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Participation in South Australian Innovation and Investment Funds: Impact on firm performance

Bilal Rafi

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Abstract

This research assesses the impact of participation in the South Australian Innovation and Investment Funds (IIFs) on firm performance. Analysis of these impacts had not been possible until recently given limitations in data. This limitation is overcome via linking Departmental programme data to the Business Longitudinal Analysis Data Environment (BLADE), resulting in a longitudinal dataset that allows a counterfactual to be established. Via the use of a matching estimator this research determines that the South Australian IIFs had a positive additional impact on aspects of firm performance. The estimated average treatment effects (ATEs) however suggest that the benefits arising from additionality are modest. Given data limitations, these findings should be treated as exploratory.

JEL Codes: H43, L16, L25
Keywords: Structural Change, Impact Analysis, Regional Assistance, Firm Performance

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For further information on this research paper please contact:

Bilal Rafi
Industry and Firm Analysis Section, Insights and Evaluation Branch
Department of Industry, Innovation and Science
GPO Box 9839
Canberra ACT 2601
Phone: +61 2 6276 1946
Email: bilal.rafi@industry.gov.au

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Key points

- **Linking Departmental data with the Business Longitudinal Analysis Data Environment (BLADE) allows for an empirical assessment of the impact of South Australian IIFs on participant firms.**
- **Via the use of a matching estimator, a reliable counterfactual is established to assess whether participation provided any additional benefits to firms.**
- **Findings reveal that South Australian IIFs exerted a positive additional impact on aspects of firm performance such as employment (FTE) and turnover.**
- **These findings are exploratory and there is scope for future refinements and research in this area.**

1. Introduction

Government assistance that allows vulnerable regions to cope and adjust to structural change is a feature of industrial policy in many economies around the world, including Australia. Within Australia the Innovation and Investment Funds (IIFs) are an example of targeted interventions. Key aims and objectives of these funds are contextual and varied, however, creating sustainable and durable employment opportunities, encouraging private investment in regions, and diversifying the regional industrial base are common refrains.

Since 1999, Australian governments have introduced a number of IIFs around Australia. Generally the trigger for the announcement of an IIF has been the closure of a large employer or other drastic change to an important industry. For example, the Structural Adjustment Fund for South Australia (SAFSA) was announced in May 2004 in response to the closure of the Mitsubishi plant in Lonsdale SA.

Meaningful econometric assessment of the IIFs is challenging given data and methodological issues, notably the difficulty in establishing a good counterfactual, given limited programme data. A counterfactual is defined as outcomes in firm performance in the absence of the government intervention. Simply put, how would firms that received assistance as part of IIFs, have performed if such assistance was not offered?

The recent availability of a powerful microeconomic data source, in the form of the Business Longitudinal Analysis Data Environment (BLADE), overcomes some of these limitations and creates new opportunities for firm-level analysis. BLADE consists of information on Australian firms from existing Australian Bureau of Statistics (ABS) survey products, but notably also includes financial and tax data on Australian firms from Pay as you go (PAYG) statements, Business Activity Statements (BAS) and Business Income Tax (BIT) statements, as well as patent data from IP Australia.

In response to stakeholder interest, the Office of the Chief Economist (OCE) at the Department of Industry, Innovation and Science (DIIS) has conducted a pilot empirical assessment of the impact of South Australian IIFs on participant firms.[1] Additionally, this study showcases the viability of BLADE as a promising data source for firm-level analysis.

The remainder of the paper is structured as follows, Section 2 briefly discusses the rationale for government assistance, and highlights recent structural change in South Australia. The key mechanics and features of the South Australian IIFs are also outlined in this section. This is followed by a brief discussion of the importance of a good counterfactual, the data linking process, associated challenges and the limitations of the linked dataset in Section 3. The results and the limitations of the current research are discussed in Section

[1] These results are based, in part on tax data supplied by the ATO to the ABS under the *Taxation Administration Act 1953*, which requires that such data is only used for the purpose of administering the *Census and Statistics Act 1905*. Any discussion of data limitations or weaknesses is in the context of using the data for statistical purposes, and is not related to the ability of the data to support the ATO's core operational requirements.

4 followed by some brief commentary and concluding remarks in Section 5 and 6 respectively.

2. The South Australian context

2.1 The rationale for government assistance

Government offers targeted assistance to firms and industries for a plethora of reasons. Assistance can be offered to promote strategic industries — the infant industry argument — to correct for market failure, for example by providing incentives to firms to invest in research and development, or to allow lagging regions to play economic catch-up. These motivations are not mutually exclusive and the interplay between these motivations means that it is possible for government assistance to have varied and diverse goals.

Notably, structural change underpins many of these considerations. Structural change is a broad concept although it generally refers to long-term shifts in the composition and distribution of output, investment and employment across industries or regions. Structural change can be driven by varied stimuli although notable influences include technological advances, evolving demographics and consumer preferences, domestic policy reforms, and international developments such as increased import competition from emerging overseas economies.[2]

It is important to note that structural change is an ongoing process, consistent with Joseph Schumpeter's theory of "creative destruction". Over time all economies evolve. Improvements in technology, productivity and relative differences in comparative advantage facilitate newer, more efficient processes to replace established ways of doing business, creating economic output and employment. In the long run, structural change can result in a more resilient economy that makes better use of scarce resources. However, in the short-to-medium term, rapid structural change can lead to adverse impacts on industries and associated labour as they face redundancy and obsolescence. This is especially true of regional economies that might have limited resources and concentrated, fragile industrial bases. Previous research indicates that gradual structural change allows greater absorption of displaced workers, while rapid structural change can lead to high levels of competition for limited job opportunities in vulnerable regions.[3] As structural change is both inevitable and destabilising[4], the public policy challenge therefore, is how to manage structural change to continually evolve regional economies, while helping vulnerable regions adjust to and cope with the short-to-medium term adverse effects.

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[2] Office of the Chief Economist (2014) *Australian Industry Report 2014*, Canberra, Department of Industry, Innovation and Science, p.72

[3] Ibid. p. 115

[4] Office of the Chief Economist (2017) Australian Industry Report 2016, Canberra, Department of Industry, Innovation and Science, p.145

2.2 Structural change in South Australia

To establish some context, this section provides a brief overview of macroeconomic performance and structural change in South Australia. This overview draws on recent commentary by the South Australian Centre for Economic Studies.[5] The historical context and exogenous factors help explain the lagging economic performance of South Australia relative to other jurisdictions, and its patterns of structural change.

In the late nineteenth century South Australia had a favourable comparative advantage relative to the other States, based on an efficient agricultural (wheat and wool) sector, favourable climate and mineral (copper) resources. However, the economic depression of 1890 had a disproportionately adverse impact on the South Australian economy relative to the other States. A sustained recovery in terms of economic output and incomes did not occur until the Second World War which led to the relocation of considerable manufacturing activity to Adelaide.[6]

Manufacturing remained an important capstone of the South Australian economy after the end of the Second World War. With the exception of Victoria, manufacturing continued to grow as a share of South Australia's State GDP, even though the share of manufacturing in gross output in other States started to decline in the late 1950s. As a result of this historical industrial trajectory and subsequent State government policies, by the 1970s the South Australian economy had a much higher dependence on consumer durables manufacturing (such as Textile, Clothing & Footwear, and Cars) than any other Australian jurisdiction.

In more recent decades notable influences have reduced the viability and competitiveness of manufacturing in South Australia. These influences range from:

- The emergence of Asian economies such as Japan, South Korea, China, Taiwan and Thailand as exporters of cars and automotive parts
- The strengthening of the Australian dollar during the mining boom years which hurt South Australian exports
- Increasing rates of automation and computerisation
- Falling trade and tariff barriers
- The concentration of financial and professional services in Sydney and Melbourne
- The Global Financial Crisis (GFC).

As a consequence of these aforementioned influences the South Australian economy has lagged other Australian jurisdictions. Over the 26 years to 2015-

[5] O'Neil M, Whetton S, Gobbet D, et al. (2015) *Should South Australia really be down in the mouth? Macroeconomic performance*, Adelaide, South Australian Centre for Economic Studies

[6] Adelaide was considered as relatively safe from attack from Axis forces.

16, Gross State Product (GSP) in South Australia grew at an average of 2.3 per cent per annum, considerably lower than the national average GDP of 3.1 per cent over the same period.[7] There is a similar story when assessing other metrics such as GSP per capita levels (only 87 per cent of the national average), and total employment growth (only 0.8 per cent relative to the national average of 1.6 per cent).[8] This has been exacerbated by an outflow of skilled labour from South Australia and a relatively older population base, which has adversely impacted labour supply.

Large scale manufacturing in South Australia has diminished with a wave of automotive plant closures in recent years. One by one, automotive companies such as Ford, Holden and Mitsubishi have first reduced their scale of operations and employment and then ultimately curtailed all production and manufacturing in South Australia and Victoria. A more mature domestic automotive market, relatively high labour costs in Australia and more favourable production opportunities overseas are commonly cited drivers of this winding down of automotive manufacturing. The loss of automotive jobs and associated economic activity (such as the adverse impact on local supply chain firms) were a major shock to the South Australian economy, especially the southern suburbs of Adelaide, a relatively poor region with a few large manufacturing employers, limited economic infrastructure and a relatively unskilled labour force.[9]

In response to these automotive closures and to assist in the adjustment of vulnerable South Australian regions the Australian government introduced a number of IIFs. The core mechanics of these IIFs are discussed in the following section.

2.3 The Innovation and Investment Funds

As discussed, generally the trigger for IIFs has been the closure of a large regional employer — automotive plant closures in the South Australian context — or other such drastic change to an important industry. IIFs are targeted at addressing the more general business and employment ramifications that may occur when there is a significant firm closure or re-structure.[10] Within South Australia, the following programmes were introduced to assist local economies transition:

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[7] ABS Cat.no.5220.0, Table 1 – *Australian National Accounts: State Accounts, 2015-16*

[8] ABS Cat.no. 6202, Table 7 – *Labour Force, Australia, Jan 2017*

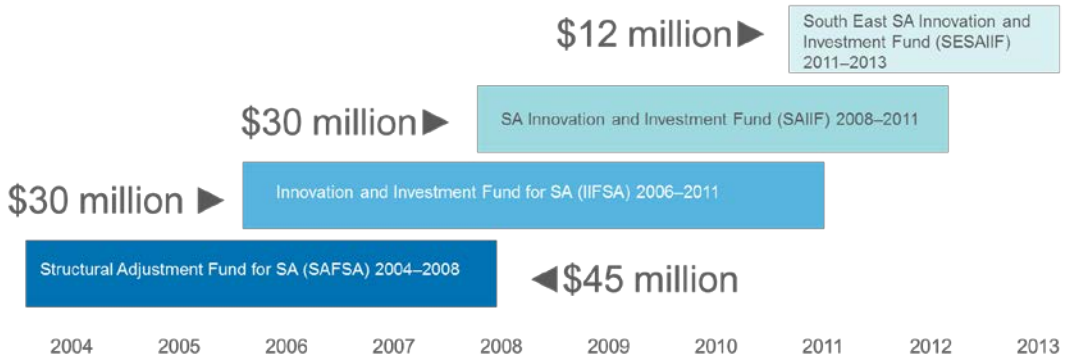
[9] Beer A and Thomas H (2007) The Politics and Policy of Economic Restructuring in Australia: Understanding Government Responses to the Closure of an Automotive Plant, *Space & Polity,* 11(3), pp. 243-261

[10] For example, the South Australia Innovation and Investment Fund Industry Development Program was established following the closure of Mitsubishi's vehicle assembly plant with the aim of creating sustainable, high-skill, full-time jobs for South Australia. The programme ($30 million) was a competitive funding round to support investments to create new industry capacity or expand existing capacity, with emphasis on innovative processes and technologies.

- **Structural Adjustment Fund for South Australia (SAFSA)**. Offered $45 million in funding with a focus on Adelaide. The trigger for the programme was the closure of the Mitsubishi plant in Lonsdale.
- **Innovation and Investment Fund for South Australia (IIFSA)**. In response to the decision by Electrolux to downsize, IIFSA focused on Adelaide. $30 million in funding was made available to eligible firms.
- **South Australian Innovation and Investment Fund (SAIIF)**. Prompted by the closure of the Mitsubishi plant at Tonsley. Offered $30 million in funding, with a focus on the southern suburbs of Adelaide.
- **South East South Australia Innovation and Investment Fund (SESAIIF)**. Focused on the Limestone Coast region of South Australia. Offered $12 million in funding in response to the restructuring of the Kimberly-Clark plant in the region.

A summary of these funds is presented in Appendix A to this paper. Each South Australian IIF was a distinct intervention targeted at a particular structural change challenge, although in terms of timing there was some overlap in these programmes due to lags in the rollout of assistance to successful applicant firms (Figure 1.1). In addition to the contribution by the Australian Government, in most cases these IIFs had a State funding component, and the core business or industry at the centre of the restructure also offered funds or other forms of help such as providing assistance with re-skilling and or assistance with job search. In most cases the bulk of the IIF funding was provided by the Commonwealth.

Figure 1.1: South Australian IIFs



Notes: Compiled from programme documentation. Each IIF programme was a distinct intervention.

Source: Department of Industry, Innovation and Science

Figure 1.2 summarises the salient features of IIFs. Key aims and objectives of each fund were tailored and contextual, however, creating sustainable job opportunities, encouraging private investment in the regions, preserving confidence in regional economies and diversifying the economic base were common refrains across the funds.

Figure 1.2: Common features of the South Australian IIFs

Notes: Compiled from programme documentation.

Source: Department of Industry, Innovation and Science

In terms of eligibility, each programme had its own criteria, although there were some common requirements. Firms that wished to apply for IIF funding needed to have an Australian Business Number (ABN), could not be tax exempt and had to be conducting business in South Australia. Preference was given to firms that proposed projects that introduced new innovations and or technologies to their businesses and the local economy. In their programme applications, firms had to commit to creating sustainable new job opportunities. Proposed projects could not simply divert employment from other regions in Australia if a firm was active in more than one jurisdiction. If deemed successful against these criteria by a panel, the IIF programmes granted up to 50 per cent of eligible capital costs for approved projects. Applicant firms had to demonstrate the ability to co-finance the balance of the capital costs of the proposed projects.

As evident from Figure 1.1, while relatively small when compared to the size of the South Australian economy, the four South Australian IIFs still represented a notable outlay of public funds.

2.4 Previous research on government assistance

There are currently no published empirical assessments of the impacts of IIFs on participant firms in Australia. This is primarily due to data limitations and confidentiality issues. What little that is available in terms of research on the

IIFs is often qualitative and descriptive in nature with an emphasis on the impact on displaced workers.

Notably South Australian researcher, Andrew Beer, has contributed research in this area.[11] His work is predominantly qualitative and presents the arguments for and against the use of government assistance to manage regional structural change and associated policy implications. Beer has conducted case study analysis of the community impacts[12] — in terms of post restructure employment and income of displaced workers — arising due to plant closures and subsequent targeted assistance. In Beer's opinion structural adjustment programmes, such as the IIFs, are an example of largely reactionary actions by government. They are not pro-active policy measures and in this regard uses of such policies in Australia differs from that in some European nations.

In a similar vein, commentary by the Grattan Institute and the Productivity Commission (PC) is sceptical of the IIFs. The Grattan Institute argues against the use of regional job attraction schemes — a core feature of IIFs — stating that such programmes show little lasting economic impacts on the regions and that despite successive waves of such policies, the major long-term patterns of regional development are primarily explained by exogenous (external) economic factors, and not by specific government intervention in a particular region.[13]

The PC has highlighted the lack of research on IIFs and points out that the limited previous research on IIFs has suggested that government funds allocated to participant firms were not as effective as intended. The PC is of the opinion that regional adjustment funds are likely to be costly and ineffective, arguing that a review of the efficacy of the IIF model of assistance was well over due.[14]

Programmes with similar motivations to the IIFs have also been used in other parts of the world, notably the European Union (EU) has a variety of programmes with similar goals — if not mechanics — to the IIFs. While an exhaustive literature review of international research on this topic is beyond the scope of this paper, Appendix B to this paper highlights some notable empirical work from overseas.

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[11] See for example, Beer A (2014b) Structural adjustment programmes and regional development in Australia, *Local Economy*, pp 21-40; and Beer A (2014a) Structural adjustment and the automotive industry: insights for regional policy and programmes, *Regional Studies, Regional Science,* 1(1), pp. 96-101

[12] Beer A (2013) *Structural adjustment prorgams in Australia: Community impacts and outcomes*, Adelaide, Centre for Housing, Urban and Regional Planning, University of Adelaide

[13] Daley J and Lancy A (2011) *Investing in regions: Making a difference*, Grattan Institute, p.20

[14] Productivity Commission (2016) *Trade & Assistance Review 2014-15*, Canberra, Productivity Commission, p. 43

3. Data, methodology and associated issues

3.1 Establishing a counterfactual

Since the primary goal of this analysis is to compare aspects of firms' performance between IIF participant and non-participant firms, a control or counterfactual needs to be established. This is a key challenge of an impact assessment of this nature. The outcomes for participating firms relative to firms that applied to the IIFs but were unsuccessful in receiving grant funding could be considered to assess whether IIF funding led to superior performance in employment, turnover or capital expenditure. This approach while straightforward, is flawed.

It is possible that the participating firms and unsuccessful applicant firms had considerably different intrinsic characteristics so that, even prior to application and participation in the IIF programmes, there could have been marked differences in the performance of these firms. In other words, such an approach is susceptible to a selection bias. Any inferences based on, for example, a simple trend analysis of successful applicant versus unsuccessful applicant firms is likely to be biased and may overstate or understate the impact of the South Australian IIFs. Simply comparing the participating firms against the unsuccessful applicant firms is also unviable as programme data on unsuccessful applicant firms was only available for two of the four South Australian IIF programmes (SAIIF and SESAIIF).

Essentially a simple comparison between the participant and unsuccessful firms does not establish a good counterfactual — where a counterfactual is defined as the outcome that would have occurred in the successful firms had there been no IIF programmes and comparing this to what actually occurs.[15]

For the current assessment of the firm impacts of the South Australian IIFs, limited availability of data rules out the use of experimental research design techniques such as randomised controlled trials (RCTs). RCTs create and track a control group via random assignment that does not receive a treatment or intervention.[16]

Quasi-experimental techniques that attempt to synthetically "construct" a control or counterfactual group are more feasible in the current scenario where the assessment is to be carried out retrospectively and where there are data limitations. Quasi-experimental techniques can make use of matching estimators, propensity scores, difference in difference estimation or regression discontinuity analysis to construct a synthetic counterfactual. Such techniques have the same fundamental goal as RCTs, however their efficacy and

[15] Rogers P, Hawkins A, McDonald B, et al. (2015) *Choosing appropriate designs and methods for impact evaluation*, Canberra, Department of Industry, Innovation and Science p 33

[16] In this particular case the intervention or treatment refers to the provision of financial grants and other forms for assistance to firms via the IIFs.

accuracy largely depends on the underpinning assumptions and the techniques used to construct the counterfactual.

3.2 The use of linked programme and BLADE data

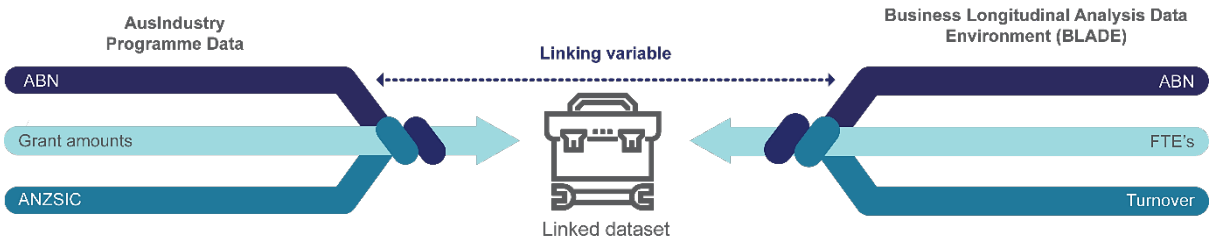
As highlighted earlier in this paper, scarce empirical research on the IIF programmes is a consequence of programme data limitations rather than a lack of policy interest. To overcome this limitation, this research project uses BLADE— formerly known as the Expanded Analytical Business Longitudinal Database (EABLD) — that integrates administrative tax data and existing ABS survey data using the ABS business register as the integrating spine. The conceptual basis of BLADE is aligned with the ABS economic statistics unit model that is the basis for producing Australian economic statistics.

BLADE contains administrative data on more than two million actively trading Australian businesses. It includes Australian Taxation Office (ATO) data, IP Australia data and some Department of Industry, Innovation and Science (DIIS) programme data. The bulk of BLADE data items are sourced from the ATO from:

- **Business Activity Statements (BAS)** that are submitted by businesses to report their Goods and Services Tax (GST) obligations. Data items include total sales, export sales, wages & salaries, capital & non-capital purchases
- **Business Income Tax (BIT)** forms that are submitted by businesses to report taxable income or loss on one of four form types (Company, Partnership, Sole Trader, and Trust)
- **Pay as you go (PAYG)** statements provided by businesses to report personal income tax obligations of their employees. This is used to model Full-Time Equivalent (FTE) and headcount employment counts.

Figure 3.1 illustrates how the Departmental data was linked and appended to the BLADE by ABS staff, using the ABN as the linking variable.

Figure 3.1: The data linking process



Source: Department of Industry, Innovation and Science

The linked dataset for the financial years 2001-02 to 2013-14 includes data on the South Australian IIF programme firms as well as data on all South Australian firms within BLADE — tens of thousands of firms — this ensures that there are more than enough non-participant firms to establish a good counterfactual. This linking methodology results in an unbalanced longitudinal (panel) dataset that includes more variables for analysis, greater variability in

the data and more years of observations on the IIF programme firms before, during and after each South Australian IIF programme.

3.3 The issue of complex firms and other data limitations

The linked dataset is richer than the IIF programme data by itself, although it still has some limitations. Notably, the ABS maintained business population which BLADE relies upon is, by its nature, composed of the more complex "managed units" in the business population. For the current research, issues arise when the Enterprise Group (EG) — essentially the parent or head entity — consists of a number of Management Units (MUs). As clarified by the ABS[17], for the allocation of relevant variables such as FTE and turnover, the ABS process is to map ABNs to EGs, by first aggregating the data to EGs, then to apportion it to the MUs associated with the EG for each financial year on the basis of relative employment etc. State of operation is not a deciding factor in this process — if the MU operates in more than one Australian State or Territory the data relates to all jurisdictions. This remains a limitation of BLADE — as the data is predominantly drawn from tax records — there is little information at the establishment (facility) level as tax information is only filed by a firm's headquarter or parent entity.

Of the 95 successful applicant firms across the four South Australian IIFs, a notable proportion of firms are classified as complex firms (MU). For these firms currently there is no reliable way to disaggregate the data on key variables such as FTE, turnover, and capital expenditure to isolate the South Australian component. Without controlling for the location, any analysis of these complex firms would be biased. Firms classified by the ABS as "simple firms" — that only operate under one ABN in one Australian jurisdiction — do not suffer from this ambiguity. Therefore the results presented first in the next section only relate to South Australian IIF programme participant firms that can be classified as "simple" using the ABS vernacular. The results of the complex firms are presented later in the next section, although with the very strong caveat that these results are likely to be biased.

3.4 Overcoming selection bias via a matching estimator

In the absence of an RCT, the issue of selection bias can be overcome via a quasi-experimental technique such as the use of a matching estimator. The intuition behind matching estimators used to measure treatment effects is outlined below. This section draws upon the work of Abadie and Imbens[18],

[17] Commentary in this section is based on personal correspondence with ABS staff.

[18] Abadie A and Imbens G (2002) *Simple and bias-corrected matching estimators for average treatment effects*, National Bureau of Economic Research Cambridge, Mass., USA

Abadie et.al[19] and Caliendo and Kopeinig[20] who discuss the theoretical underpinning and mathematical notation of matching estimators.

For an individual firm, $i = 1, \dots, N$, with all units exchangeable, let:

$\{Y_i(0), Y_i(1)\}$ denote the two possible outcomes, namely $Y_i(0)$ is the outcome when an individual firm does not receive the treatment and $Y_i(1)$ is the outcome when it does receive the treatment.

The average treatment effect (ATE) can then be expressed as the difference between the two outcomes:

$$\tau = E\{Y(1) - Y(0)\}$$

However, when estimating the ATE, only one of the two outcomes is observed. Intuitively, if an individual firm receives treatment then it can also not receive the treatment. For an individual firm the two outcomes are mutually exclusive. The observed outcome can be denoted as:

$$Y_i = Y_i(W_i) = \begin{cases} Y_i(0) & if\ W_i(treatment) = 0 \\ Y_i(1) & if\ W_i(treatment) = 1 \end{cases}$$

Since only one of the two outcomes is observed we must estimate the other unobserved potential outcome for each individual firm in the sample.

If the decision to take the treatment is random for individual firms with similar characteristics (often referred to as pre-treatment variables or covariates) then the average outcome of similar firms that were not treated can be used to estimate the unobserved (untreated) outcome for the treated firms.

To ensure that the matching estimators identify and consistently estimate the treatment effects, it is assumed that:

For all x in the support of X,

W (Treatment) is independent of $(Y(0), Y(1))$ conditional on $X = x$. This is referred to as un-confoundedness or 'selection on observables'.

Additionally it is also assumed that:

$c < \Pr(W = 1 \mid X = x) < 1 - c$, for some $c > 0$

This is referred to as the identification assumption, and states that the probability of assignment to the treatment is bounded away from 0 and 1. This assumption is also known as the overlap assumption. Essentially the overlap assumption must hold otherwise, if all individuals with similar characteristics (covariates) choose the treatment (probability of 1) or did not receive treatment (probability of 0), there would be no observations on similar individuals in the opposite outcome category which could be used for comparison.

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[19] Abadie A, Drukker D, Herr JL, et al. (2004) Implementing matching estimators for average treatment effects in Stata, *Stata journal,* 4, pp. 290-311

[20] Caliendo M and Kopeinig S (2008) Some practical guidance for the implementation of propensity score matching, *Journal of economic surveys,* 22(1), pp. 31-72

The nearest neighbour matching estimator used for this project uses a scaling matrix S to determine the distance between vector covariate patterns (characteristics) to weight observations and find a close match for each individual firm from the other group (treated or untreated). Specifically, the Mahalanobis Distance, which is the inverse of the sample covariate covariance matric is used:

$$S = \frac{(X - \bar{x}'1_n)'W(X - \bar{x}'1_n)}{\sum_i^n w_i - 1}$$

Where 1_n is a n x 1 vector of ones, $\bar{x} = (\sum_i^n w_i x_i)/\sum_i^n w_i)$, and W is an n x 1 diagonal matrix containing frequency weights.

The following firm characteristics are used for matching:

- **Firm size**, established via initial employment numbers
- **Industry sector**, as given by the four-digit ANZSIC
- **Exporter status,** binary variable equal to 1 if the firm has generated revenue from foreign sales
- **Temporal proximity,** achieved via matching observations that are at the same point in time (are active in the same financial year).

In this particular case each observation from the treated group of firms is matched to at least three close observations with similar characteristics from the untreated group based on the Mahalanobis Distance. The outcomes for the nearest neighbours are then averaged and compared against the outcome for each treated observation.

Nearest neighbour matching is implemented with replacement, which means that each observation from the untreated group can potentially be used as a match more than once. This results in reduced bias in the ATE estimates and a higher quality match although it does increase the variance of the estimates. However, this issue becomes less serious in large datasets, such as the one used for this project.

Compared to other matching estimators such as propensity scores, nearest neighbour matching has some advantages. By not imposing any functional form assumptions, the nearest neighbour matching estimator is more flexible relative to propensity score matching. This implies that it can be used to estimate ATEs for a much wider class of models. However the drawback is that the nearest neighbour matching estimator requires much more data, and the bias in the ATE estimate starts to increase as more continuous covariates are added to the model.[21] However, for this particular research project the advantages of the nearest neighbour matching estimator outweigh the negatives — there are a sufficiently large number of untreated South Australian firms in the BLADE data to draw a counterfactual from, and only one continuous covariate (number of FTEs).

[21] Huber C (2015) *Introduction to treatment effects in Stata: Part 2*, Stata Press, http://blog.stata.com/2015/08/24/introduction-to-treatment-effects-instata-part-2/

To assess whether participation in the South Australian IIFs had an impact on employment (FTE), turnover and capital expenditure of treated firms — these variables are set as the outcome variables in the matching estimation — the Average Treatment Effects (ATEs) for the one year forward and two year forward change in these variables was estimated to assess whether there was any evidence of additionality due to the South Australian IIFs. Due to limited number of observations, the data for the four South Australian IIF programmes were pooled together.

4. The impact of participation in South Australian IIFs on firm performance

The results from the matching estimation are presented below.[22] Given the issues surrounding the complex firms discussed earlier, the results for simple participant firms are reported separately from the complex firms. Only statistically significant results are reported. The estimated ATE and their level of statistical significance are reported in Appendix C to this paper.

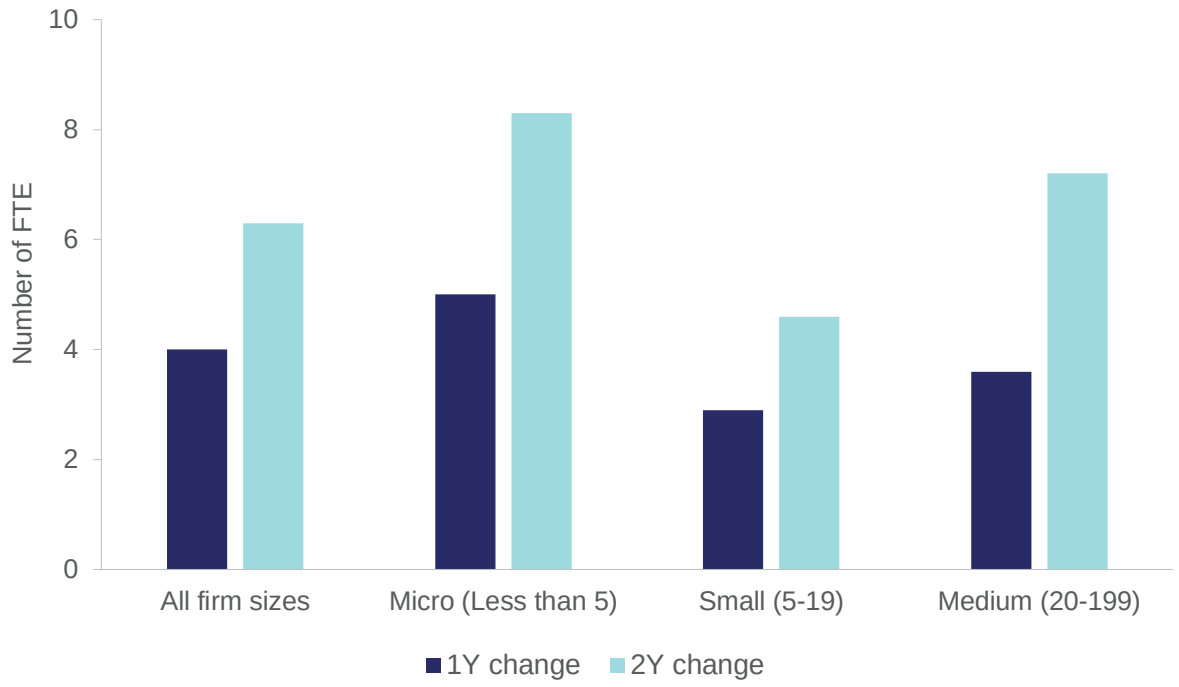
4.1 Simple participant firms

FTE

Figure 4.1 reports the ATE for the one year forward and two year forward change in FTE. The length of the bars shows the additional impact in terms of number of FTEs created — as measured by the ATE — of the South Australian IIF programmes. It is important to note that Figure 4.1 does not report the total number of jobs created by the IIF participant firms during their enrolment in the IIFs.

[22] The results presented below are robust to heteroscedasticity. Additionally, observations that did not report information on the outcome variables of interest were omitted from the sample. Outliers identified by exploratory data analysis were also excluded from the analysis to avoid bias.

Figure 4.1: Additionality in employment (number of FTE), average treatment effect – Simple South Australian IIF firms



Notes: Length of the bars depicts the premium in FTE change relative to the counterfactual. Firms size was controlled for by using initial employment size as a proxy for firm size.

Source: BLADE (2001–02 to 2013–14*)* Author's calculations

Relative to the counterfactual, the bars show, on average, the number of **additional** FTEs created by the simple participant firms that otherwise would not have been created had there been no South Australian IIF programmes.

Across all firm sizes when considering the ATE for the one year forward change, the treated (participant) firms created on average 4.0 more FTEs than the untreated (counterfactual) South Australian firms. There is evidence that this positive effect persists as the two year forward ATE is larger, with the treated firms creating on average 6.3 additional FTEs relative to the counterfactual. When controlling for firm size, it is observed that the positive additionality effect of the South Australian IIFs prevails although the benefits are disproportionate. Treated micro firms, which are starting from a very small employment base, benefit the most. The one year forward ATE for such firms was 5.0 FTEs, with the two year forward ATE being higher at 8.3 FTEs. Treated medium sized firms also benefit but to a lesser extent, exhibiting a one year forward ATE of 3.6 FTEs and a two year forward ATE of 7.2 FTEs. Small (5-19 employees) treated firms benefit the least in terms of additionality, the one year and two year forward ATEs for these firms was 2.9 and 4.6 FTEs respectively.

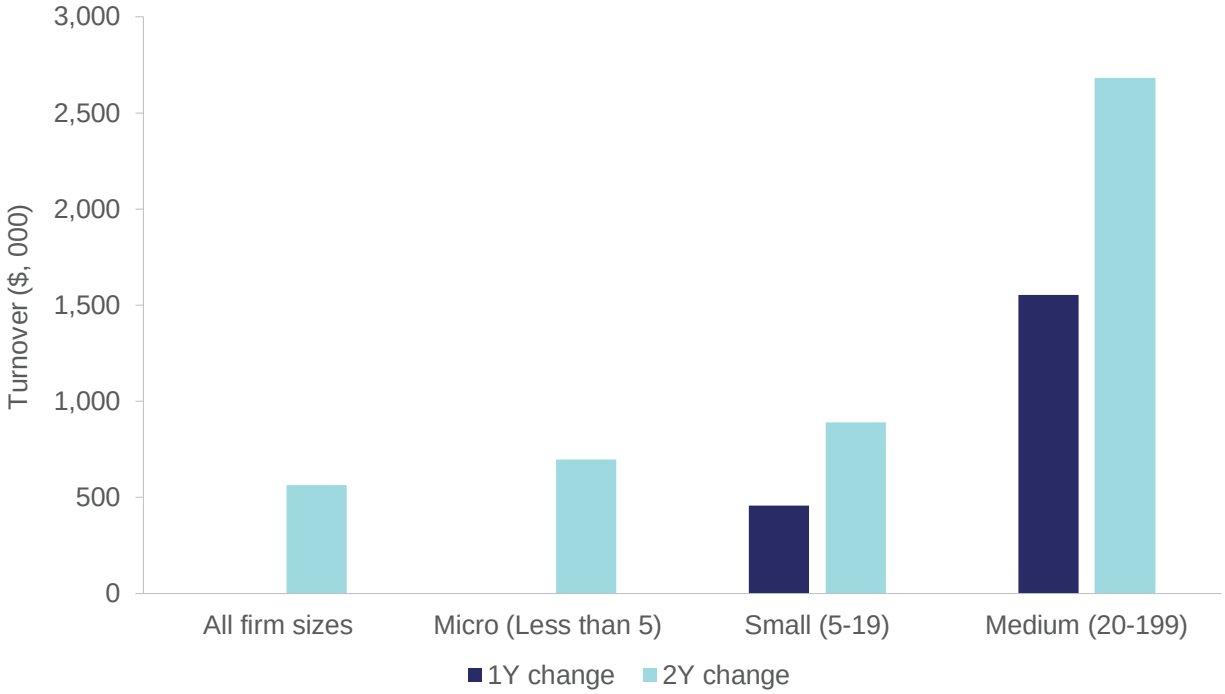
Turnover

Figure 4.2 reports the ATE for one year forward and two year forward change in annual turnover relative to the counterfactual. One year forward ATE

estimates for the all firm sizes and micro firm cohorts were not statistically significant and are not reported.

It is likely that the statistically insignificant results for the all firm size one year forward ATE are due to the lack of year-to-year variability in annual turnover of micro firms. The relatively larger, small and medium sized firm cohorts exhibit more variability in their year-to-year turnover and the one year forward ATE for these firms was statistically significant. Similar to employment creation, there was also a positive additional impact on the annual turnover of the treated IIF firms. On average, as suggested by the one year forward ATE for small treated firms, turnover was $457,000 higher than the counterfactual. For medium sized firms on average the one year forward turnover was $ 1.5 million higher than the counterfactual.

Figure 4.2: Additionality in turnover ($, 000), average treatment effect – Simple South Australian IIF firms



Notes: Length of the bars depicts the premium in turnover change relative to the counterfactual. Firms size was controlled for by using initial employment size as a proxy for firm size.

Source: BLADE (2001–02 to 2013–14*)* Author's calculations

The benefits from additionality are also visible in the two year forward ATE again suggesting persistence in the benefits from participation in the South Australian IIFs. On average, the ATE for micro firms suggests that the two year forward turnover was $698,000 higher than the counterfactual. For small firms, it was $890,000 higher. The premium is the largest for medium size treated firms, with a two year forward ATE suggesting turnover that was $2.6 million higher than the counterfactual.

Capital expenditure

The empirical results of this research finds very weak evidence that participation in the South Australian IIFs provided any additional benefit to treated firms in terms of capital expenditure. All of the one year forward and two year forward ATEs for the various firm size cohorts were statistically insignificant. The only statistically significant result was for the all firms, two year forward ATE, which suggests that on average capital expenditure in the treated firms was $77,000 greater than the counterfactual. However, from the linked BLADE data, the statistical evidence on this outcome variable is not definitive. It is possible that a lesser degree of year-to-year variability in capital expenditure data is responsible for the statistically weak results. A rate of change beyond two years may better pick up changes in capital expenditure. This should be explored in future analysis as more years of BLADE data is made available.

Chances of survival

Additional to the analysis of the impact of the IIFs on firm performance, this paper also considered whether participation in the South Australian IIFs had any impact on the survival rates of the firms. Given data limitations some simplifying assumptions had to be made to conduct this survival analysis.

Firm survival time was considered to be the number of years a firm appears in the BLADE. This is a truncated data item as it is only possible to observe firms in the data from 2001-02 to 2013-14. It is probable that many firms in the data already existed prior to this time frame, so that their true survival time is likely to be different. A failure event occurs if a firm drops out of the BLADE prior to 2013-14. Due to limited number of observations for each of the four South Australian IIFs, the observations across those four programmes were pooled together.

Hazard ratios were estimated via a Cox regression to assess whether successful and unsuccessful IIF programme firms differed in terms of their relative risk of failure when compared to non–participant firms. Additional dummies were included for the secondary and tertiary sector to assess whether there were any differences in rates of survival across the broad industrial sectors. Average values of FTE, turnover and capex for each firm were also included as explanatory variables. The omitted or base category for comparison were South Australian firms that did not apply to the IIF programmes.

Table 4.1: Survival analysis, hazard ratios – Simple firms

	Hazard ratio	*Decrease in rate of failure (per cent)*	
IIF successful	0.478	52	***
IIF unsuccessful	0.174	83	***
Secondary sector	0.976	2	*
Tertiary sector	0.968	3	***
Average FTE	0.979	2	***
Average Turnover	1	0	
Average Capex	1	0	***
n	118,346		

Notes: *** significant at 1 per cent, ** significant at 5 per cent, * significant at 10 per cent. n refers to the number of distinct firms used for the survival analysis. Decrease in the rate of failure is (1 – hazard ratio).

Source: BLADE (2001–02 to 2013–14) Author's calculations

Table 4.1 reports the hazard ratios from the survival analysis. As shown by the hazard ratios and the more intuitive, decrease in the rate of failure[23], both firms that successfully applied for IIF funding and those that applied but were unsuccessful, were less likely to fail relative to non-participant South Australian

[23] The decrease in the rate of failure is a percentage calculated as 1 minus the hazard ratio.

firms. While most of the other variables were statistically significant, they do not contribute greatly towards reducing the rate of failure.

It is interesting to note that firms that were unsuccessful in securing IIF funding were less likely to fail (had a smaller hazard ratio and a greater decrease in the failure rate) than the successfully funded IIF programme participant firms. Why this might be should be explored in future analysis.

While illustrative, this survival analysis should be seen as a marker for further research, and due to the data limitations, simplifying assumption and time constraints, the current commentary on the failure rates should be interpreted as exploratory. As assessed by a comparison of the Cox-Snell residuals against the cumulative hazard function, the Cox regression performs adequately in terms of statistically significant predictors. However, the residuals do not have a perfectly exponential distribution, a condition necessary for a well performing survival model.

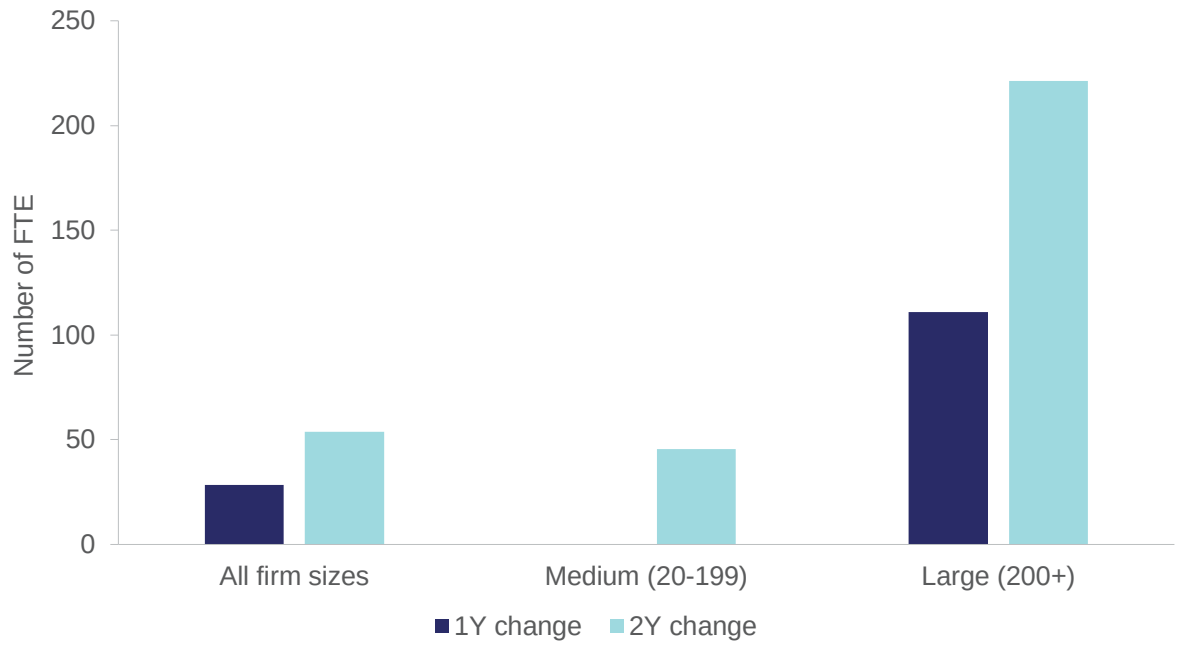
4.2 Complex participant firms

The ATEs for the larger complex participant firms are presented in this section. *As discussed in Section 3.3, the ATEs for complex participant firms are likely to be biased upwards* — primarily due to a lack of a definitive method within BLADE to disaggregate the South Australian component of a complex firm that conducts business in multiple Australian jurisdictions — the results in this section should be treated in this context.

FTE

Figure 4.3 reports the ATEs for complex participants firms. The one year forward ATE for medium sized firms was not statistically significant and is not reported. Like the simple participants firms, there is evidence of additional benefits from participating in the South Australian IIFs above and beyond the outcome that would have occurred in the absence of the programmes.

Figure 4.3: Additionality in employment (number of FTE), average treatment effect – Complex South Australian IIF firms



Notes: Length of the bars depicts the premium in turnover change relative to the counterfactual. Firms size was controlled for by using initial employment size as a proxy for firm size.

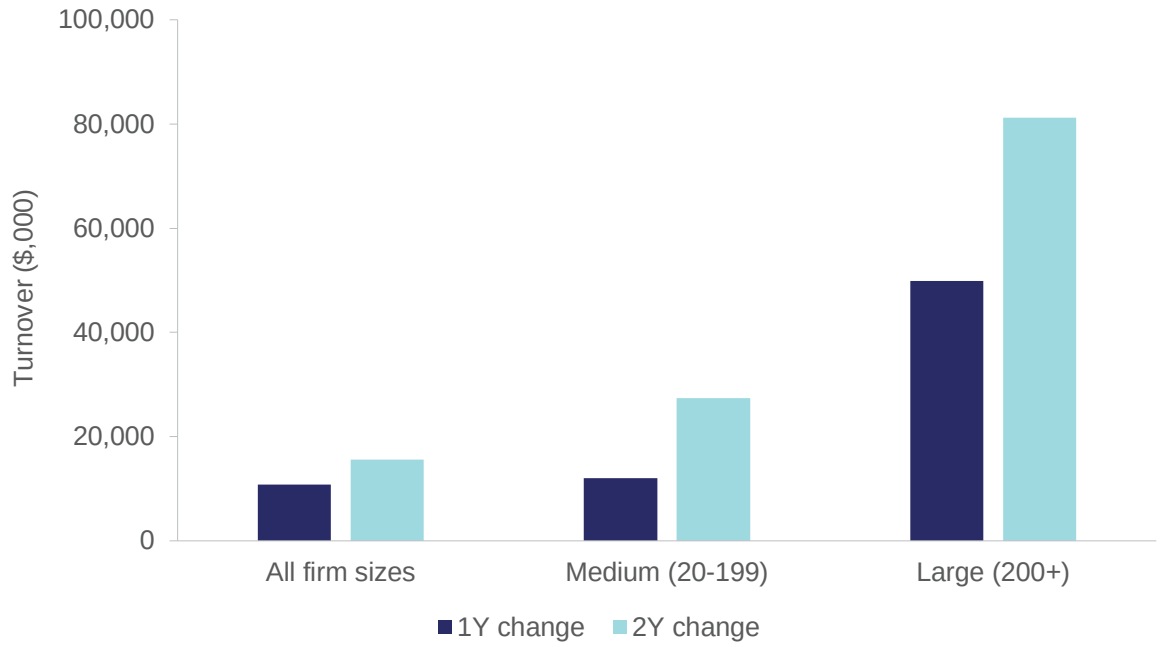
Source: BLADE (2001–02 to 2013–14*)* Author's calculations

Due to the complex firm issues identified earlier, the magnitudes of the ATE estimates are likely biased upwards. With that caveat, the one year forward ATE for all firm sizes suggests that on average the complex treated firms created 28.3 additional FTEs, with the two year forward ATE suggesting the creation of an additional 53.7 FTEs over the counter factual. For large firms the one year forward ATE suggests that on average the treated firms created an additional 111 FTEs relative to the counterfactual. With the two year forward ATE being even higher — 221.3 additional FTEs relative to the counterfactual.

Turnover

Figure 4.4 reports the ATEs for the one year forward and two year forward turnover. When not controlling for firm size, on average, for complex treated firms the one year forward turnover was $10.8 million higher than the counterfactual, and the two year forward turnover was $15.6 million higher. There are differences in terms of the additionality, for medium sized firms the one year forward ATE suggests that turnover was higher by $12 million relative to the counterfactual, and the two year forward ATE was $27.4 million.

Figure 4.4: Additionality in turnover ($, 000), average treatment effect – Complex South Australian IIF firms



Notes: Length of the bars depicts the premium in turnover change relative to the counterfactual. Firms size was controlled for by using initial employment size as a proxy for firm size.

Source: BLADE (2001–02 to 2013–14*)* Author's calculations

For large complex treated firms, the one year forward ATE indicates that on average turnover was $49.9 million higher than the counterfactual, with the two year forward ATE being even higher at $81.2 million.

Capital expenditure

Similar to the results for the simple firms, the results for the capital expenditure outcome variable are the weakest in terms of statistical significance. Treated medium sized complex firms were the only cohort of complex firms that returned statistically significant ATEs. For these firms, the one year forward ATE suggests that on average capital expenditure was $700,000 higher than the counter factual and the two year forward ATE was $1.8 million higher.

4.3 Limitations of the analysis

The average treatment effects presented in the previous two sections are useful as a metric of how aspects of firm performance were influenced due to participation in the South Australian IIFs. However, they should not be treated as definitive. This current research is exploratory and while BLADE enables analysis that was previously not possible — some hurdles and limitation still remain.

The current impact assessment pools observations on firms from the four South Australian IIF programmes. It is possible that the impact of each of the four programmes was disproportionate. Given the limited number of observations for each programme it was not feasible to assess the impact of

each South Australian IIF separately, even though ideally this should be the case.

This paper only considers the impact of the South Australian IIFs on the participant firms. It does not consider any secondary (spill over) effects on the wider regional economy. These secondary effects can be notable and ideally should be considered in future analysis. The current research does not consider these secondary effects due to time and data constraints — accurately quantifying these secondary effects would require an Input-Output model or a computable general equilibrium (CGE) model.

Care is taken to minimise selection biases via the use of an estimator that matches on firm characteristics such as size and industry, to establish a reliable counterfactual. However, there are other characteristics beyond the ones that are controlled for that might be responsible for differences in the performance between the treated firms and untreated firms. For example, it is possible that in addition to the impact of the IIFs on firm performance, differences in firm performance could be due to differences in managerial quality and motivation, human capital, or other sources of comparative advantage, such as a well-developed supply chain. Additionally the ability of a firm to secure IIF funding can be influenced by access to a consultant that assists with the application process, or in general the prior experience of the firm in applying for government assistance. Differences in aspects of firm performance can also be due to access to other forms of State or Australian Government funding in addition to IIF funding. Ideally, these additional influences need to be controlled for when assessing the impact of IIF participation on firms, although given current data limitations this is not possible. The richness and variety of data variables in BLADE and DIIS programme data would need to be expanded for these effects to be controlled for.

5. Potential benefits of the South Australian IIFs

The results presented in the previous section suggest that participation in the South Australian IIFs had a positive additional impact on aspects of firm performance. This summary of the findings is however presented with the caveat that the current pattern of results may be influenced by the limitations of the data outlined in the previous section.

In terms of the additional benefits the current statistical evidence is the strongest for employment (FTE), followed by turnover, and weak for capital expenditure. Since employment generation was a key consideration of the South Australian IIFs, the finding that participant firms created additional employment opportunities, is encouraging. Participant firms also generated additional turnover — since profit can be considered as a function of turnover, the implication is that participant firms were more economically vibrant relative to the counterfactual — although this statement is predicated on the assumption that the participant firms had similar cost structures to counterfactual firms.

The current research is exploratory and only considers one specific aspect, namely impacts from participation in the IIFs on firms. This is admittedly a narrow approach and ignores the potential broader impact of the IIFs on regional economies. Future modelling and assessment of these secondary spill-overs effects, and a consideration of the magnitude of type I and type II multiplier effects[24] is likely to supplement the current research findings and make any future inferences about the impacts of the South Australian IIFs more definitive. Improvements in programme data collection for any subsequent programmes, for example via the use of standardised smart-forms would also assist in making any future research on IIF impacts more definitive.

It should be recognised that beyond any tangible benefits arising from the IIFs, there are bound to be intangible benefits that are of economic and social value, but are difficult to recognise and quantify. Notably, government targeted interventions to rapid structural change in the form of the IIFs is likely to have demonstration effects.

The current research should be seen as a proof of concept in terms of what is currently possible with BLADE in terms of firm-level analysis. Rather than a definitive assessment, it should be seen as a stepping stone for further research. Intuitively, as the next stage, an analysis of the secondary impacts of the IIFs on regional economies should be considered.

6. Conclusion

This research set out to assess the impact of participation in the South Australian Innovation and Investment Funds (IIFs) on firm performance. This had previously not been possible given limitations in programme data. This limitation is overcome by linking DIIS programme data to BLADE, resulting in a longitudinal dataset that allowed researchers to establish a counterfactual. Via the use of a matching estimator this research determines that the South Australian IIFs had a positive additional impact on aspects of firm performance. In terms of the additional benefits the statistical evidence is the strongest for employment (FTE), followed by turnover, and weak for capital expenditure. Ultimately, this research should be treated as exploratory and a showcase of what is currently possible with BLADE.

[24] In input-output analysis, a type I multiplier measures the direct and indirect effects as a result of changes in final and intermediate demand. Type II multipliers also include the induced effect, resulting from a change in employee compensation and income.

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Appendix A – Background information on the South Australian IIFs

Structural Adjustment Fund for South Australian

The Structural Adjustment Fund for South Australia (SAFSA) was a $45 million competitive grants program announced in May 2004. The SAFSA formed part of a wider package of measures established in response to the decision of Mitsubishi Motors Corporation to close its plant in Lonsdale and reduce the workforce of its Tonsley Park facility which resulted in approximately 1,000 job losses.

The SAFSA was jointly funded with the Commonwealth contributing $40 million and the South Australian government contributing $5 million.

The purpose of the SAFSA was to support investment that would create sustainable new jobs in South Australia with a focus on the Adelaide area and particularly the southern districts of Adelaide. The package combined labour market program assistance tailored to meet the needs of displaced workers as well as support for new investment that would create sustainable job opportunities in South Australia.

Innovation and Investment Fund for South Australia

The Innovation and Investment Fund for South Australia (IIFSA), announced on 14 September 2006, was a $30 million competitive granting program established in response to the decision by Electrolux to scale back its Adelaide manufacturing facilities, affecting approximately 500 jobs.

IIFSA officially commenced on 15 November 2006 and closed to new applications on 30 June 2010. The fund was jointly funded by the Australian and South Australian governments. The Australian government contributed $25 million and the South Australian government contributed $5 million.

The purpose of the IIFSA was to support investment aimed at creating sustainable new jobs in South Australia, with a focus on the Adelaide region. The investment could be in new or additional capacity that would enhance employment, business and economic opportunities. Infrastructure investment was not funded unless it was incidental to the new or additional business capacity being created.

South Australian Innovation and Investment Fund

The South Australian Innovation and Investment Fund (SAIIF) was announced on 5 February 2008 as part of a package to support workers and the region affected by the closure of the Mitsubishi Motors Australia Limited's (MMAL) Tonsley Park vehicle assembly plant in March 2008. SAIIF funding totalled $30 million, comprising $27.5 million Commonwealth and $2.5 million South Australian State Government funds.

The purpose of the SAIIF was to support investment aimed at creating sustainable new jobs in South Australia, with a focus on the southern suburbs of Adelaide which was where MMAL was located. Eligible investment was expected to create new, or additional, business capacity designed to enhance

sustainable employment, business and economic opportunities with a focus on innovative manufacturing and/or technology projects.

South East South Australia Innovation and Investment Fund

A $17 million assistance package was announced on 25 January 2011 in response to Kimberly-Clark Australia's decision to restructure its operations and reduce its workforce at its Millicent site and the close the Tantanoola Pulp Mill, both in the Limestone Coast region of South Australia. Approximately 235 full time jobs were lost as a result of the restructure.

The package comprised the $12 million South East South Australian Innovation and Investment Fund (SESAIIF), and a $5 million Labour Adjustment Fund. The Commonwealth contributed $10 million towards the SESAIIF, while the South Australian Government provided $2 million in SESAIIF funding and the $5 million to cover the Labour Adjustment Fund which it administered.

SESAIIF's purpose was to support innovative job creation projects that would strengthen the South East South Australian regional economy and employment base. Manufacturing projects that generated high quality, skilled jobs were particularly encouraged.

Appendix B – International empirical research on structural adjustment funds

Ederveen, De Groot and Nahuis[25] assessed structural adjustment funds in the EU that assist lagging member countries. Using a neoclassical growth accounting framework that controlled for the endogeneity of assignment to the funds, Ederveen *et.al* concluded that, overall assistance offered by the EU via the structural funds did not improve member countries growth performance, however they did find evidence that such assistance can enhance growth in EU countries with better institutions.[26]

Fortuna, Silva and Medeiros developed a theoretical computable general equilibrium (CGE) model to assess the impact of various EU assistance funds on employment and the economy of lagging regions of Portugal (the Azores and Madeira).[27] They reported that in the absence of EU assistance to the lagging regions in Portugal there would be a decrease in public consumption and quality of life, a modest decline in employment, but an increase in investments. However as their analysis is purely theoretical, it should be treated in the right context.

Criscuolo et.al. considered the impact of government regional assistance on firms in the United Kingdom.[28] After controlling for various biases, notably, controlling for endogeneity via instrument variables, they concluded that assistance had a positive and statistically significant impact on employment and investment rates in recipient British firms. However these positive benefits were confined to smaller firms — those with less than 150 workers — furthermore in terms of productivity there was a detrimental effect as government assistance in the form of subsidies lowered aggregate productivity as it increased the employment share of low productivity firms.

The impact of government assistance on the productivity of Australian firms, is an important potential area for future research with the OCE. The brief overview of existing research provided in this section illustrates that the evidence on government regional assistance is mixed and contextual. The international research discussed above is more complex and empirical than what has been produced in Australia, primarily due to the availability of richer micro data in Europe.

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[25] Ederveen S, Groot HL and Nahuis R (2006) Fertile soil for structural funds? A panel data analysis of the conditional effectiveness of European cohesion policy, *Kyklos,* 59(1), pp. 17-42

[26] As proxied by degree of openness, absence of corruption and bureaucratic quality and capacity.

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Appendix C – Treatment effects and levels of statistical significance

Simple South Australian firms

Table A.1: Average treatment effects – Simple firms

Average Treatment Effects						
			FTE			
	1Y change		**n**	**2Y change**		**n**
All firm sizes	4	***	508,711	6.3	***	411,921
Micro (Less than 5)	5	***	374,201	8.3	*	298,080
Small (5-19)	2.9	**	100,954	4.6	***	82,252
Medium (20-199)	3.6	***	33,556	7.2	***	28,589
			Turnover			
All firm sizes	–			563	***	400,053
Micro (Less than 5)	–			698	***	288,370
Small (5-19)	457	**	100,066	890	***	84,492
Medium (20-199)	1554	***	32,017	2682	***	27,191
			Capex			
All firm sizes	–			77	**	400,579
Micro (Less than 5)	–			–		
Small (5-19)	–			–		
Medium (20-199)	–			–		

Notes: *** significant at 1 per cent, ** significant at 5 per cent, * significant at 10 per cent. n refers to the number of observations used in the matching exercise rather than the number of firms. Statistically insignificant ATEs are denoted by –.

Source: BLADE (2001–02 to 2013–14) Author's calculations

Complex South Australian firms

Table A.2: Average treatment effects – Complex firms

Average Treatment Effects						
	FTE					
	1Y growth		**n**	**2Y growth**		**n**
All firm sizes	28.3	***	71,527	53.7	***	61,386
Medium (20-199)	–			45.5	*	18,055
Large (200+)	111	***	19,842	221.3	***	17,470
	Turnover					
	1Y growth			**2Y growth**		
All firm sizes	10825	*	71,096	15627	*	60,964
Medium (20-199)	12070	*	20,893	27408	***	18,024
Large (200+)	49914	***	19,521	81224	**	17,160
	Capex					
	1Y growth			**2Y growth**		
All firm sizes	–			–		
Medium (20-199)	712	*	20,840	1847	***	17,978
Large (200+)	–			–		

Notes: *** significant at 1 per cent, ** significant at 5 per cent, * significant at 10 per cent. n refers to the number of observations used in the matching exercise rather than the number of firms. Statistically insignificant ATEs are denoted by –.

Source: BLADE (2001–02 to 2013–14) Author's calculations