpose of creating the panel dataset was obtained from actual returns; on average, data was provided for around 300 firms per R&D survey between 1999-2005 and over 600 firms for 2007-08.

The CoE is a statutory survey, conducted by DETI (and its predecessors), which has been carried out in Northern Ireland every two years since 1978 (it was carried out annually between 1971-78). It is a full count of the number of employee jobs in all industries except for agriculture (and excludes the self employed). The survey provides data on male, female, full-time and part-time employees up to a five-digit Standard Industrial Classification (SIC92) level. The units to be surveyed are drawn from the IDBR, which is a register held by the Office for National Statistics (ONS), combining information from the VAT based business register and the HM Revenue and Customs’ computerised PAYE system. All units considered to be live on the IDBR at September in the year of the survey are selected. The data provided for the panel dataset is given at local unit level, which has to be amalgamated into reporting unit or firm level to link in with the other datasets. On average, data was provided for around 50,000-60,000 local units bi-annually which was amalgamated into 33,000-42,000 firm level records per Census survey.

The CIS is a voluntary survey carried out by EU member states that allows the monitoring of Europe’s progress in the area of innovation.  The survey is conducted in Northern Ireland by DETI (and its predecessors) and was originally conducted every four years (the first in 1993), but since 2005 has been conducted every two. It is based on a core questionnaire developed by the European Commission (Eurostat) and Member States and provides a range of information related to innovation activity among enterprises, including the extent of innovation activity; the impact of innovation on businesses; expenditure on innovation; sources of information and co-operation; and the barriers to innovation. A sample of firms drawn from the IDBR is surveyed; typically it covers enterprises with 10 or more employees in sections C to K of the (SIC) 2003. The first data available from the CIS for the panel dataset is from CIS 3 which covers the period 2002-04; data was provided on approximately 1,300 firms.

The Invest NI data is collected by the agency through their Client Executives, the agency’s client-facing account management team. Data is stored primarily on the Client Contact Management System (CCMS) and contains contact and background information on the client companies; letters of assistance awarded; proposed new jobs to be created or promoted and jobs to be safeguarded. A longitudinal dataset has also been developed, by Invest NI, from this, covering an 8 year period up to March 2010, which contains information on financial assistance offered to companies and expected jobs created or safeguarded. The payments data on Invest NI clients is held by them on a separate database and is currently being reconciled with client company information; however there is historic payments data available on the largest client companies (drawn from Invest NI’s predecessor, the Industrial Development Board’s databases). This payment data contains information on the project category and type; acceptance date of offer; amount offered and amounts paid out on an annual basis; the annual data on payments made covers the period 1983/84 – 2008/09. Both the payments and client data contain a unique identifying company reference number, as assigned by Invest NI. However work has been undertaken to match these reference numbers to the unique IDBR reference number, as provided on the other surveys above, for the purposes of data linking. The data provided for the panel dataset includes information on 2,900 client companies (of which 1,400 were significantly assisted firms in 2006[[10]](#footnote-10)); the payments data covers 640 client companies.

The methodology for constructing the panel dataset is to link each of the annual DETI datasets, via the IDBR reference number, to create, in the first instance, annual cross-sections. These annual cross-sections are then linked together to provide the longitudinal panel dataset. The Invest NI data is matched in at the end as it does not follow the format of the other datasets. The method of creating the annual cross-sections first (rather than creating panels of each individual dataset and then merging them together) was undertaken for a number of methodological reasons. Firstly, the earlier datasets did not contain complete lists of IDBR reference numbers for each firm, thus matching across datasets had to take place also on name[[11]](#footnote-11) and following that manual matches had to be undertaken comparing postcode and turnover data[[12]](#footnote-12); this was much more straightforward to carry out on an annual basis than would be after the data had been linked longitudinally. Additionally it allowed for gaps in reference numbers to be imputed from other surveys (where it was available) and thus led to easier linking longitudinally. Secondly, for a number of administrative reasons, the IDBR reference numbers tend to change over time which can create problems when creating time-series data. As the reference numbers for each survey came from the same source it was more likely that any reference number that changed would appear, under the new reference, across all the survey data in any given year. Linking cross-sectionally first meant that data was matched together, under the new reference, across the surveys. When linking longitudinally it then was easier to spot any gaps due to reference changes (for example the entire linked data for a particular year would be missing for a firm whilst simultaneously a new firm would wrongly appear in that year under the new reference number), thus once these were identified the linked data could be slotted correctly into the record of its previous reference number (and thus removed as a new firm)[[13]](#footnote-13).

A further methodological problem which had to be accounted for was that, whilst the majority of the survey return data was provided at firm/reporting unit level, the Census of Employment was not. This data was provided at plant level and also contained its own Census plant and firm-level reference numbers, as assigned by the Department. The accompanying IDBR reference numbers were only provided in full for the 2007 dataset[[14]](#footnote-14). Thus a number of steps had to be taken before the data could be linked into the other datasets. Firstly the plant level data had to be amalgamated into firm level, this left an issue as to which SIC code to be assigned to the firm level version, where it differed across plants. A decision was made to retain the SIC of the largest plant within the firm, by employment size (although for the purposes of the panel the SIC code from the ABI was used to define sector as it was thought to be more consistent over time). Amalgamating into firm level data also provided a difficulty when it came to assigning a postcode; this was not remedied as it was felt that the postcode provided by the other surveys would also suffice. Once the data was at firm level, measures had to be undertaken to assign IDBR reference numbers to the earlier years (by applying the 2007 reference numbers to earlier years where the firm was alive) and by manual identification of firms. Once this was complete the data could be linked into the remaining datasets.

Other issues which arose, due to the nature of the underlying surveys, was that of missing data. The MSES, BERD and CIS data are all voluntary surveys and thus the response rates vary. Smaller firms in particular are less likely to reply due to the administrative burden of form-filling and also, if they do not perceive themselves to undertake the activities the survey concerns e.g. exporting or R&D. In addition many of the surveys conduct stratified sampling beneath a particular size band and thus there will also be missing values for years in which firms are not surveyed. Due to the number of data that would have had to be estimated to no attempt was made to fill in missing data or to undertake estimation, thus resulting in an unbalanced panel.

**3.3 Modelling Techniques and Problems**

As described above one of the purposes of the study is to create a panel dataset of Northern Ireland firms. This is important in the analysis as it enables firm heterogeneity to be controlled for; in a cross-section there are a number of unmeasured explanatory variables that affect the behaviour of firms, similarly there are variables that affect firms uniformly but differently in each time period. Omitting these variables causes bias in the estimation, which is corrected using panel data. The use of such a dataset also creates more variability, by combining variation across plants with variation over time, thus alleviating problems of multicollinearity and also permitting more efficient estimation (Kennedy, 2003).

The assessment of the impact of grant assistance on firm performance and productivity must deal with the fundamental problem, associated with the effects of programs or treatments, that the counterfactual outcome for individual entities had they not received the treatment, is unobservable. This is problematic in that if those firms who received assistance already had favourable characteristics then any observed growth in productivity may not be caused as a result of the assistance given but actually due to the underlying characteristics of the firm – however we cannot tell as we do not observe what would have happened if they had not received assistance. If we do not control for this then we can overestimate the effects of the assistance by wrongfully attributing any growth to its effects.

There are a number of techniques which can be used to detect the true effect of a program/treatment on an outcome variable when the program users differ (in other ways than program use) from the non-users. Bartik (2002) suggests 5 methods:

1. Statistically controlling for observed variables that affect the economic outcome and might be correlated with program use by including these observed variables in the estimation equation that is used to predict the outcome variable. However this approach cannot correct for biases that might be caused by unobserved variables that are correlated with both economic outcomes and program use. It is also assumed we know the functional form by which the observed variables affect economic outcomes.
2. Using difference-in-differences estimation (DD). Under this approach we can compare the difference before and after the program of the differences between users and non-users of the program. The limitation of this approach is that there may be many other variables, observed and unobserved, that also affect economic outcomes and are correlated with program use.
3. Matching program users with non-users who are similar in observed characteristics. This can be done with propensity score matching, where the propensity score is an estimated probability given observed variables, that a given entity will use the program.
4. Explicitly modelling selection into the program and how it is correlated with unobserved variables affecting economic outcomes. This requires three equations: one equation explaining economic outcomes for program users; a second explaining economic outcomes for non-users and a third explaining whether a given entity is a program user. The estimation of the third equation allows a selection bias correction term to be added to each of the first two equations, which in theory corrects for the bias cause by unobserved variables that affect economic outcomes and are correlated with program use. This approach assumes that we have accurately specified that variables and functional form that should enter all three equations. It also assumes a particular statistical distribution for the error terms of all three equations.

1. Using an instrumental variable that predicts program use and is uncorrelated with unobservable variables that affect economic outcomes. The effects on economic outcomes of the instrument-induced shifts in program use show the true effects of the program because the shifts in program use are uncorrelated with unobservable variables predicting economic outcomes. The problem with this technique is finding such instruments – they must do a good job of explaining program use but have zero correlation with unobservable variables affecting economic outcomes. It is difficult however to test assumptions about the correlation of a proposed instrument with unobservable variables.

It is advisable to undertake at least two of these approaches in order to perform a sensitivity analysis of the robustness of the choice of method. The preferred methodology[[15]](#footnote-15) will follow point five and use a treatment model, such as the Heckman two-step methodology. In this framework a probit model is estimated for the endogenous assistance variable; the Inverse Mills Ratio is extracted from this and augmented to the second stage OLS productivity regression. The model must be identified correctly with the use of an instrumental variable.

The problem with this technique is finding such instruments – they must do a good job of explaining program use but have zero correlation with unobservable variables affecting economic outcomes.

Typically in this type of evaluation work instrumental variables are not readily available, as traditional variables such as size, age and sector can directly impact the likelihood of receiving assistance as well as impacting on the continuous growth or performance variable. However, for the purposes of the analysis Invest NI has provided a variable (named willing to engage) which is extracted from the administrative exercise that the agency undertakes when it first makes contact with a potential client. In order for the firm to become a client it must, along with other criteria, be willing to provide the agency with regular updates on company accounts and performance indicators. If the company is unwilling to do this then it does not receive grant assistance. This variable is deemed a suitable instrument as it quite clearly impacts on the decision to receive assistance but it does not necessarily have any such impact on the subsequent productivity of a firm.

There are a number of econometric techniques which can be used to detect the true effect of a program/treatment on an outcome variable when the program users differ (in other ways than program use) from the non-users. One of the main ways of dealing with the problem is explicitly modelling selection into the program. This requires three equations: one equation explaining economic outcomes for program users; a second explaining economic outcomes for non-users and a third explaining whether a given entity is a program user. The estimation of the third equation allows a selection bias correction term to be added to each of the first two equations, which in theory corrects for the bias caused by unobserved variables that affect economic outcomes and are correlated with program use. Technically, this approach involves estimating a relatively standard selection model, where a probit and the outcome equation are estimated simultaneously, but the second stage (the productivity growth model) is only performed on the selected firms (i.e. the assisted firms). This tests, and subsequently allows for, sample selection bias but then only estimates the growth effects on the selected firms. This approach is potentially important in allowing for sample selection bias, in that if one simply runs an OLS regression on this, the selectivity question is ignored, and the effect of financial assistance on productivity growth is likely to be overstated. Results of the Difference-in-Difference and Propensity Score Matching approaches will also be presented and discussed in the following section.

Chapter 4: Impact of Invest NI Assistance in NI

**4.1 Introduction**

What impact has Invest NI had on the performance of its clients since 2001? More formally, the objectives of the research task are:

1. To assess the effects and effectiveness of Invest NI assistance to the private sector.
2. To profile and benchmark Invest NI clients against similar firms in the private sector in Northern Ireland.

We do this by setting out in the first instance a simple analysis of the job creation propensity of assisted and non-assisted firms in Northern Ireland. While these comparisons are insightful they fall a long way short of robust evidence of impact. Therefore, we harness the specially constructed panel dataset to undertake econometric models which begin to isolate the effects of Invest NI intervention.

**4.2 Description of the Panel Dataset for Northern Ireland**

Survey data has been linked together for the period 1998-07 and the number of observations we have in each dataset at the start and end of this period are as follows:

* ABI (n 1998: 2,395; n 2007: 3,749)
* MSES (n 1998: 1,527; n 2008: 2,647)
* COE (firm level version created by ERINI) (n 1998: 36,579; n 2007 42,862)
* CIS (n 2002-04: 1,359)
* BERD (n 1999: 253; n 2007: 601)
* INI (n 2006-08: 2,940)

Each annual dataset merged by using the IDBR “RUREF”. The resulting dataset contained 14,171 individual firm records, however, not every one had complete data. To create a dataset which would have financial and exports data for every firm a panel was created containing only those records which had both an ABI and an MSES record in any year (note: they did not have to have continuous data for the entire period). The BERD and CIS data were kept in the panel dataset but were not used as part of the rules for inclusion (i.e. it was not a requirement that the data had ABI, MSES and BERD data in any year) as the sample size for these two surveys was too restrictive, and also the CIS is only undertaken periodically. The resulting dataset contained 2,057 records.

Invest NI data was now merged in and this dataset contained 2,940 private sector businesses. These were a combination of clients and more significantly assisted clients for 2006 and 2008. To be termed an Invest NI client the firm had to have met the criteria of threshold of % of export sales and employment growth required by Invest NI. To be termed significantly assisted the firm had to have received £250,000 in assistance in the previous 10 years or £25,000 in the previous 5 years. The 2,940 were composed of 1,443 firms who were clients or significantly assisted on 31st March 2006 and 1,497 who were clients or significantly assisted on 31st March 2008. Of the 2,940 Invest NI firms, 1,071 were matched into the panel dataset – the 1,869 firms not matched were due to a combination of missing IDBR refs (around 900); small firms that were not on the ABI and new openings (particularly for the 2008 clients) that had not yet appeared on the other survey databases.

A willing to engage dummy variable was provided by Invest NI, which indicated whether a firm was prepared to engage with the agency if they received assistance. This was merged into the data to be used as an instrumental variable in the econometric work i.e. the modelling work requires a variable that is correlated with receiving assistance but is not correlated with subsequent performance.

For the descriptive analysis of job creation in assisted and non-assisted firms in Northern Ireland a single dataset was used: Census of Employment for the years 2001; 2003; 2005 and 2007. This was linked together at the level of the plant (Local Unit) using the COE RUREF – or Reporting Unit. The resulting dataset contained 81,891 plant level records. This was merged with data from Invest NI on their clients (in 2006) and significantly assisted. Of the total plants 2,998 were assisted. Data was coded into a sub-regional geography - Parliamentary Constituency, District Council and NUTS areas. As the analysis was done at plant level it enabled us to include, within the job generation analysis, only those parts of the firm that were assisted e.g. the call centre parts of banks. The following section sets out this methodology in more detail.

**4.3 Invest NI Assisted and Non-Assisted Firms: Job Generation**

The aim is to examine more closely the level of net employment change over the 2001-07 period in Northern Ireland and decompose it into its gross components. The analysis will compare the job generation performance of ‘significantly assisted’[[16]](#footnote-16) Invest NI client companies against that of non-assisted firms (Hart and Bonner, 2009)[[17]](#footnote-17).

***4.3.1 Methodology and Definitions***

Using plant-level records from the bi-annual Census of Employment (CoE)[[18]](#footnote-18) for the period 2001-2007 net employment change in Northern Ireland is separated into four main gross components: openings, closures and the expansion and contraction of surviving plants. This accounting framework, further broken down by size, sector and ownership, allows us to identify how particular types of plants (e.g., small versus large; new versus survivors; assisted versus non-assisted, local versus externally owned) contribute to gross and net job[[19]](#footnote-19) creation over the 6 year period for Northern Ireland as a whole. Here we apply a basic job accounting framework to the private sector overall, and to the manufacturing, business service and ‘other’[[20]](#footnote-20) sectors for the period 2001-2007.

The basic building block of the CoE is the ‘local unit’ (LU) and these are related to a higher level ‘reporting unit’ (RU)[[21]](#footnote-21). In effect, a LU can be interpreted as a plant and the RU as an enterprise and they are linked by a common reference number[[22]](#footnote-22). In the first instance the four CoE datasets (2001 to 2007) were merged using the LU reference number and three broad groups of plants - ‘openings’, ‘closures’ and ‘survivors’ were identified. The resulting dataset was linked to the Invest NI client dataset and markers assigned to the LU records to indicate whether they were part of significantly assisted clients[[23]](#footnote-23), or non-assisted firms.

We make the assumption that the presence of an LU in each of the CoE datasets (2001 through 2007) represents a survivor plant. Further, an LU without employment in a previous dataset is taken to represent an opening in the first year that employment is recorded, whilst an LU without employment in a subsequent dataset after at least one year when employment was recorded is taken to represent a closure.

We are also working in the first instance over the period as a whole. For example, we identify all new openings since 2001 *that survived to 2007* and record their contribution to total employment at the end of the period. In so doing we ignore for the moment all new openings in the period that subsequently did not survive to be included in the 2007 CoE. The employment size of new openings is defined as their starting size and they are assigned to a category on this basis.

***4.3.2 Descriptive Statistics***

In the private sector as a whole there were 1,250 significantly assisted plants in 2001, rising to 1,258 in 2007; around four-fifths were locally owned plants[[24]](#footnote-24). Overall three-quarters of the assisted had employment of less than 50. In comparison, there were 37,191 non-assisted plants in 2001, and 46,817 in 2007; almost all of these plants (98 per cent) had employment under 50[[25]](#footnote-25).

Of the assisted plants just over three-quarters of the stock in 2001 survived to 2007 whilst openings and closures numbered around 270 each, (around 20 per cent of the base year stock). Just 60 per cent of the non-assisted plants survived to 2007[[26]](#footnote-26); however there were more new openings than survivors over the period for this group (25,000 versus 22,000 survivors).

The number of significantly assisted plants in manufacturing fell from 704 in 2001 to 694 in 2007; four fifths were locally owned. Almost 83 per cent of the original plants survived and, once again, there were a similar number of births and deaths (around 120 each). Manufacturing plants were larger than the private sector as a whole, with around one third having employment greater than 50 (almost three quarters of the externally owned assisted plants had employment larger than 50).

The non-assisted in manufacturing started with 2,894 plants in 2001, rising to 3,121 in 2007; less than 60 per cent of the original stock survived, however new jobs arising from openings equalled half of the base year stock.

There were just 194 significantly assisted plants in the business services sector in 2001, and 221 by 2007; around 86 percent had employment less than 50. Three quarters of the original stock survived whilst there were 81 new plants (42 percent of the 2001 stock). Around four-fifths of the significantly assisted in this sector were locally owned.

There were 4,665 non-assisted plants in business services, rising to 7,703 in 2007. There were actually more new openings than there were plants in 2001 (4,999 versus 4,665) whilst just 58% of the original stock survived.

***4.3.3. Employment Change 2001-2007***

Total employment within the Northern Ireland private sector rose by 11.6 percent between 2001 and 2007[[27]](#footnote-27); employment within significantly assisted plants increased by 3,017 or 3.7 per cent over the period, standing at 84,588 in 2007[[28]](#footnote-28). It must be noted that manufacturing plants account for over half of the significantly assisted; performance in manufacturing will thus have a large impact on the overall performance of assisted plants[[29]](#footnote-29).

Table 1 displays the gross components underlying the net growth in employment in significantly assisted plants. Expansions amongst survivors drove the gains, with almost double the number of jobs created through expansions than openings. The locally owned assisted plants comprised less than half the total jobs (46 per cent) yet they accounted for more than half of the gross job gains. In particular the locally owned accounted for almost three fifths of all expansions. Regarding the gross job losses, contractions amongst survivors accounted for the majority of losses in the assisted plants. The externally owned plants were responsible for more than half of all losses; in particular they accounted for 63 percent of all contractions. The locally owned did account for more jobs lost through closures (almost 6,000 compared to 3,000 for externally owned) however in total, the closures comprised just one third of all losses.

**Table 1: Job Creation and Destruction in NI 2001-2007 - Private Sector**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Significantly Assisted** | **Locally Owned** | **Externally Owned** |
| **Total Employment 2001** | **81,571** | **37,244** | **44,327** |
|  |  |  |  |
| **Gross Job Gains** | **28,416** | **15,017** | **13,399** |
|  |  |  |  |
| Openings | 9,524 | 4,122 | 5,402 |
| Expansions (Survivors) | 18,892 | 10,895 | 7,997 |
|  |  |  |  |
| **Gross Job Losses** | **-25,399** | **-11,695** | **-13,704** |
|  |  |  |  |
| Closures | -9,050 | -5,726 | -3,324 |
| Contractions (Survivors) | -16,349 | -5,969 | -10,380 |
|  |  |  |  |
| **Total Employment 2007** | **84,588** | **40,566** | **44,022** |

***Source: DETI Census of Employment (NI)***

Note: There were 1,250 plants in 2001 (1,017 local; 233 external) rising to 1,258 in 2007 (1,038 local; 220 external). Over the period there were 279 new plants (233 local; 46 external) and 271 closures (212 local; 59 external).

Turning to the components of the private sector there was a marked variation in performance according to sub-sector, with manufacturing experiencing a decline in employment of over 10 per cent; business services rising by over one third and the remainder of the private sector increasing by 15 per cent. The significantly assisted plants followed a pattern similar to that for all, with a declining manufacturing employment base and increasing services (Figure 1).

**Figure 1: INI Significant Assists: Net Employment Change 2001-07 – Private Sector**



Note: Manufacturing represents over half of all significantly assisted plants and thus dominates the performance for “All” sectors

Comparing the assisted and non-assisted by broad sector (Figure 2), it is obvious that assisted plants performed better in terms of net employment change (due to the skewed nature of the assisted plants as mentioned above the comparison for ‘all’ is not included). Manufacturing employment for the non-assisted group declined rapidly over the period, falling by 3.9 per cent per annum. The assisted group also declined but to a lesser degree, 1.6 per cent per annum. The resulting change meant that employment in manufacturing was one fifth lower for non-assisted plants by the end of the six year period compared to one tenth lower for the assisted.

Unlike manufacturing employment in business services rose rapidly between 2001-07. For the assisted plants the growth equated to 6.9 per cent per annum, resulting in an overall net change of almost 50 per cent. The non-assisted expanded by one third overall, averaging 4.9 per cent per annum. The rate of change for the remainder of the private sector, although also positive, was lower than that for business services. Again, net employment growth amongst the assisted was more than twice that of the non-assisted group.

**Figure 2: INI Significant Assists vs Non-Assists:**

**Net Employment Change 2001-07 – Private Sector**



Note: To make the sectors comparable only the 2-digit SIC groups which contain significantly assisted plants are included

**4.4 Modelling the Impact of Invest NI Interventions**

We have now seen that Invest NI clients experienced greater levels of net job creation than other non-assisted private sector plants in Northern Ireland. However, what we do not know is whether this job increase would have happened anyway in these Invest NI assisted firms. This section summarises the findings of our analysis of a firm-level/plant-level longitudinal database for Northern Ireland constructed from official business surveys[[30]](#footnote-30) and linked to Invest NI client records (see Chapter 3). This new panel dataset contains data on around 16,000 firms of which around 1,400 are Invest NI clients.

*4.4.1 How do Invest NI Assisted Firms Compare with Non-Assisted Firms?*

What determines the likelihood that a firm in Northern Ireland is a client of Invest NI? We examine this probability using a probit model and our findings show that Invest NI clients are different from non-assisted firms in Northern Ireland in the following ways – they are:

* more innovative (they are statistically more likely to engage in product and process innovation);
* more likely to export (they are statistically more likely to sell both outside the NI and UK markets);
* larger: Invest NI clients have a median turnover almost double (£5m compared to £3m) and have on average almost twice as many employees (72 compared to 46 jobs)

This different profile reflects a potential selection issue – either Invest NI select firms with these characteristics or firms with these characteristics approach Invest NI for assistance – any attempt to model the impact of Invest NI financial assistance to individual firms needs to take account of this issue.

***4.4.2 Trends in GVA and Turnover per Employee: 2001-2008***

We now focus on a sub-group of firms which have annual data on employment, turnover and GVA over the period 2001 to 2008 (Figure 3). In total, we track 480 firms (253 Invest NI clients and 227 non-assisted firms). Since 2004/05 there has been an upward trend in GVA per employee in Invest NI clients compared to non-assisted firms.



In contrast to GVA, we can see that turnover per employee remained virtually unchanged between the start and end points for both assisted and non-assisted firms (Figure 4). Over the period the trend for Invest NI clients appears to be slightly cyclical whilst it is more stable for non-assisted firms.



***4.4.3 What Impact has Invest NI had on the Private Sector since 2001?***

We answer this question by using the panel datasets discussed in Chapter 3 to estimate three econometric growth models for employment, sales and GVA. We start by adopting our preferred method of a 2-stage Heckman model which, as explained in the previous section, controls more effectively for the selection bias inherent in this type of assistance. The sole objective is to isolate the net effects of Invest NI assistance after controlling for the differing characteristics of the two groups of firms (i.e., Invest NI clients and other non-assisted firms). In other words the ‘counterfactual’ is embedded within the analysis.

In summary, the results show that, *ceteris paribus*, Invest NI assistance in the period 2001-08 was found to have:

* had a **positive and significant effect on GVA growth**; with Invest NI clients having higher GVA growth than non-assisted firms.
* had a **positive and significant effect on turnover growth** with Invest NI clients having higher turnover growth than non-assisted firms.
* had **no significant effect on employment growth.**

The detailed results supporting these summary conclusions are set out in Tables 2-4 below.

**Table 2: Treatment Model containing first stage probit (determinants of being an INI client) and second stage OLS (determinants of GVA growth)**

|  |  |  |
| --- | --- | --- |
|  | **Basic Model** | **Extended Model** |
| ***OLS*** | ***GVA Growth*** | ***GVA Growth*** |
| Constant | -0.413 (0.338) | -0.501 (0.372) |
| LTurnover | -0.010 (0.020) | 0.020 (0.045) |
| Turnover squared | -0.000 (0.000) | -0.000 (0.000) |
| Year 2002 | - | -0.61 (0.043) |
| Year 2003 | 0.053 (0.042) | -0.004 (0.041) |
| Year 2004 | 0.057 (0.043) | - |
| LEmp Costs |  | -0.031 (0.04) |
| External Sales Share |  | -0.063 (0.059) |
| Product Innovate |  | 0.006 (0.042) |
| Process Innovate |  | -0.004 (0.042) |
| Urban |  | -0.085 (0.095) |
| INI Client | 0.725 (0.400)\* | 0.726 (0.430)\* |
|  |  |  |
| λ (selection parameter) | -0.341 (0.197)\* | -0.340 (0.211) |
|  |  |  |
| N. obs | 606 | 606 |
| Wald Chi2 | 33.25\*\* | 39.24\*\* |
|  |  |  |

**Probit**

* Firms are found to be more likely to be Invest NI clients if they are larger (in terms of both turnover and employment size); INI clients have a mean turnover of £19m compared to £4m for the non-assisted whilst mean employment size is around 100 for the non-assisted compared to 180 for the assisted.
* Firms are also more likely to be Invest NI clients if they export and innovate.

**OLS**

* The probit indicated that certain types of firms are more likely to be Invest NI clients thus to control for this the OLS contains a selection parameter (drawn from the probit).
* After controlling for size and sector, assistance was found to make a significant difference to GVA growth; with Invest NI clients having higher GVA growth than non-assisted firms.
* Weak selection effects were found suggesting that there was selection into receipt of assistance, however the negative selection term indicates that without assistance these firms would have lower than average GVA growth.

**Table 3: Treatment Model containing first stage probit (determinants of being an INI client) and second stage OLS (determinants of Turnover growth)**

|  |  |  |
| --- | --- | --- |
|  | **Basic Model** | **Extended Model** |
| ***OLS*** | ***Turnover Growth*** | ***Turnover Growth*** |
| Constant | -0.552 (0.193)\*\*\* | -0.515 (0.168)\*\*\* |
| LnTurnover | 0.001 (0.012) | 0.065 (0.024)\*\*\* |
| Turnover Squared | -0.000 (0.000) | -0.000 (0.000) |
| Year 2002 | -0.024 (0.025) | -0.022 (0.023) |
| Year 2003 | 0.004 (0.023) | -0.006 (0.021) |
| Year 2004 | - | - |
| LnEmp Costs |  | -0.068 (0.024)\*\*\* |
| External Sales Share |  | -0.047 (0.031) |
| Product Innovate |  | 0.006 (0.022) |
| Process Innovate |  | 0.039 (0.022)\* |
| Urban |  | -0.053 (0.048) |
| INI Client | 0.705 (0.220)\*\*\* | 0.453 (0.215)\*\* |
|  |  |  |
| λ (selection parameter) | -0.336 (0.107)\*\*\* | -0.211 (0.105)\*\* |
|  |  |  |
| N. obs | 615 | 615 |
| Wald Chi2 | 56.33\*\*\* | 81.15\*\*\* |

**Probit**

* The probit results are as previously reported.

**OLS**

* Controlling for size and sector, assistance was found to make to make a significant difference to turnover growth with Invest NI clients having higher turnover growth than non-assisted firms.
* Selection into assistance did occur however without assistance these firms would have had lower turnover growth than average.
* Other variables which had a significant impact on turnover growth were turnover and employment costs; the higher a firm’s turnover the greater the turnover growth whilst the lower the employment costs the higher the turnover growth.
* Additionally, firms who engage in process innovation have higher turnover growth than those who do not.

**Table 4: Treatment Model containing first stage probit (determinants of being an INI client) and second stage OLS (determinants of Employment growth)**

|  |  |  |
| --- | --- | --- |
|  | **Basic Model** | **Extended Model** |
| ***OLS*** | ***Emp Growth*** | ***Emp Growth*** |
| Constant | -0.231 (0.149) | -0.195 (0.163) |
| LnTurnover | 0.003 (0.009) | 0.015 (0.019) |
| Turnover Squared | -0.000 (-0.000) | -0.000 (0.000) |
| Year 2003 | 0.006 (0.019) | 0.008 (0.019) |
| Year 2004 | 0.011 (0.019) | 0.013 (0.019) |
| LnEmp Costs |  | -0.006 (0.019) |
| External Share of Sales |  | -0.052 (0.027)\* |
| Product Innovate |  | 0.019 (0.018) |
| Process Innovate |  | 0.020 (0.019) |
| Urban |  | -0.036 (0.042) |
| INI Client | 0.234 (0.177) | 0.158 (0.192) |
|  |  |  |
| λ (selection parameter) | -0.098 (0.088) | -0.058 (0.095) |
|  |  |  |
| N. obs | 618 | 618 |
| Wald Chi2 | 53.86\*\*\* | 64.11\*\*\* |

**Probit**

* The probit results are as previously reported.

**OLS**

* There was found to be no impact of Invest NI assistance on employment growth.
* The only significant variable is share of external sales; the greater the share of sales to external markets, the lower the employment growth.

**4.5 Alternative Econometric Techniques**

***4.5.1 Difference in Differences Estimation***

The impact of a policy/treatment on an outcome can be estimated by computing a difference in differences (DID) model. It works by estimating a difference over time (before and after treatment) and a difference across subjects (between beneficiaries and non-beneficiaries) and produces an estimate of the impact of the treatment. If we were to just measure the difference in outcomes between beneficiaries and non- beneficiaries, measured after the intervention has taken place we may leave ourselves open to selection bias. However by incorporating data on the outcome variable for beneficiaries and non-beneficiaries observed before the intervention takes place we can then subtract the pre-intervention difference in outcomes from the post-intervention difference to eliminate selection bias related to time-invariant individual characteristics.

Thus, the DID estimator works on the principle that if what differentiates beneficiaries and non-beneficiaries is fixed in time, subtracting the pre-intervention differences eliminates selection bias and produces a plausible estimate of the impact of the intervention.

In our case we want to identify the effects of Invest NI assistance on performance measures (GVA growth, turnover growth and employment growth). We first identify firms that have received assistance and then compare changes in GVA (for example) for assisted firms to non-assisted firms, and across two periods (pre- and post-assistance). The resulting DID estimator is an unbiased estimate of the effect of the assistance if, without the assistance, the average change in GVA would have been the same for treatment and controls.

Obviously the key element of DID estimation is this latter assumption, known as the ‘parallel trend’ i.e. that the counterfactual trend is the same for treated and non- treated units. This, along with other elements suggest that DID estimation may be limited in terms of its usage for certain evaluations. A pre-condition of the validity of the DID assumption is that the program is not implemented based on the pre-existing differences in outcomes and therefore it is only appropriate to use when the interventions are as good as random; conditional on time and group fixed effects.

Use of this method on Invest NI assistance may, therefore, not be suitable due to the fact that we are not certain that assistance is assigned on a random basis (as opposed to a set criteria based on performance measures) and in fact a Heckman selection model has shown that selection is not on a random basis. Also the assistance data we have does not cover a specific set period of time, rather it can be ongoing or sporadic and also firms (both assisted and non-assisted) may have received similar interventions in the ‘before’ period, under a previous intervention programme.

We therefore proceed with the econometric estimation with caution. As Invest NI came into existence in 2001 we use the post-2001 period as the ‘after’ intervention period and the pre-2001 period as the ‘before’ intervention period. However, as we only have data from 1998 onwards we restrict the ‘after’ period to end in 2004 so that the periods before and after the intervention cover an identical time scale. The resulting difference in difference estimates for the period 1998-2004 are set out in Table 5.

**Table 5: DID Estimates 1998-2004**

|  |  |  |  |
| --- | --- | --- | --- |
| **VARIABLES** | **gvagrowth** | **turngrowth** | **Totalempgrowth** |
| Lturnover | 0.0838\*\*\* | 0.136\*\*\* | -0.00712 |
|  | (0.0290) | (0.0250) | (0.0178) |
| Lturnover squared | -0 | -0 | -0 |
|  | (0) | (0) | (0) |
| Log emp costs | -0.0419 | -0.127\*\*\* | 0.0465\*\* |
|  | (0.0315) | (0.0273) | (0.0195) |
| External share of sales | -0.0326 | 0.0416 | -0.0384 |
|  | (0.0503) | (0.0444) | (0.0313) |
| Urban | -0.0698 | 0.00823 | -0.0226 |
|  | (0.0830) | (0.0729) | (0.0521) |
| INI client | 0.0981\* | 0.122\*\* | 0.114\*\*\* |
|  | (0.0590) | (0.0521) | (0.0407) |
| Post2001 | 0.0557 | 0.0161 | -0.624\*\*\* |
|  | (0.0556) | (0.0483) | (0.0388) |
| INI\_Post2001\_interaction | -0.0876 | -0.0778 | -0.0917\*\* |
|  | (0.0663) | (0.0573) | (0.0465) |
| Constant | -0.413\*\*\* | -0.347\*\* | 0.375\*\*\* |
|  | (0.157) | (0.136) | (0.0992) |
|  |  |  |  |
| Observations | 2,612 | 2,651 | 2,612 |
| Number of ruref | 1,076 | 1,098 | 1,089 |
| Standard errors in parentheses |  |  |  |
| \*\*\* p<0.01, \*\* p<0.05, \* p<0.1 |  |  |  |

***Discussion of Results:***

Turning firstly to the GVA growth model, the results show that:

* Larger firms (in terms of turnover) have higher GVA growth than smaller firms
* INI assisted clients have higher GVA growth than non-assisted firms
* There is no significant difference in the mean GVA growth pre and post-2001
* There is no significant difference in GVA growth for assisted firms in the post-2001 period i.e. there is no assistance impact

The results for turnover growth show that:

* Larger firms (in terms of turnover) have higher turnover growth than smaller firms
* Firms with higher employment costs have lower turnover growth
* INI assisted clients have higher turnover growth than non-assisted firms
* Again there are no effects from assistance

The employment growth model displays a different set of results from the previous two, it shows that:

* Smaller firms (in terms of turnover) have higher employment growth than larger firms
* Firms with higher employment costs have higher employment growth
* INI assisted clients have higher employment growth than non-assisted firms
* The post-2001 period saw lower employment growth than the pre-assistance period
* Employment growth for INI assisted firms was lower in the post-2001 period than it was for non-assisted firms.

The negative and significant findings for the INI interaction term in the employment growth model are not what we would expect *a priori*; as was stated earlier this could be due to the fact that in the model we assume that assistance was given in 2001. However, our data do not actually correspond to this – INI clients may have received assistance in any year, or combination of years, post-2000 so the 2001 cut off is not strictly accurate. In addition they may have received assistance prior to 2001.

***4.5.1 Propensity Score Matching (PSM)***

The central idea of propensity score matching is to use a control group to mimic a randomized experiment. It uses information from a pool of units that do not participate in an intervention to identify what would have happened to participating units in the absence of the intervention. By comparing how outcomes differ for participants relative to observationally similar nonparticipants, it is possible to estimate the effects of the intervention.

**Assumptions for PSM:**

*Assumption 1:* (Conditional Independence Assumption or CIA): there is a set X of covariates, observable to the researcher, such that after controlling for these covariates, the potential outcomes are independent of the treatment status.

*Assumption 2:* (Common Support Condition): for each value of X, there is a positive

probability of being both treated and untreated.

The variables available for matching are critical to justifying the assumption that, once all relevant observed characteristics are controlled for, comparison units have, on average, the same outcomes that treated units would have had in the absence of the intervention.

In effect, the propensity score is a balancing score for X, assuring that for a given value of the propensity score, the distribution of X will be the same for treated and comparison units.

**Procedure for PSM:**

1. Estimate the propensity score using variables that affect both the probability of participation and the outcome; and are not affected by the treatment. Use these covariates to estimate the propensity score with a probit or logit model.

2. Choose a matching algorithm that will use the estimated propensity scores to match untreated units to treated units (e.g. nearest neighbour, radius, stratification matching etc.)

3. Estimate the impact of the intervention with the matched sample and calculate standard errors.

**Nature of the Matching algorithm:**

Nearest neighbour matching is one of the most straightforward matching procedures. An individual from the comparison group is chosen as a match for a treated individual in terms of the closest propensity score (or the case most similar in terms of observed characteristics).

Stratification matching consists of dividing the range of variation of the propensity score in intervals such that, within each interval, treated and control units have on average the same propensity score.

***Results:***

1. ATT estimation of GVA growth with the Stratification method

Analytical standard errors

---------------------------------------------------------

n. treat. n. contr. ATT Std. Err. t

---------------------------------------------------------

5436 22929 -0.003 0.010 -0.320

---------------------------------------------------------

2. ATT estimation of GVA growth with Nearest Neighbour Matching method

(random draw version)

Analytical standard errors

---------------------------------------------------------

n. treat. n. contr. ATT Std. Err. t

---------------------------------------------------------

5436 2205 -0.018 0.019 -0.972

---------------------------------------------------------

Note: the numbers of treated and controls refer to actual

nearest neighbour matches

The ATT shows the Average Treatment Effect of the Treatment on the Treated. In both cases the ATT is negative and insignificant. Both matching techniques thus indicate no significant effect of INI assistance on GVA growth. This differs from the results from the 2-stage Heckman model and in this case the issues surround the adequate identification of variables in the linked datasets. The model to generate the propensity score is very basic and there were problems getting it to balance when all the relevant variables included in the previous techniques were included.

**4.6 Summary**

The analysis presented in this chapter has demonstrated that an assessment of the impact of business support interventions can be successfully derived from a linked panel dataset based on official government surveys. It, therefore, reduces the need for expensive bespoke beneficiary and non-beneficiary surveys which are extensively used in evaluation work. The reduction of the burden on business is obvious. However, an important next step is to develop this work by harnessing official business demography datasets based on the administrative data on the population of businesses. This is currently underway in the UK and again Northern Ireland has been chosen, along with Scotland, as an important case study to show the value of this approach. The use of business surveys has been important but as we saw earlier in the chapter many are small samples and therefore, this has an impact for the econometric work by reducing the final sample size of the linked panel dataset.

**Annex A: PSM Method – Output File**

**Method:**

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Algorithm to estimate the propensity score

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

The treatment is Invest NI

Invest NI | Freq. Percent Cum.

------------+-----------------------------------

0 | 166,720 93.70 93.70

1 | 11,216 6.30 100.00

------------+-----------------------------------

Total | 177,936 100.00

Estimation of the propensity score

Iteration 0: log likelihood = -13859.109

Iteration 1: log likelihood = -12104.053

Iteration 2: log likelihood = -12033.336

Iteration 3: log likelihood = -12032.836

Iteration 4: log likelihood = -12032.836

Probit regression Number of obs = 28365

LR chi2(2) = 3652.55

Prob > chi2 = 0.0000

Log likelihood = -12032.836 Pseudo R2 = 0.1318

------------------------------------------------------------------------------

Invest NI | Coef. Std. Err. z P>|z| [95% Conf Interval]

-------------+----------------------------------------------------------------

lturnover| .2774612 .0050499 54.94 0.000 .2675635 .2873588

turnsq | -5.55e-14 3.84e-14 -1.45 0.148 -1.31e-13 1.97e-14

\_cons | -2.907958 .0397104 -73.23 0.000 -2.985789 -2.830127

------------------------------------------------------------------------------

Description of the estimated propensity score

Estimated propensity score

-------------------------------------------------------------

Percentiles Smallest

1% .0084957 .0010731

5% .022137 .0011001

10% .0330065 .0011085 Obs 28365

25% .0746503 .0011385 Sum of Wgt. 28365

50% .1640507 Mean .1903977

Largest Std. Dev. .1424798

75% .2689228 .7956584

90% .3862538 .7985051 Variance .0203005

95% .4758019 .8148734 Skewness 1.040747

99% .6213371 .8194999 Kurtosis 3.931399

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Step 1: Identification of the optimal number of blocks

Use option detail if you want more detailed output

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

The final number of blocks is 14

This number of blocks ensures that the mean propensity score

is not different for treated and controls in each blocks

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Step 2: Test of balancing property of the propensity score

Use option detail if you want more detailed output

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

The balancing property is satisfied

This table shows the inferior bound, the number of treated

and the number of controls for each block

Inferior |

of block | ini

of pscore | 0 1 | Total

-----------+----------------------+----------

0 | 148,580 5,833 | 154,413

.05 | 1,161 25 | 1,186

.0625 | 1,048 43 | 1,091

.075 | 1,823 133 | 1,956

.1 | 1,853 195 | 2,048

.125 | 1,597 316 | 1,913

.15 | 1,627 395 | 2,022

.175 | 1,410 416 | 1,826

.2 | 2,477 878 | 3,355

.25 | 1,695 856 | 2,551

.3 | 1,913 1,081 | 2,994

.4 | 1,328 880 | 2,208

.6 | 206 165 | 371

.8 | 2 0 | 2

-----------+----------------------+----------

Total | 166,720 11,216 | 177,936

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

End of the algorithm to estimate the pscore

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

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1. Part of this project will undertake a review of the precise ways in which EU funding provided has been drawn down by DETI and Invest NI to support their business support interventions. [↑](#footnote-ref-1)
2. See Harris, RID; Trainor, M; Roper, S and Hart, M (2002) The Effectiveness of Selective Financial Assistance in Northern Ireland: 1983-4 to 1996-7. Report for the Department of Enterprise Trade and Investment (DETI); and Hart, M., Driffield, N., Roper, S., Mole, K., 2007, Evaluation of Selective Financial Assistance (SFA) in Northern Ireland, 1998-2004, DETI [↑](#footnote-ref-2)
3. Beason, R. and Weinstein, D.E., 1996, Growth, Economies of Scale and Targeting in Japan (1955-1990), *The Review of Economics and Statistics*, 78, 2, pp. 286-295 [↑](#footnote-ref-3)
4. Yorkshire and the Humber had the lowest spend at 1.1% of GVA, Northern Ireland’s spend was joint second lowest, with London and Wales, and was well below the UK average of 2.0%. [↑](#footnote-ref-4)
5. Northern Ireland’s export of goods accounted for 18.3% of GVA in 2009 compared to a UK average of 17.8% and was lower than 6 other UK regions. The North East had the highest share at 24.2%. [↑](#footnote-ref-5)
6. There are also arguments to be made against government intervention in the market in that it may prevent the exit of inefficient firms and thus hamper productivity. [↑](#footnote-ref-6)
7. See section 3 for the methodological details. [↑](#footnote-ref-7)
8. Roome (2005) made the following observation which illustrates issues related to the choice of the unit of analysis when data-linking is undertaken:

   “We should consider a more differentiated approach, between schemes, as to whether we use Local Unit, Reporting Unit or Enterprise aggregation. In the case of regional support schemes we clearly should work at local unit level, and the information held in the administrative data would support this. In the case of research and development support schemes there is a strong case to be made for Enterprise or Reporting Unit analysis. Of course for the majority of SME, Enterprise, Reporting and Local Unit will relate to the same sole plant. Again, for comparison purposes between schemes, we should do higher level aggregation (Enterprise or Reporting Unit) analysis for those schemes where we can attempt Local Unit analysis”. [↑](#footnote-ref-8)
9. The information that identifies which firms carry out R&D is gained from previous surveys and other sources such as the Office for National Statistics (ONS), Invest NI and filter questions on the ABI and the CIS. [↑](#footnote-ref-9)
10. Significantly assisted clients are defined as those client companies that were in receipt of an offer of assistance worth £25,000 or more in the previous five years, and/or £250,000 in the previous ten years. [↑](#footnote-ref-10)
11. Names of companies are not always recorded the same way on survey returns, differences can arise with trading names used instead of owner names and also differences in spelling/use of abbreviations. [↑](#footnote-ref-11)
12. The ABI, MSES and R&D surveys all contain data on sales/turnover so where there was no match on reference number or name, matches were manually identified for the largest firms based on identical postcode and turnover data. [↑](#footnote-ref-12)
13. This method may not have captured all firms in cases whereby there was a reference number change and an accompanying name change, resulting in the failure to recognise the firm as an existing one. [↑](#footnote-ref-13)
14. This difference in referencing created further issues for a number of firms (mostly containing subsidiaries) whereby the firm was recorded under the IDBR as one entity with one reference number but was recorded under the CoE referencing as a number of distinct firms each with its own reference number, and vice versa. [↑](#footnote-ref-14)
15. Although this is our preferred methodology we do run two of the alternative econometric models outlined by Bartik (2002), namely Difference in Difference models and Propensity Score Matching. [↑](#footnote-ref-15)
16. Significantly assisted clients are defined as those client companies that were in receipt of an offer of assistance worth £25,000 or more in the previous five years, and/or £250,000 in the previous ten years. [↑](#footnote-ref-16)
17. Hart, M and Bonner, K (2009) Job Generation in Northern Ireland 2001-2007: The Performance and Contribution of Assisted and Non-Assisted Plants. [↑](#footnote-ref-17)
18. We are grateful to DETI for permitting access to the individual records of the CoE to undertake this work. [↑](#footnote-ref-18)
19. The Census of Employment counts the number of jobs rather than the number of persons with jobs. Thus a person holding both a full-time job and part-time job, or someone with two part-time jobs will be counted twice. [↑](#footnote-ref-19)
20. The Other sector is defined as the private sector excluding manufacturing and business services. [↑](#footnote-ref-20)
21. The CoE is a postal enquiry and a full response is sought in order to obtain an accurate count of the number of employee jobs as the Census date. Census forms are sent to the addresses where employers hold their pay records and employers are asked to return the number of employees and the business activity for each address where they have employees. Forms go to Reporting Units who then fill out the details of their Local Units. In some cases, companies may request that individual forms are forwarded to selected Local Units. The ‘Local Units’ to be surveyed are drawn from the IDBR. A response rate of around 98% is normally achieved. This survey is now unique in the context of the UK as it is the only regular census of all employers. [↑](#footnote-ref-21)
22. A meeting was held with the DETI unit responsible for the CoE to discuss the process of data collection and the adequacy of using LU and RU reference numbers in this way. [↑](#footnote-ref-22)
23. In cases where only part of the company received assistance e.g. the call centre part of a financial institution, only the plant(s) corresponding to this part of the company were assigned the assisted marker. [↑](#footnote-ref-23)
24. We have ownership information for the assisted plants only. [↑](#footnote-ref-24)
25. Financial payments data is available for 272 of the significantly assisted firms; in total these firms received £221 million over the 2001/02 – 2006/07 period. [↑](#footnote-ref-25)
26. This is not panel attrition but the actual closure of non-assisted plants and illustrates the degree of churn in evidence in the Northern Ireland economy. [↑](#footnote-ref-26)
27. This figure includes employment within Invest NI clients that were significantly assisted, other clients that were not significantly assisted and the non-assisted. For comparison purposes the 2 digit sectors comprising the private sector include only those in which significantly assisted firms were present. [↑](#footnote-ref-27)
28. If the definition is relaxed to include all Invest NI clients, then employment growth is 6.6 per cent over the period. [↑](#footnote-ref-28)
29. Non-assisted employment grew by 41,176, a rise of 13.4 per cent, to 347,922 however it is not comparable to the assisted due to the widely differing structure of the two groups. [↑](#footnote-ref-29)
30. These include the ABI; MSES; BERD; CoE as well as the CIS which is an ONS survey. [↑](#footnote-ref-30)