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Evidence-Based Policy: Data Needed for Robust Evaluation of Industry Policies

A Report for the Australian Department of Industry, Innovation, Science, Research and Tertiary Education

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EXECUTIVE SUMMARY

- While capability has developed in the evaluation and empirical analysis in the areas of health, welfare, education and the labour market, this is largely absent from industry policy. This is due to our failure to date to find a workable compromise between the confidentiality requirements of the Australian Bureau of Statistics (ABS) and what researchers need.
- Access to business longitudinal data through a basic CURF CD ROM and through remote access 'Expanded on RADL' has been problematic as they do not facilitate granular data manipulation required to conduct rigorous policy research that can isolate program impacts or handle the logic of cause and effect.
- Detailed micro data are needed for sound robust evidence because:
  - aggregated data can conflate effects;
  - many questions, such as firm-level economic decisions, cannot be considered without micro data;
  - dynamics are difficult to model using aggregate data;
  - micro data can decompose effects into gross and net.
  - aggregate data is too blunt to capture the effects of specific small scale policies; and
  - longitudinal micro data can account for self-selection and unobserved characteristics.
- Examples of the use of micro data include:
  - In the US, researchers have found that most productivity growth occurs from the exit of less productive workplaces and entry and growth of high productivity workplaces – rather than the transformation of low productivity workplaces into high productivity workplaces.
  - The Productivity Commission analysed HILDA data to show that mothers who are not entitled to paid maternity leave, struggle financially. As a result, the Australian Government introduced a comprehensive Paid Parental Leave Scheme for new parents who are the primary carers of a child born or adopted on or after 1 January 2011.
  - The Department of Education, Employment and Workplace Relations used micro data to examine the characteristics of low-paid jobs. They found that low-paid jobs were not necessarily an end in themselves, but can provide a bridge to higher paid jobs. This information was included in a submission on minimum wages to the Australian Fair Pay Commission.
  - In the US, researchers examined the effects of newly ratified bilateral free trade agreements on firm performance.
- Most economic evaluations depend on observational data – either from national statistical offices or the program administering unit. If there are no factors that determine both selection into treatment and the outcome of that treatment (called a 'confounding' factor), and the number and spread of observations is large, then the analyst can simply compare the outcomes of two groups to get a measure of the treatment outcomes. However, it is rare that the analyst can be sure that there are no confounding factors. Therefore, it is considered prudent in most cases to employ one or more techniques to control for the presence of confounding factors. Five relevant econometric techniques comprise: *multivariate regression* analysis, which depends on confounding factors being measured and

included in the data set; *instrumental variable analysis* which tries to control for unmeasured confounding factors but relies on the presence of suitable 'instruments'*; panel data analysis* which controls for unmeasured confounding factors if they are time invariant; *matching analysis* involves constructing a synthetic control group but only eliminates the effect of measured confounding factors; and *difference-in-difference estimators* which can wash out both macroeconomic influences and time invariant firm-specific unmeasured confounding factors. Which technique is most suitable depends on the properties of the data set.

- While still comparatively rare in economic analysis, experimental data collected through a 'random assignment' program gives the strongest and most objective results if the number of observations (i.e. firms) is large. This program design rules out confounding factors (or selection into the treatment) but requires the program administrators to work closely with the analyst.
- Confidentiality restrictions and the associated concerns over disclosure are common to all statistical agencies. The US has been addressing these issues since the 1970s. Australia is in a position to learn from the US experience. The US experience has shown that in order to make micro data analysis possible, the concept of micro data for research use must be built into the national statistical office's operating system.
- The National Opinion Research Center (NORC), University of Chicago has data access methods that balance the often conflicting goals of data confidentiality, protecting privacy, maintaining data quality, and making data accessible.[1] The protocols and technological solutions being developed for both remote and physical (enclave) access could provide insights for strategic directions that could be taken by the ABS in handling the comparatively difficult area (than health data) of firm-level data access.
- Given the pressures on government to maximise efficiency and effectiveness of business assistance programs, it is desirable to revisit and adjust perceptions about how value from ABS collections of *firm-level micro data* can be maximised. The challenge in the present context is to develop data access methods that strike the best balance between data confidentiality, protecting privacy, maintaining data quality and making data accessible.
- The ideal data system must be capable of integrating data from an array of sources—private and public, business and household, cross-sectional and longitudinal, survey and administrative, national and sub-national. These data sources permit business dynamics to be measured in ways that are just now being conceptualised.
- Given the history of enterprise data collections in Australia, the most efficient options are to work with the ABS unit record data sets. Accordingly, the proposed future strategy would encourage the ABS to:
    - continue to produce and release Basic CURFs for use in the user's environment;
    - progressively replace RADL with a remote execution environment for micro data (REEM); and
    - to increase the use of the ABSDL for complex analysis of micro data, including providing access to longitudinal and linked datasets.
- An efficient data and research facility works most efficiently when the client (i.e. the departments of industry or productivity) controls the budget. The governance of the firm-level data access facility is critical to its success. Key stakeholders comprising data

[1] Mulcahy, T. M., Lyons, R, Harris, K, Stodden, V, Dwork, C. 2012. How to Share Research Data: Views from Practitioners. National Opinion Research Center, University of Chicago. USA.

custodians, program policy officers, program delivery officers and academic policy researchers should be part of the decision making body.

- Given the cost and burden on companies of collecting enterprise data, it is most efficient for one party to be responsible for collecting the main or master enterprise dataset. Currently, this is done by the ABS in collaboration with the ATO but other government agencies also collect intellectual property registrations and data on participation in grant, information, networking or training programs. Rather than requiring the government agencies to collect this basic information (on top of the ABS collections) it is more efficient for the agency to be able to link their data into the ABS micro data collection.
- Direct access to the micro datasets by the research community (from government and university sectors) should be done in a way that is legal, maintains the trust and confidence of the Australian reporting public and enables research to be conducted in a cost effective manner. At present, the few instances where researchers have been able to use the MURFs have proven to be slow, exceedingly expensive and difficult to negotiate. A streamlined way to access the data will deliver considerable benefits to governments needing to make policy decisions. Governments will be able to compare the impacts across different program types and be able to make an informed decision about which program to expand or contract.

I. INTRODUCTION

This paper is a review of how Australia can improve is evidence based policy making, in particular by using currently restricted micro datasets from the Australian Bureau of Statistics (ABS). In the first section we review the rationale for evidence-based policy, recent government attitudes towards evidence-based policy, and provide examples of polices that have changed as a result of robust, analytical evidence.

Over the last couple of decades, major advances in micro-econometrics has not only made economic research more precise and robust but also expanded the scope of questions that can be asked. These new analytic methods have necessitated access to micro datasets (also called unit record datasets). In section 2 of the paper we review why micro data analysis produces superior results over aggregate data analysis. While program evaluation is not the only form of research and analysis that can or should be used for policy making, they are a major source of immediately useful information. As such, we review some of the main program evaluation methods and then discuss some examples from various strands of research where micro data analysis has been used to change our understanding of the economy.

The final section of the report considers how confidential micro datasets are accessed by researchers around the world. While the US is arguably the best practice in this area, many of the Northern European countries are also well advanced in giving researchers the opportunity to contribute towards evidence-based policy. We consider some of the difficulties Australian researchers have had in accessing enterprise micro datasets at the ABS and suggest a way forward.

II. EVIDENCE-BASED POLICY

a. The value of evidence-based policy

Evidence-based policies is a decision making process which combines deductive logic with statistical analysis to inform policy decision making.[2] Its hallmark is rigour and objectivity. Since economic theory typically predicts that policy changes will produce tradeoffs and countervailing effects (that is, different groups react in different ways or are differentially affected; feedback or second-round effects occur), it is often not possible to know whether the final effect will be a rise or fall, or a net benefit or net cost to society. Moreover, theory in most cases does not indicate how large effects will be. Accordingly, logic alone cannot identify the optimal policy and empirical estimates are needed to adjudicate.

Good evidence-based policy not only allows the decision maker to select the program that suits his or her given ends but also arms them with the evidence to convince others. An evaluation makes transparent the lost benefits from pursuing one course of action over another. As Lindsay Tanner once observed: 'Every government dollar wasted on a poor program is a dollar that a working person doesn't have to spend on groceries, health care and education. It is ... a dollar that the Government does not have available to spend on its policy priorities' (quoted in Banks 2009, 20). The importance of informed decision making is not of course confined to public policy. According to the National Research Council of the National Academies (NRC 2005, 18), both George Washington and Thomas Jefferson believed that an uninformed public was incompatible with preserving democratic principles and practices.

[2] According to Heckman (2000, 3) 'Economic theory plays an integral role in the application of econometric methods because the data almost never speak for themselves, especially when there are missing data and missing counterfactual states'.

Evidence-based policy:

- estimates which parties are (notably) affected, the size of these effects and the net effect on societal well-being. Good economic policy should consider both pecuniary effects (e.g. productivity, income) and non-pecuniary effects (e.g. environmental and social impacts). Where possible these effects may be converted into monetary equivalents but where this is not possible, some qualitative mention should be made (such as years of life extended, air quality). An example is the R&D tax incentive scheme. There may be direct pecuniary effects on the scale of the firms R&D program but there may also be indirect effects on the environment which does not lend itself to monetisation;

- estimates the counterfactual of a given program or policy. This involves identifying 'silent' or uninformed third parties who will be affected by a change and evaluating the impact on their choices, incomes and behaviours;

- questions habits and existing ways of doing things. All productivity change involves changes in the way work is conducted and the first step in the process towards improving productivity is to question whether established ways of operating are efficient. Inevitably, evidence-based policy tools are valued by reforming governments;

- enables policy makers to learn and refine existing programs. Radically new programs typically start life as small pilot programs and then evolve by incremental improvements. Learning from both doing and evaluation is an essential part of good program design. For example, there were several pilot programs delivering business management advice to SMEs before the full roll out of Enterprise Connect. Lack of transparency hides failures and allows the status quo to continue. The lack of evaluation of the Automotive Competitiveness and Investment Scheme (ACIS) resulted in an expensive and poorly targeted program continuing for many years with little change ;

- allows the analyst to assess whether the impact of programs is weighted towards one sub group – be it demographic, economic, or spatial. Regular evaluations of the impact of tariffs made it quite clear which industries and regions – which seemingly had no connection to tariffs – were in actual fact negatively impacted by tariffs; and

- is useful in the public sector in the absence of relevant price signals. While the private sector can use stock prices and revenue data to indicate whether a project is meeting needs or producing the desired results, the public sector must often create its own measures of impact and value. This is because the public sector does not aim to maximise profits or sales, but rather aims to maximise societal well-being. Good analysis and evidence from reputable and independent parties can win the confidence of stakeholders and the public.

Evidence-based policy is best when:

- datasets are large, flexible and reliable. These data need to be of sufficient quality to meet the end user needs. This might be fit-for-purpose aggregate statistics or fit-for-purpose micro data. The larger, more reliable and more flexible the dataset, the more able analysts are to answer a range of questions;

- the work of the evaluating organisation is open to critical challenge. Data sharing fosters an open research community and reinforces transparent scientific inquiry. It also provides expansive views as opposed to siloed information; and

- the analysts are independent and reputable. While in-house analysis, appropriately done, has value, it should not be the sole source of evidence-based policy advice. All parties to a dispute can find or buy evidence to their liking, and policymakers and the community, can find it difficult to separate the reasoned from the self-serving. The standing and independence of voices in this space is critical to winning over the confidence of people who do not have the skills or the time to make their own assessment of a policy option.

By contrast:

- it is rare that a single study is robust enough to give people confidence that it has uncovered a 'stylised' fact.[3] Understanding causes and consequences typically emerges from systematic (meta) reviews of all available research;

- the absence of objective evidence can leave policy makers beholden to interest groups, which do not represent the range of affected parties, and to speculation and sensationalism; and

- when good datasets are not made available, or people skilled-in-the-art are not available, then evaluations can proceed with sub-standard data and inferior analysis.

According to Banks (2009), all good evaluations have a number of features in common in that they:

- test a theory or proposition as to why policy action will be effective in promoting community well-being;

- treat the counterfactual – what would be in the absence of the program - seriously. While the counterfactual is ideally derived from randomised trials, this is expensive and politically difficult to achieve in economic analysis. Alternatives, such as synthetic control groups, requires a large volume of micro data to create;

- quantify impacts where possible;

- include both direct and important indirect effects;

- set out the uncertainties and control for confounding influences;

- are designed to avoid error that might arise through self-selection or other sources of bias;

- include sensitivity tests; and

- can be tested and replicated by third parties. Wide access to research data helps prevent misrepresentations of the evidence.

According to Banks (2009), there are many Australian examples of good policy reform that have been guided and argued by evidence-based policy. This includes the reduction of tariffs on imports, the Higher Education Contribution Scheme (HECS), lifetime community rating on private health insurance and national competition policy.

[3] A 'stylised' fact is a simplification of regular and robust empirical findings. It is a broad generalization that which although essentially true may have inaccuracies in the detail.

b. Government attitudes to evidence-based policy

Globally, the appreciation of data analysis has grown over time with the explosion of digital data collections, acceleration of computing power and the expansion of analytic capacity in the research sectors, particularly with respect to the analysis of micro data. Heckman (2000, 3) reminds us that the major development in the last half of the twentieth century has been the growth of large databases that can describe the economy, test theories and evaluate public policy. Before these developments, economics was largely a deductive discipline that drew on anecdotal observations and introspection. National statistical agencies are key players in this changing landscape. However, the mission of these agencies is dependent on their credibility as objective and disinterested data collectors. Analysing their own data, and producing controversial finding from their own data, could undermine this reputation. As such, many national statistical agencies do not perform analytic functions.

In step with this changing data landscape, evidence-based policy decision making is now feasible, cost effective and has the potential to produce reliable findings. Many governments around the world now have explicit statements demanding evidence-based policy decision making as part of their policy processes (e.g. Office of Management and Budget (2012)). In the US, program appraisal has been mandated as a condition of program funding although the practical experiences of evaluation remain diverse and somewhat fragmented across agencies and levels of government (Boaz et al 2008). The change in attitude has been reflected in the establishment of dedicated centres and bureau whose mission is to conduct evidence-based evaluations for policy makers (for example, the Center for Economic Studies (CES) of the US Census Bureau established in 1982 and the Center for Evidence-based Policy at University of Oregon established in 2003). In the late 1990s, the UK adopted the evidence-based policy mantra to increase policy capability and drive the fresh thinking needed for reform and (UK Cabinet Office 1999).

In Australia, the concept of 'evidence-based policy' entered the public policy discourse in the late 1990s; an emphasis which has continued until today (Head 2010). Some progress has been made to develop evaluation and empirical analysis capability – both inside and outside of government – in the areas of health, welfare, education and the labour market. However, the experience in other areas is mixed. In particular, evidence in the area of industry policy has been largely absent, in part due to our failure to date to find a workable compromise between the confidentiality requirements of the ABS and what researchers need. Australian industry researchers have to resort, to a large extent, on foreign datasets.

While the importance of learning from overseas experiences is clear, the particular circumstances of the Australian economy – being geographically remote, having a small population and an industry structure skewed towards highly variable mining and agriculture – mean it can be misleading to rely exclusively on what works overseas.

c. Examples of evidence-based policy in practice

Establishing direct and certain links between a piece of empirical research and a policy change is difficult, not only because policy changes tend not to formally acknowledge their evidence base, but because many policy changes depend on a wave of evidence, debate and discussions, not just one piece. Typically, the larger the policy change, the deeper and more varied the evidence base it draws upon. Below we outline two areas of Australian reform where the changes can be traced most clearly back to analytic work involving state-of-the-art economic research: the reduction of trade barriers tariffs and more general social reforms. In addition, we give an example where firm-level analysis has raised the understanding of productivity and industry dynamics in the US.

From the 1970s to 2008, a succession of reports, papers and inquiries by academics (most particularly Max Corden, Richard Snape, Ross Garnaut and Peter Lloyd) and government bodies (Tariff Board, Industries Assistance Commission and Productivity Commission), first, documented the cost to the Australian economy of high tariffs; secondly, analysed the economic consequences of a reduction in tariffs and thirdly, injected objectivity into the debate and disseminated this information to the wider community. According to the Productivity Commission (2003), the average effective rate of assistance to manufacturing was 35 per cent in 1969-70. By 2012, this had been wound back to below 5 per cent.

The process of tariff reduction was long and complicated: there were many vested interests from the labour movement to industry. The first part of the process of policy change was to present objective evidence on the actual size of effective tariffs. However, these calculations, although revealing, were not enough. Subsequently, the (then) Industries Assistance Commission developed quantitative models to analyse the economy-wide consequences of policy and policy changes for economic activity and employment, as well as for regions, sectors and individual industries. These models were used to make estimates of the potential gains from implementing reduced tariffs. Work by academics and modelling by the Productivity Commission led to consultative processes and gave governments confidence to gradually dismantle trade barriers.

Successive governments have used the reports and research of the Productivity Commission to raise the level of community debate on this issue. All Productivity Commission publications are readily available and all academic publications are in the public domain and this accessibility has facilitated increased media coverage of the issue. Leigh (2002) gives an overview of the political economy of this reform process.

The second example we wish to provide is how one particular dataset, the Household Income and Labour Dynamics in Australia (HILDA) survey has been used to inform a wide range of social and economic policies. To date, HILDA has been used in the following ways to inform policy[4]:

- The Productivity Commission found, using HILDA data, that mothers who are not entitled to paid maternity leave, struggle financially. As a result, the Australian Government introduced a comprehensive Paid Parental Leave Scheme for new parents who are the primary carers of a child born or adopted on or after 1 January 2011.
- The Australian Social Inclusion Board used HILDA data to analyse trends in family joblessness in Australia and identify the main factors that have driven these trends. This research also discussed the relationship between family joblessness and income poverty and other forms of disadvantage.
- The Pension Review, as part of the broader Tax Review, used the data to develop a comprehensive understanding of what pensioners lives are like. This work was undertaken by the Department of Families, Housing, Community Services and Indigenous Affairs.
- The Department of Education, Employment and Workplace Relations used the data to examine the characteristics of low-paid jobs. They found that low-paid jobs were not necessarily an end in themselves, but can provide a bridge to higher paid jobs. This information was included in a submission on minimum wages to the Australian Fair Pay Commission.
- The Reserve Bank of Australia has looked at the level of debt that households have entered into and their ability to repay that debt.

[4] We thank Michelle Summerfield for providing these examples from the brochure ‘Living in Australia HILDA’.

- The Productivity Commission has investigated the role of casual employment in the workforce and found it is often a stepping stone into longer term employment.
- The Australian Institute of Family Studies has considered the financial consequences of divorce for older Australians and the subsequent implications for their retirement incomes.
- The Department of Families, Housing, Community Services and Indigenous Affairs has used the data to contribute to a report on child custody arrangements to the House of Representatives Standing Committee on Family and Community Affairs. They also used the data for policy development in the areas of workforce participation and retirement.

The third example of the use of micro firm-level data comes from the US. Researchers have found that most productivity growth occurs from the exit of less productive workplaces and entry and growth of high productivity workplaces – rather than the transformation of low productivity workplaces into high productivity workplaces. Furthermore, researchers have used firm-level data to examine the effects of newly ratified bilateral free trade agreements on firm performance.

III. MICRO DATASETS

a. Precision of micro data relative to aggregated data

In general, economic analysis relies on comparative static and dynamic analysis of the parameters resulting from solving economic agents' optimisation problem. Through this approach, analysts investigate how economic units (such as individuals, households, or businesses) react to changes in their social or economic environment. Often, to reduce the complexity of the optimisation problem, the heterogeneity of the agents is purged by assuming the existence of a representative agent. If, for example, we can assume that the economic behaviour of each individual business follows that of a representative firm, then behavioural models estimated with aggregate data may produce valid inferences. Or, at the very least, even if a representative agent model cannot be assumed, as long as we can instead assume that the extent of aggregation bias is small enough (that is, the degree of heterogeneity is not too high), aggregate data may still be enough.

However, since the early 1990s, there has been increasing evidence that the representative agent approach is not relevant to reality. For instance, McGuckin (1990) argued that the idea of a representative firm is not supported by detailed micro level data. Furthermore, citing Fisher (1993) and Solow (1957), he also argued that the conditions to ensure that the aggregation bias is negligible are difficult to meet (McGuckin, 1995). In fact there is an increasing amount of empirical evidence that the degree of heterogeneity among businesses, firms, or establishments is very high. This is shown by a large volume of empirical work based on US micro data conducted by researchers at the US Center for Economic Studies (CES). For example, studies by Baily, Hulten and Campbell (1992), Davis and Haltiwanger (1990, 1992), Doms and Dunne (1994), and Lichtenberg and Siegel (1987) cited in McGuckin (1995) showed that the degree of heterogeneity in terms of productivity, employment, output growth, investment, and ownership of businesses in the same markets or industries is very high. Similar evidence is also found by more recent studies using Australian micro data such as Palangkaraya and Yong (2007, 2011).

There are many areas where analysis based on aggregate data is simply inadequate when the objective of a policy evaluation is to know the differential policy effects on the very unit targeted by the policy. Burgess, Lane and Stevens (2000) is a study of worker movement between jobs within the same firms and its relationship with job creation that could not be undertaken with aggregated data.

Furthermore, even if we are only interested in estimating the aggregate effects of alternative policies such as how reduction in tariffs affects total employment in various industries, or how introduction of new pollution regulation affects economic growth, our estimates of the behavioural model using aggregate data may suffer from significant aggregation biases if there is significant heterogeneity in the responses of economic agents (McGuckin, 1995).

Heckman et al. (1999) argues that different data may yield different estimates of the same policy even under a social experiment setting, as clearly illustrated by the studies of Fraker and Maynard (1987) and LaLonde (1986) in the case of US labour market program. In both studies, the impacts of the National Supported Work Demonstration on the earnings of Aid for Families with Dependent Children (welfare) women in 1978 and 1979 were estimated using administrative data on annual earnings from the US Social Security Administration (Fraker and Maynard, 1987) and data from one baseline and up to four follow up surveys of the treatments and controls (LaLonde, 1986). The survey data yielded estimates of the program impacts of $1641 and $851 in 1978 and 1979 respectively. For comparison, the administrative data yielded estimates of the impacts of $505 and $351 in both years respectively. In the above case, the difference between the two estimates is actually significant enough to alter the conclusion of the cost-benefit analysis of the program.

These examples illustrate why the quality of the data is very important and, depending on the strengths and weaknesses of the data, different forms of analysis are needed. For non-experimental evaluations, existing survey-based datasets is a potential source for the researchers to construct the comparison groups to identify the impacts of a given policy. One key advantage of this data source is that the data are already collected. However, sample size limitations and, more importantly, limitations in terms of details at the unit of observations imposed by privacy concerns make it very difficult to construct the counterfactuals. In labour market program evaluation, for example, variation across local labour markets is an important determinant of variation in earnings and employment of unskilled workers targeted by labour market programs (Heckman, et al., 1998). If the researcher is unable to construct 'comparable' persons according to labour markets due to data confidentiality restrictions, then the resulting estimates would be biased.

Administrative data represent another important source of information for policy evaluation. While this type of data is also low cost to collect or extract, the information provided is usually very basic. For example, information on earnings, wages, hours worked, and employment spells, all common variables to indicate policy outcomes, are typically not available from administrative datasets (Heckman, et al. 1999). Additionally, administrative data usually provide little demographic information and lack basic information on conditioning factors. For example, person level administrative data often lack information on education, labour force history, family background or training history. Business level administrative data often lack accurate information on past revenues, exports, R&D, investment, managerial ability and staff training.

Finally, a third type of data for policy evaluation comes from new surveys designed for the purpose of evaluation. The key disadvantage of this data source is the cost involved, which becomes even more important if a long term impact estimate is required. However, new data collection has many benefits including the ability to collect information that is not available from existing survey or administrative data. Whether new data collections are justified depends on these relative costs and benefits.

Because of the advantages and disadvantages of different sources of data, combining and linking the different data can be an attractive solution. For example, by linking administrative data on outcomes and program participation to survey data on the characteristics of the participants, researchers are in a better position to construct the counterfactuals and estimated the policy impact of interest. In the US, many evaluation studies of the impacts of the Comprehensive Employment and Training Act

(CETA) were helped by the use of linked data on program trainees' records and comparison group data drawn from US Current Population Survey (CPS). Another example is the US National Job Training Partnership Act Study (NJS) which linked newly collected survey data with administrative earnings data from US states' Unemployment Insurance system, administrative income data from the US Internal Revenue Service and administrative social assistance data from US states' welfare agencies (Heckman, et al. 1999).

Furthermore, the combination of different data sources can provide the researcher with rich enough information required to identify the causal model that needs to be estimated in order to generate unbiased estimates of policy impacts. For example, Gerfin and Lechner (2002) combined different administrative data from Switzerland to obtain a rich dataset that allowed them to observe all important confounding factors that simultaneously determine labour market outcomes and program selection.[5] Because of their 'unusually informative data' they were able to obtain estimates of the positive effects of one particular ALMP program unique in the country. This result would not have been robust and as well cited and accepted if the data were not linked and accessible.

Broadly, the more detailed the data and the greater the number of observations, the more value it has for research. Micro data, especially if organised as a panel dataset and linked to other micro data, offer several advantages over aggregated data:

- Aggregated data can conflate effects. The analyst may want to know the influence of the size of the money supply on demand for products. This is very difficult to disentangle using aggregate data since there are sound theoretical reasons why the money supply might influence demand and vice versa. However, in a microeconomic setting, where we can deduce that the actions of one firm or household cannot affect macro factors, we are clearer about the direction of causation.
- Some questions cannot be considered without micro data. The extent of knowledge spillovers and the entry and exit of firms are some of the classic issues requiring micro data in the industrial economics area. One cannot estimate spillovers, or trace indirect effects of one activity on another entity using aggregated data since this data does not enable the analyst to tease out different tiers of effect. Unless spillover (i.e. third-party) effects are catered for, estimate of the value of R&D activities and its impact on growth will be severely underestimated.
- Detailed micro data are also needed for modelling firm-level economic decisions and other kinds of social behaviour that were not even analysed until recently. This might include the determinants of R&D by firms or the effect of patenting on company profits. Micro data are also needed if we want to simulate outcomes under different possible policies or programs and therefore estimate the costs and benefits associated with various policy options. They allow the marginal effects of key variables to be isolated, adjusting for other factors.
- Dynamics are difficult to model using aggregate data since the analyst cannot be sure what has changed in the 'unit' (be it an industry or, region) between time periods. For example, the analyst may be measuring productivity using industry aggregated data and may use last period's level of production in that industry as a measure of learning-by-doing. However, if

[5] The administrative data they combined were: the information system for placement and labour market statistics (AVAM) and the unemployment offices payment systems (ASAL). The merged data provide information on individual labour market histories, earnings, socio-demographics (age, gender, marital status, native language, nationality, type of work permit, language skills), location (town/village and labour office in charge), subjective valuations of placement officer (qualifications, chances to find job), sanctions
imposed by the placement office, and details on past and desired job (occupation, sector, position, earnings, full-/part-time).

there was a lot of gross entry into and exit out from that industry, then last period's production may be a poor proxy for learning in that industry.

- More generally, micro data usually allow the analyst to decompose effects into gross and net. An example is the entry and exit of firms into a market or industry in any given time period. Aggregated data can only reveal net entry. It cannot tell us whether this is associated with large or small gross flows either into or out of the market. Longitudinal micro data allow more accurate estimation than is possible with a single cross-sectional survey of transitions between states (for example, a firm's profits falling below the survival line), durations in a particular industry, and changes in other factors of interest.
- Micro evaluation methodology has also evolved to control for self-selection, into a program or given state of affairs, using either instrumental variable or matching techniques (alone or in combination with difference-in-differences). Not controlling for self-selection will overstate or understate the effect of treatments. Instrumental variable approaches have usually been estimated and while they have the advantage of being relatively easy to estimate, one faces the perennial question of instrument validity. By contrast, matching attempts to reduce heterogeneity between treatment and control groups using observable firm characteristics. It has the disadvantage of removing observations from the data set and requiring specific assumptions about non-observable factors such as managerial ability. Establishing causality is probably the most challenging issue facing researchers in this area. Our view is that matching offers the sounder foundation, but we leave arguments to which of these methodologies should be preferred to Blundell and Costa Dias (2000) and focus instead on results from each. The impact of applying these alternative techniques has been largely to confirm self-selection is more important than learning. On selection issues (Wedervang 1965), Olley and Pakes (1996) developed an innovative methodology to address both simultaneity (omitted variable bias) and selection problems, which is increasingly being applied in production function estimation.
- Aggregate data analysis may be too blunt to capture the effects of specific small scale policies – such as product market regulations and trade restrictions – on firm or industry performance. For example, aggregate data on a whole industry cannot reveal the effects of a small pilot program that may only involve 10 businesses. Likewise, differences in growth patterns at the industry level may also point to variations in the extent to which countries are benefiting from broader economic changes, or from the potential offered by new technologies. While technological change has promoted productivity growth, there are considerable variations in the degree to which different industries and types of firms have benefited from these opportunities. Macro level data does not give the analysis enough data points or spread in the data to detect these effects. If there is cross-sectional variation but not over time (that is from regulations and institutions), then it is impossible to pick up effects with aggregated data. According to Heckman, the econometric literature on the aggregation problem (Theil, 1954; See Green, 1964, Fisher, 1970, Hildenbrand, 1986 as cited in Heckman 2000 for surveys) demonstrated the fragility of aggregate data for inferring either the size or the sign of micro relationships. He believed that the macroeconomic literature produced negative results and demonstrated the importance of using micro data as the building block of an empirically based economic science.
- Longitudinal micro data allow a researcher to control for the role of unobserved characteristics in explaining variation in outcomes among individuals, so long as the unobserved characteristics are relatively stable for individuals over time.

b. Common evaluation and analysis methods

Generally speaking, there are two conceptually distinct policy evaluation questions (Heckman 2000, 6):

1. 'What is the effect of a program in place on participants and non-participants compared to no program at all?'; and

2. 'What is the likely effect of a new program or an old program applied to a new environment?'

These questions require different evaluation approaches. To address the first question, the common evaluation method is based on estimation of 'treatment effect'. The underlying idea of the treatment effect approach is to mimic the hard science approach such as when biostatisticians attempt to evaluate the effect of a drug (Heckman 2000). The average outcome of persons exposed to the policy (the treated group) is compared to the average outcome of persons who are not (control group). However, unlike in the case of the biostatisticians' study, policy analysts need to take into account potential influences coming from the persons' social interactions which result in the distinction between direct and indirect policy impact.

The second question is less focused and more ambitious than the first. It requires answers based on estimates that are of higher degree of interpretability, transportability and comparability than the ones produced by the treatment effect approach. In other words, to answer the second question requires estimation of tightly specified economic structural models (Heckman 2000).

The central problem in evaluating government policies is the construction of counterfactuals (Heckman et al., 1999). There are different counterfactuals to consider depending on the objectives of the policy. For example, one may want to compare what happens under the presence of a program to when the program is implemented differently, or to the absence of the program altogether. In order to have a full policy evaluation, outcomes (direct and indirect, participants and nonparticipants) in all alternative states of interest need to be compared.

Furthermore, it is not enough for a full evaluation of a program to focus only on outcomes. The valuation of the outcomes is also important. Different people may have different valuation to the same outcomes. Only if people's outcome valuations (i.e. preferences) are similar will there be a unique evaluation of the outcomes associated for each possible state from each possible program. This is why policy evaluation at the macro level such as the effect of a program on GDP is insufficient because it ignores people heterogeneity in the valuation of the outcomes. Where programs have more than one desired outcome – such as employment growth, export growth, productivity growth – the evaluation typically presents a cost per single outcome. Combining these separate outcomes into a single performance indicator is an extension that involves subjective weightings from the analyst.

The prime issue to account for when estimating structural econometric models is the problem of finding the sources of identification of the model while accounting for heterogeneity and self-selection. The sensitivity of estimates from these models to alternative identifying assumptions should be noted (Heckman 2000). The issue of identification largely depends on controlling for confounding factors in a treatment effect approach. As mentioned earlier, treatment effect approach of policy evaluation essentially compares the outcomes of 'treated' and 'untreated' persons.

Policy evaluation data can be collected through experiment (where the independent variables are controlled by the analyst) or observation (where they are not). While still comparatively rare in economic analysis, experimental data is usually collected through the implementation of 'random assignment' on program participants. This requires the program administrators to work closely with the analyst. Together they randomly assign subjects to different treatments (or no treatment). If subjects are randomly assigned, then any observed difference in the outcomes between treatment groups should be due to the treatment and is not due to differences in the characteristic of individuals in the group (i.e. due to selection factors). While random assignment helps ensure that pre-treatment differences between groups are not systematic it does not guarantee that the groups are matched or equivalent. It only ensures that any differences are due to chance. The US Government (Office of Management and Budget 2012) recommends evaluating randomly assigned variations of a given program as one way to collect systematic evidence.

Random assignment, in the experimental data setting, rules out confounding factors (or selection into the treatment). If there are enough observations, experimental data permits the most rigorous evaluation. Unlike experimental data, observational data may not directly identify causal relationships because even though two variables are related, both might be caused by a third, unseen, variable (the confounding factor). However, econometricians have devised various techniques to mitigate the complications caused by confounding influences including multivariate analysis; instrumental variable analysis; and panel data analysis.

Most economic evaluations depend on observational data – either from national statistical offices or the program administering unit. If there are no factors that determine both selection into treatment and the outcome of that treatment (the confounding factor), and the number and spread of observations is large, then the analyst can simply compare the outcomes of two groups to get a measure of the treatment outcomes. However, it is rare that the analyst can be sure that there are no confounding factors. Therefore, it is considered prudent in most cases to employ one or more techniques to be confident that these factors are controlled for.

There are five main econometric methods for eliminating confounding effects and therefore estimating the treatment or program effect:

Multivariate regression analysis assumes that if a third confounding factor is measured and included in the data set, then it can be statistically excluded, to give a true measure of the impact of the treatment.

Instrumental variable regression aims to overcome the problem when the third confounding factor is unmeasured and therefore not included in the data set. This method depends on the researcher's ability to identify some indicator (known as an instrument) of treatment participation that is entirely uncorrelated to other attributes which determine outcomes. Unfortunately such instruments can be hard to find.

Panel data analysis is a multivariate regression based on a time-series cross-sectional data set. It can control for unobserved confounding factors if they are time invariant.

Matching analysis involves constructing a synthetic control group; a sample of firms (from a larger population) that is observably similar to the treated sample. The estimate of the treatment effect utilises information about the magnitude of similarity between each treated firm and its 'pair' in the synthetic control group. It can only eliminate the effect of measured confounding factors.

Difference-in-difference estimators can be seen as comparing the firm against its former self, its behaviour in a period prior to receiving the treatment. Macroeconomic influences are washed out by comparing the change in the treated behaviour with change in a comparison group. This variation in panel data analysis relies on fewer data points than standard panel data analysis.

Further details of these methods is given in Appendix A.

Heckman et al. (1999) reviews thirty years of research on the evaluation of active labour market policies (ALMP) mainly in the US. They stress a number of important methodological lessons for future studies. First, the impacts of the programs are heterogeneous and, as a result, require different estimators in different settings. The heterogeneity comes from various sources including differences in the measured program treatments and how people respond to the same measured program treatment. More importantly, such heterogeneity may influence people's participation in different treatments. Second, there is no clearly preferable method of evaluation and that the choice should be guided by the underlying economics, data availability and the question that needs to be addressed. Third, the best solution to problems faced in policy evaluation is in the improvement of the quality of the data that can be used to conduct the evaluation. Fourth, because many programs are not designed with experimental evaluations in mind, it is very important to make sure that comparable people are being evaluated. With non-randomised program participation, it is possible that different non-experimental estimators produce different estimates of the same parameter of interest. In that case, the problem of selection bias still exists. When there is no selection bias different evaluation estimators yield identical estimates of the same parameter. Fifth, social experiments can provide a benchmark to evaluate different non-experimental estimators. Sixth, because the programs are usually implemented at the national or regional level, they could impact both participants and nonparticipants. It will be misleading to ignore the indirect impacts if they are substantial. In that case, a general equilibrium framework is required.

In the US, agencies are encouraged to routinely include measurement of costs and costs per outcome as part of program administration and funding agencies should demonstrate that they are increasing the use of evidence in the criteria to allocate funds (Office of Management and Budget 2012). These funding agencies should have senior analysts who are responsible for the agency's research agenda and program evaluation. Duties include conducting or overseeing rigorous and objective studies and providing independent input to agency policymakers.

c. How micro datasets have been used

Enterprise performance and macroeconomics

Research with longitudinal micro data has been at the centre of macroeconomics especially when it is realised that to understand aggregate fluctuations in economic performance one needs to understand the fluctuations in the cross-sectional distribution of activity across establishments over time. For example, McGuckin (1995) points out that the conventional view of recessions, that workers are temporarily laid off and then re-hired when the economy recovers, appears to be incorrect. Micro data show that job creation continues almost as fast during recessions, except that job destructions have increased. Micro data evidence also suggests that most created jobs are permanent and most lost jobs are lost permanently, at least for the manufacturing sector (Davis and Haltiwanger 1990, 1992; Davis et al. 1994). All of these suggest that the standard empirical approach to business-cycle analysis that is based on representative agent macroeconomic models and an assumption that firm behaviour is symmetrical over the cycle is incorrect.

The above studies and subsequent micro data based on macroeconomic research also find that the variations in new job creations and destructions, estimated from longitudinal micro data on establishment employment, are possibly caused by workers moving between plants in the same industry. In other words, both lost and new jobs are simultaneous phenomena in the same industry. This has an important policy implication because the effects of policy change may be felt through shifts of workers between plants or firms within the same industry. This process of change cannot be seen through aggregated data.

These findings also highlight some fundamental implications for statistical data programs (McGuckin 1995). First, it is clear that job creation and destruction statistics should be published regularly. Second, aggregate measures of the mean of the distribution of economic activity within sectors may be inadequate to understand what is going on in the macro-economy. This calls for new measures of economic activity at least based on higher level moments (e.g., variance, skewness, and kurtosis) of the distribution of economic performance of interest as suggested in work by Caballero (1992), Caballero and Engel (1992a, b), and Haltiwanger (1993) as cited in McGuckin (1995).[6]

Enterprise heterogeneity

Gollop and Monahan (1989) show how aggregated data inferences can be enlightened by micro data analysis. While aggregate data showed that firms had been becoming increasingly diversified in terms of the kinds of output they produced, Gollop and Monahan used new micro data to identify sources of this diversity. They found that plants were becoming homogeneous. Firm-level diversity was being driven by a trend towards firms operating multiple plants, not by increasing heterogeneity in the output of those plants.

Productivity growth

Schumpeter (1942) coined the term, 'creative destruction', to explain the process of restructuring and reallocation across producers in a market economy. This process ultimately results in aggregate productivity growth. However, it has only been since the late 1980s that empirical evidence supporting the Schumpeter's 'creative destruction' theory has become available. In fact, it is only when longitudinal plant, firm, and enterprise level data becoming more and more accessible to researchers that we can obtain better understanding on the micro foundations of aggregate economic growth.

In other words, the exit and entry of firms, which enables the analyst to study the process of creative destruction, are important phenomena that cannot be studied from aggregated data. In their 2004 study, Bertelsmann et al use a harmonised firm-level dataset to compare the factors that lead to

[6] Cardellichio (1990) highlights a fundamental problem in the use of aggregate data to study firm production behaviour in that it essentially assumes the existence of an aggregated production obtained by aggregating firm production functions. As shown by Houthakker (1955-1956), it is only if firm technologies were Leontief and their efficiencies followed a Pareto distribution that the aggregate production function could be assumed to be Cobb-Douglas. Instead of assuming an aggregated production function, Cardellichio used micro data to estimate a production model based on profit-maximization of producers in the softwood lumber industry in Washington. The micro data were used to avoid many traditional aggregation problems and to address directly the important role of capital utilization in lumber production. He found that in sharp contrast to the typically constant or increasing returns to scale production technology found by studies using aggregated data, the lumber industry actually exhibit inelastic upward sloping supply curves as predicted by industry market models.

firm start-ups and exit across countries. This enables international comparisons and the identification of country-specific factors as well as firm-level, sector and time effects. This process of creative destruction affects productivity directly, by reallocating resources towards more productive uses, but also indirectly through the effects of increased market contestability.

Another example that needs microeconomic data is the evolution of market structure. The study by Jovanovic and MacDonald (1994) considers the shakeout of firms as product markets mature. The transition to the new technologies involves a shakeout of first generation firms and the survival of a smaller number of firms which employ larger-scale technologies. Klepper (1996) also uses micro data to show how larger firms invest more in the fixed costs of product innovation and therefore tend to displace smaller firms generating the shakeout.

Haltiwanger (1997) find that establishment level heterogeneity in output, employment, capital equipment and structures, and productivity growth rates *within* a sector is massive compared to (sector-level) heterogeneity across the sectors. Furthermore, there are various intertwining factors which explain such heterogeneity that will need to be considered to understand micro sources of aggregate level productivity growth and how they interact with government policy programs to stimulate economic growth. These factors include uncertainty, managerial ability, capital vintage, location and disturbances and knowledge diffusion (Foster, et al. 1998). For example, variation in demand uncertainty for new product may lead firms to different approaches to product development and experimentation and technology adoption. Similarly, firms may differ in their managerial ability including the ability to innovate and organise production activity. All of these may result in differences in the performance of the firms.

Foster, et al. (1998) reviewed micro-econometric evidence on the patterns of output, input and productivity growth that studies the decomposition of aggregate level productivity into plant level productivity.[7] From the resulting evidence, they identified a few key patterns, particularly for the manufacturing sector. First, there is a large scale reallocation of outputs and inputs within sectors. While more than 1 in 10 jobs are either created or destroyed every year in the US, only 10 per cent of job reallocations in that country reflect employment movements across 4-digit industry. Second, firm entry and exit is an important source of within sector reallocation process. For example, there is evidence that around 40 per cent of job reallocation is due to firm entry and exit (Baldwin, Dunne, and Haltiwanger, 1995). Third, there is a high degree of heterogeneity in firm-level productivity and the productivity differentials are persistent (Bartelsman and Doms, 1997). High productivity firms tend to stay highly productive over time. Third, low productivity is a good predictor of exit.

Foster et al. (1998) also reviewed studies that attempted to understand the implications of firm-level reallocation and restructuring on aggregate level productivity dynamics. However, they argued that the existing studies used data from different countries and empirical methodologies that make it hard to assess how reallocations affect aggregate productivity growth. So they studied the issue themselves using plant-level data from the US Census of Manufactures. They found a positive aggregate productivity effect from more productive entering plants which replace less productive exiting plants. Also, the reallocation of both output and labour inputs are productivity enhancing at the aggregate level. Furthermore, they conducted similar analyses to plant level data from the service sector and found that, unlike in the manufacturing sector, all aggregate productivity growth in this sector is due to the net entry effect.

[7] The reviewed studies (such as Baily, Hulten and Campbell, 1992; Olley and Pakes (1996), Liu and Tybout (1996) basically consider different ways to decompose an index of aggregate (industry) level productivity given by $P_{it} = \sum_{e \in I} s_{et} p_{et}$ where P_{it} is the index of industry productivity, s_{et} is the share of plant *e* in industry *i* (e.g., output or employment share), and p_{et} is an index of plant-level productivity.

Based on their analysis and the review of other relevant studies, Foster, et al. (1998) concluded that it is essential to have high quality micro data on establishments with measures of output, input and productivity growth in order to understand the determinants of aggregate productivity growth. Because of the unintegrated practice[8] of statistical agencies' data collection at the establishment level for information on output and input measures and prices on outputs and inputs, to improve our understanding of the determinants of aggregate productivity growth requires that we make progress on the data collection and processing issues.

Theoretical models of firm dynamics supported by micro-econometric evidence have shown that, at least in developed countries, the process of outputs and inputs churning across firms is productivity enhancing because reallocation of business resources and activities from less productive to more productive firms. Bartlesman et al. (2009) asked how cross-country differences in the efficiency of their business churning explained their differences in economic performance and whether or not differences in regulations and institutions matter. They argued that the use of micro data to assess cross-country differences in economic performance is attractive because it avoids common problems affecting macro analyses. For example, it is difficult to understand why differences in income per capita across countries persist over time at the macro level because there are so many possible factors. With micro data analysis, a tighter theoretical link between specific institutional measures and relevant outcomes is possible. Using carefully harmonised indicators of firm dynamics based on firm-level data assembled from more than twenty countries[9], Bartlesman et al. (2009) found significant firm-level heterogeneity in each market and country in terms of size, growth, and productivity.

Another area of study identified by McGuckin (1995) in which establishment micro data are essential is in the evaluation of competitive policy on the performance of the economy. For example, to assess the effects of ownership change (mergers, divestitures, leveraged buyouts, etc.) on firm productivity require detailed micro data. Early studies that look at how ownership change in establishment affects productivity found significant impacts (Lichtenberg 1992; Lichtenberg and Siegal 1987; Long and Ravenscraft 1992, 1993; McGuckin and Nguyen 1993; McGuckin et al. 1991). From understanding the impacts of competition policy through how ownership change affects firm performance we have a better idea of the evolutionary process of firms and how they relate to aggregate economic measures. In this regard, McGuckin (1995) noted the importance of the ability to link micro data from more than one source because many economic problems require that data from different sources to be linked.

Exports

Arguably, micro data analyses of firms or establishments have appeared to provide the most effective way in the investigating microeconomic causality and understanding macroeconomic consequences. In particular, with longitudinal micro data in which individual establishments or firms can be traced over time, researchers can study firm heterogeneity better. In their extensive survey of the literature on the evaluation of impacts of globalization on corporate activities based on micro data, Hayakawa et al. (2010) argue that to empirically analyse the impacts of globalisation on business activities we clearly need to examine the viewpoint of individual firms. How firms adapt to the enhanced competitive pressures and new opportunities afforded by globalisation depends on

[8] For examples, components of the data are collected by different surveys with different units of observations (e.g., plant/establishment vs firm/enterprise).

[9] The countries in the study are those in the firm-level project organised by the World Bank (Estonia, Hungary, Latvia, Romania, Slovenia, Argentina, Brazil, Chile, Colombia, Mexico, Venezuela, Indonesia, South Korea, and Taiwan [China]) and those in the OECD study with the same firm-level data collection procedure (Canada, Denmark, Germany, Finland, France, Italy, the Netherlands, Portugal, United Kingdom, and the US). It is interesting to note that Australia is missing from the list.

their heterogeneous characteristics. For example, a newly ratified bilateral free trade agreement may affect firms differently and only with firm-level data we can examine measure the impacts of the agreement as well as understand why and how the impacts materialise.

In their extensive review, Hayakawa et al. (2010) classified the literature on the impacts of globalisation at the firm-level into eight groups depending on the research question: which firms enter the overseas market; where and how they enter (modes of entry); which firms survive in the foreign market; how they survive; how important is product variety; what are the impacts of foreign market activities on performance at home; how FDI inflows affect domestic firms performance, and what are the impacts at the macro level (GDP, employment, productivity).

For example, on the question of why firms export, in the recent decade efforts have been spent on understanding the relationship between firm performance and the decision to export. Firm heterogeneity is the main theme of this literature (Hayakawa et al. 2010). The main hypothesis proposed was that firms enter the foreign markets (through export or foreign direct investment) because they have relatively higher performance in the domestic market (Melitz, 2003; Helpman *et al.*, 2004). Whether or not this 'selection' hypothesis is supported empirically is important for guiding industrial policy that is intended to encourage exporting and investing abroad. The hypothesis has been tested by many studies using (longitudinal) micro data from many different countries using reduced form equation in the form of

$$\Pr\left[Export_{it} = 1\right] = \beta_0 + \beta_1 \text{Productivity}_{it-1} + \gamma X_{it-1} + \varepsilon_{it}$$

where the probability of firm *i* to export in *t* is linked to its previous period productivity and other exogenous variables that control for (observed) firm heterogeneity (Hayakawa et al. 2010).[10] Hence, it should be clear that in each of the eight groups of literature described above it is virtually impossible to conduct the analysis without micro data and, in many cases, the required micro data may need to be linked from different sources.

Energy prices and income distribution

How can we evaluate the effect of energy price shocks brought about by the introduction of economic or environmental policies such as an energy or carbon tax? McGuckin (1995) argues that to ascertain the impacts of the policy requires estimates of short-run and long-run substitution elasticities of consumers and producers. To obtain those estimates we need information on inputs and outputs structure of establishments and, for long-run analysis, how factors evolve over time. Consumers can be expected to substitute away from products which require more energy to produce and consume. Their options for substitution will be greater the longer the time horizon. On the other hand higher energy costs would lead establishments to economise on their use of energy.

Berry, Levinsohn and Pakes (1995) use longitudinal establishment micro data linked to data on product characteristics to evaluate how price shocks or government gasoline-mileage requirements affect the automobile market. The detailed data allow them to model both demand and supply. Without micro data, it is not possible to properly describe the effects of the policy change. For example, according to McGuckin 1995, there will be significant income effects and equity issues if the responses of the small, high-mileage car makers may differ from the response of low-mileage car makers and, more importantly, because poorer customers may not be able to afford the more expensive fuel efficient cars, they may need to continue their use of high-mileage cars longer than high-income drivers (income effect). Furthermore, the analysis for the case of Australia will be further complicated by the fact that Australia is a small, open economy.

[10] Alternatively, $Export_{it}$ can be replaced by FDI_{it} to examine the decision to invest abroad.

Education

Baptista et al. (2011) studies the impact of higher education on entrepreneurship by estimating the effects of the presence of a 'new university' on the level of firm creation in a region in Portugal. Using the propensity score matching approach, they compared the average firm entry rates in municipalities where new universities are observed to that of comparable regions where no new university was observed overtime. They find that the establishment of a new university has a positive and significant effect on subsequent levels of knowledge-based firm entry in various municipalities. Given the importance of identifying appropriate municipalities as the control group and since commonly published aggregate statistics at the municipality level may not provide what they need for the matching analysis, their ability to construct municipalities measures based on longitudinal, firm-level micro data is crucial. This study illustrates the importance of researchers' ability to access establishment level data, particularly their location, in order to link the data to location characteristics such as the presence of universities.

Health

A recent study illustrates why analysis of establishment data is also important for health policy evaluation. Dunne et al. (2011) studies the effect of a US government policy to offer subsidies to dentists and chiropractors who open businesses in markets designated as Health Professional Shortage Areas (HPSA) during the 1982-2002 period. In order to assess the cost and benefit of this policy and compare it to an alternative policy that subsidises the fixed cost of incumbent firms, the authors of the study need to take into account the relationship between market structure and the competitiveness of market outcomes. In particular, given the long period of study, to properly evaluate the impact of the two policies, market structure needs to be viewed as endogenous to the competitive process. This is because market structure is determined by the entry and exit decisions of individual producers that depend on profits expectation which, in turn, would be determined by the nature of competition within the market. Therefore, they estimate a dynamic structural model of firm entry and exit decisions using micro data collected as part of the US Census of Service Industries containing establishment level information for more than 400 small geographic markets in the US. They find that the mean entry cost is 22 per cent lower in the Health Professional Shortage Areas and these areas attract approximately 16 more firms per market, on average. In terms of cost and benefit, the subsidy cost amounts to approximately $73,000 per market on average. However, the long-run cost is almost $600,000 for each increase of one firm. In contrast, a subsidy that targets the fixed cost of incumbent firms has a slightly lower cost, $547,000 per firm but with the same effect on long-run market structure. One important lesson from the study is the difficulty in estimating policy impacts of supply stimulation through market entry when there is both endogenous exit and negative effects of entry on firm profits.

Labour market economics

From labour supply perspectives, one of important areas in policy evaluation is the effectiveness of active labour market policy. Martin (2000) reviews studies on the effectiveness of active labour market programs (ALMP)[11] in OECD countries to answer the questions of: *what works* and *in what circumstances*. He looks at macroeconomic evaluation studies that estimate the ultimate impacts of ALMP on overall unemployment and/or increased earnings such as Nickell (1997) and concludes that the evidence is mixed. More importantly, he stresses that the main problem faced by macroeconomic evaluation studies is that the amount of spending on ALMP is endogenous (i.e.

[11] These include the provisions of job training, wage subsidies and job search assistance through various government funded active labour market programs: public employment services and administration, labour market training, youth measures, subsidised employments, and measures for the disabled.

positively related) to the unemployment rate. Hence, he concludes that evidence, based on micro-econometric evaluations of individual programs, is preferable. Individual program evaluations based on micro data not only tells us what works and why, but also make it possible to assess the potential long run outcomes of the program including the social impacts of the programs such as improvement in health and reduction in crime and the impacts of combined programs from labour and other government policies. To do this, it is important that administrative data is linked with other survey based database such as household longitudinal database.

Bonnal et al. (1997) evaluates some of French ALMP targeted at the improvement of the labour market outcomes of unskilled young workers in the 1980s. Using a non-experimental longitudinal micro data recording the employment histories of individuals, they estimated the policy impacts on the durations and outcomes of subsequent spells of unemployment and employments. The use of micro data allows them to estimate a reduced form multi-state multi-spell transition model where participation in the ALMP program is included as one of the states while still allowing for unobserved heterogeneity in order to control for potential selection bias in program enrolment. The micro data they used are based on the administrative records collected by INSEE (Institut National de la Statistique et des Etudes Economiques, Paris) amended with interviews data conduced over one and half years. The individual labour market data makes it possible to identify unobserved heterogeneity and duration dependence (Elbers and Ridder 1982, Ridder 1990, Honore 1993). As a result, they were able to deal with the endogeneity of programme participation and to obtain reliable training effect evaluations. In addition, the micro data also allow them to separate the effects of programmes on subsequent durations of unemployment and employment. Making such distinction could be important because policy makers may prefer funding programs that extend the duration of employment to those that shorten the durations of unemployment (Ham and Lalonde, 1996, p. 176).

Establishment level micro data are also important for conducting labour market policy evaluations because they allow us to look at the demand side of the labour market (McGuckin 1995). For example, labour supply models estimated using worker or household data to explain individuals' earnings differences find that education, sex, race, age, family status, and occupation only explain 50 per cent of this variance. The other half may be explained by variation from the demand side, which has been assumed away by the use of representative firm model (Dunne and Roberts 1993; Dunne and Schmitz 1992). The Dunne and Roberts study finds significant aggregation errors in labour-demand functions when elasticity estimates from aggregate and micro data labour demand functions are compared. The Dunne and Schmitz study, on the other hand, shows that plants which use advanced technologies pay higher wages than those that do not. This implies that differences in the skills of workers may not be adequately controlled by demographic variables. Finally, linking workers' data to establishment data has delivered additional important insights for labour market policy evaluation (Troske 1993, 1994).

More recently, following the literature on enterprise dynamics using establishment level data, it has also become feasible to study employment dynamics using micro data. It is often not clear as to why and how official changes in total employment or unemployment come about. It is less commonly realised that underlying the increase of X number of jobs in the economy in a given month is substantial reallocation and restructuring of millions of businesses (some expanding, some contracting, some just opening up and some closing down). Studying employment dynamics at the business level is important to understand how what causes the net gain of X number of jobs may. Is it due to purely the entry of new businesses, the expansion of existing businesses, or a combination of both factors coupled with the exit of some businesses with relatively smaller employment size?

Boon et al. (2008) explains how the highly detailed micro data from the US Bureau of Labor Statistics (BLS) Business Employment Dynamics data allows researchers to study employment dynamics to further our understanding of producer dynamics and, eventually, the dynamics of aggregate productivity. Interestingly, the BLS was able to create the new data with virtually no new data collection efforts and no additional respondent burden because the micro data were constructed based on already existing data from the Quarterly Census of Employment and Wages (QCEW) merged with Unemployment Insurance (UI) database which contains monthly employment and quarterly wages data submitted by all US businesses to the State Employment Security Agencies[12] (Clayton and Spletzer, 2009). With the data, one can conduct a decomposition analysis of aggregate net employment growth using a similar approach to study the decomposition of aggregate economic growth. For example, Clayton and Spletzer (2009) find that the 2001 US recession was associated with large job losses of relatively few establishments.

In theory, there is no reason why mass layoffs should affect different occupations and workers in the same way. Itkin and Salmon (2011) use business establishment micro data they constructed by linking micro data from the US Occupational Employment Statistics program and the Mass Layoff Statistics program to study who were affected more by mass layoffs in the US between 2000 and 2007. Their micro data allow them to set up the appropriate counterfactuals based on the propensity of establishments to experience extended mass layoffs or not. They find that in the period of study American workers who worked in establishments experiencing extended mass layoffs and lost their employment tended to be those whose jobs required less training and fewer analytical skills. In contrast, those workers whose jobs are in occupations that were core to their industry were more likely to keep their jobs. The findings confirm the intuition that establishments are more likely generally let go of workers who were easier to train such as those in the clerical and personal care occupations or occupations that require less analytical skills.

VI. ACCESSING THE MICRO DATA

a. Accessing national statistical office business micro data

In the US, it has long been realised that the extensive amount of micro data collected by the Census Bureau and other agencies can provide extremely useful information for policy analysis. Shirley Kallek (1975, 257), who was the Associate Director for Economic fields of the US Bureau of the Census at the time, points out that essentially the same questions – “Will analysis of micro data sets prove more useful in explaining economic phenomena than aggregated series? Will the integration of micro data sets with macro series enhance economic research and shed more light on existing economic theory?” – are what people are asking now in Australia. She further explains that confidentiality restrictions and the associated concerns on disclosure were major reasons why the use of micro data at the Census Bureau to facilitate research about enterprises was lagging behind the use of micro data in the demographic area. These constraints are common to all leading statistical agencies. Furthermore, significants costs and data processing problems were also notable given that the entire system design, review and processing phases of data collection in the Census Bureau were generally not compatible with enterprise micro data analytical needs. Australia is in a position to learn from the US Census Bureau experience. This experience has shown that in order to make micro data analysis possible, the concept of micro data for research use must be built into the national statistical office’s operating system and that in-house research utilising the data must be undertaken, to complement external users. An in-house research facility works most efficiently when the client organisation – in the Australian case this would be the departments of industry or productivity – control the budget.

According to Haltiwanger et al (2007, 3) ‘...The “ideal” data system must be capable of integrating data from an array of sources—private and public, business- and household- based, cross-sectional

[12] All employers subject to state Unemployment Insurance laws are required to file the information.

and longitudinal, survey and administrative, national and sub-national—that permit business dynamics to be measured in ways that are just now being conceptualised.' The US National Academies Panel on Measuring Business Formation, Dynamics, and Performance identified four principles to guide the collection and use of business micro data (Haltiwanger et al, 2007, 3-4):

Principles

1. **Confidentiality:** Agencies should protect the confidentiality of information and maintain the data so identification is not disclosed for administrative, regulatory, or enforcement purposes.
2. **Public Purpose**: Data sharing should be facilitated when it serves a substantial public purpose such as improve the quality and usefulness of government statistics; provide evidence to inform government policies; and advance scientific knowledge.
3. **Targeting Deficiencies**: Improvements to data collection should focus first on areas in which policy and research relevance is high but in which statistics needed to inform those policies and research are weakest i.e. infrastructure for measuring business dynamics.
4. **Cost Efficiency**: High priority should be given to actions that can be done expeditiously and at low cost.

Modes of access

In the US, the current imperatives are to improve business data through linking existing information sources and to change the legal and organizational environment so enable more data sharing and confidentiality protections. These imply overcoming technical and legal hurdles so that administrative data from businesses, such as the use of tax return data on self-employed individuals, can be better exploited. In 2002, the US established new minimum standards for protection of information gathered by a federal agency for a statistical research purpose under a promise of confidentiality.[13] Information may not be disclosed in identifiable form for non-research purposes without the consent of the respondent. Non-research purposes include administrative determinations, law enforcement investigations, and adjudicatory proceedings. Identifiable business records can, however, be shared for 'statistical' purposes if such data sharing, which fully maintains confidentiality protection, can support significant improvements in the nation's ability to obtain high-quality data on business formation, policy evaluation, internationalization of employment, and other critically important issues for economic policy.[14]

The US has led the field in developing ways to provide access for researchers needing micro business data. Since the 1970s, the main government statistical agencies have been, first, linking datasets together and, second, making the full data file available to appropriate external researchers (Atrostic 2009). Chief among the modes of access for external researchers are the creation of 'Special Sworn Status employees'[15], fellowships and off-site research data centres. The US statistical agencies have offered fellowships for researchers to work with confidential data at the agency's site since the 1980s. However, these fellowships, while invaluable, were always limited in number and off-site research data centres were established in 1994 to meet growing demand. While the early centres were located in regional statistical agency offices, by the late 1990s they were being opened in universities and the offices of the central bank (Atrostic 2009). As of 2012, the US census bureau has 15 off-site research data centres. Researchers submit proposals that are reviewed for feasibility,

[13] Subpart A of the Confidential Information Protection and Statistical Efficiency Act (CIPSEA) as cited in NRC (2005).
[14] Australia has a different 'social reporting contract' between data providers and government in general.
[15] Violation of the terms of that status subjects the researcher to the same legal penalties as Census Bureau employees: for disclosure of confidential data, a fine up to $250,000, imprisonment for up to 5 years, or both.

scientific merit, alignment with the agency's mission, and conformity with confidentiality protection protocols. Work is done on a secure site, with secured computers. In addition, researchers sign a confidentiality protocol or are subject to a special sworn status as a Census Bureau employee. The rules governing use of the research data centers are more constraining than those encountered in most research settings. These centres allow researchers to analyse the type of detailed business data that is not possible to de-identify and distribute on a CD. These centres increase the utility of data by providing confidential micro data to qualified researchers under conditions that do not pose unacceptable disclosure risks. At some sites, researchers can merge their own enterprise or industry data files with the statistical agency's data. This practice is however carefully monitored. The research centre concept has been widely acclaimed and Hildreth (2003), for example, has said that it has led to some of the most innovative research in the US.

While, the US research data centres represent an important step toward facilitating research access to confidential data, several reviews have noted that they are less well used than they should be. Two of the three reasons for this trend are the length of the review process and the costs involved in doing research away from one's home institution. The third reason is a very stringent interpretation of the five criteria for approving research projects.

There are currently moves to use data enclaves instead of brick and mortar research centres (see NORC at the University of Chicago). Enclaves use secure terminal access to allow researchers to analyse sensitive data in a convenient and cost-effective manner. Data does not leave the secure data centre. The cost of providing access is greatly reduced. Data linking occurs through enclave access by providing secure access to identifiers. However, only approved data users can independently link datasets. Approved data users upload their own data and restrictions can be put in place to prevent inappropriate file sharing. Data Enclave staff not only assist approved data users in data linking but also assist with more complex linking algorithms.

Feedback effect on data quality

In the US, researchers' access to and use of the complex data has also been used to maintain and improve data quality (Abowd and Lane, 2004, McGuckin, 1992). Researchers' use of data creates an effective feedback loop by revealing data quality and processing problems, as well as new data needs. The use of data by outside researchers can also verify or improve sampling frames for surveys and censuses and produce ideas for the generation of new data products. There is no substitute for actual research use of micro data to identify data anomalies. The NRC (2005) argues that there is general recognition that the quality of a statistical agency's data and its openness to external research are positively correlated.

Confidentiality breaches

Confidentiality pledges, and other procedures to prevent disclosure by researchers, improves the quality and detail in the data that can be made available for research. It is essential that survey respondents believe they can provide accurate, complete information without any fear that the information will be disclosed inappropriately. The ABS undertakes post-enumeration surveys in business collections for the purpose of assessing a range of potential reporting errors. The ABS also recognises that an important dimension to data quality is the trust of providers. This is the reason ABS and other leading statistical agencies establish firm protocols around data access. However, most studies which have tried to quantify the size of this disclosure fear have looked only at the provision of personal or household information such as health records and social security data. The NRC (2005), for example, cities studies which found that people who held these fears saw the census as an invasion of privacy. These people were significantly less likely to return their census form by mail than those who had fewer privacy and confidentiality concerns. The NRC (2005) believes that this fear of disclosure is less for enterprise information since much of the information is in the public record and commercial information is rarely asked (or given).

There are two types of confidentiality breach:

1. simple carelessness—not removing identifiers from questionnaires or electronic data files, leaving cabinets unlocked, not encrypting files containing identifiers, talking about specific respondents with others not authorised to have this information. The NRC (2005) believes there is no evidence of respondents having been harmed as a result of such negligence. However, they note that it is important for data collection agencies to be alert to these issues, provide employee guidelines for appropriate data management, and ensure that the guidelines are observed.
2. illegal theft. While there are media stories of identity theft from such sources as credit card and banking data, according to the NRC (2005) there is no documented evidence of misuse of research data in the US. Nonetheless, this does not mean that this does not occur. Overall, little is known about how many breaches of confidentiality may actually occur in such settings or how many people are harmed as a result.

Below we outline an approach used overseas that would enable researchers to access the micro data and preserve the high confidentiality standards that the ABS currently maintains. This is as current as we can be from OECD reports and on-line information. We have not made site visits to these offices to verify the information.

Existing business micro data availability in other countries

Most European countries, the US and New Zealand have processes for giving external researcher access to business micro data. Table 1 shows these holdings in selected countries and indicates whether access to the full unit record is available to researchers or not. Typically, use is either confined to a data lab and users have to be an experienced researcher; are from a 'certified' research institution; and/or have to have projects approved.

The table shows that almost all countries make their micro data available to appropriately qualified researchers where the data is available. The exceptions are the Swiss and US R&D data, which are collected but not available on a disaggregated basis. This is odd given that many countries GAAP – Generally Agreed Accounting Principles - mandate disclosure of information about R&D expenditure and activities in the annual report and in the US micro R&D data is available from COMPUSTAT Active and Research files.

Table 2 presents more information on the data access policies at selected counties, albeit these include access to individual and household level data as well as business data. It reveals that non-anonymised data is available via remote data centres (as opposed to CDs or email/webportal access) with the exception of Germany, which allows both data centre and remote execution. More details can be found in Appendix B.

Below we present a few experiences of external researchers using micro business data sets at the ABS.

Table 1: Micro data holdings and whether agency data can be matched at unit level to other information, selected countries (Note: This is based on an OECD 2009 report and on-line information. We have not made site visits to these offices to verify the information or corroborate details)

	Australia		Germany		New Zealand		Norway		Sweden		Switzerland		US	
	Data Exist?	Access	Data Exist?	Access	Data Exist?	Access	Data Exist?	Access	Data Exist?	Access	Data Exist?	Access	Data Exist?	Access
Patents by patent holder (person and/or institution)	Y	N	N		Y	A	Y	A	Y		Y	A	Y	A
Business register	Y	R	Y	A	Y	A	Y	A	Y	A	Y	A	Y	A
Entry-exit of business units	Y	N	N		Y	A	Y	A	Y	A	N		Y	A
Accounting data (business units)	Y	N	N		Y	A	Y	A	Y	A	N		Y	A
ICT use, business units	Y	N	N		Y	A	Y	A	Y	A	Y	A	N	
Innovation survey (CIS), business units	Y	R	Y	A	Y	A	Y	A	Y	A	Y	A	N	
R&D survey business units	Y	R	Y	A	Y	A	Y	A	Y	A	Y	N	Y	R

Legend:
Y=yes, data exists
N=no, data does not exist – or not available to researchers
A =available to researchers with no restricted access
R=available to researchers with restriction
Missing indicates information not available

Note: 'Restriction' implies – limited data fields or only part of the data is available. Typically, use may be confined to a data lab and users may have to be an experienced researcher, from a 'certified' research institution, and/or have projects approved.

Source: OECD (2009) and online sites. Supporting information is in Appendix B.

Table 2: Data access policies for researchers (Note: This is based on an OECD 2009 report and on-line information. We have not made site visits to these offices to verify the information or corroborate details)

NSO	Access Options for Anonymised Data			Access options for Non-anonymised data				Location of Data Centers
	Off Site (CD-Rom/Mass Storage)	Electronically (email/webportal)	Data Center	Off Site (CD-Rom/Mass Storage)	Electronically (email/web portal)	Data Center	Remote Execution	
Statistics New Zealand	Yes	No	NA	No	No	Yes	No	Wellington, Auckland, Christchurch
Germany	Yes	No	Yes	No	No	Yes	Yes	Berlin, Bonn, Wiesbaden and 14 regional offices
Statistics Norway	Yes	Yes	No	No	No	No	No	NA
US Census Bureau	No	Yes	NA	No	No	Yes	No	Atlanta, Cambridge, Berkley and 12 others
FRANCE INSEE	No	Yes	NA	No	No	Yes	No	
Spain INDE	No	Yes	NA	No	No	Yes	No	
Eurostat/CIS	Yes	No	NA	No	No	Yes	No	Luxembourg

NA - for countries who do operate data centres, it is unclear whether non-anonymised data which is available through other means can also be accessed in the data centers.

This table has been constructed using national statistical agencies general access policies and individual data sets may have additional restrictions.

Source: OECD (2009) and online sites. Supporting information is in Appendix B.

b. A way forward

The mission of the ABS is to '...assist and encourage informed decision making, research and discussion within governments and the community, by leading a high quality, objective and responsive national statistical service' (ABS mission statement). The ABS has some of the best enterprise data collections in the world. By reputation, the ABS employs highly skilled staff with significant competences in the design, testing and validation of the data collections. Moreover, high response rates are achieved, in part, due to strong provisions for safeguarding privacy and confidentiality embedded in legislation including the *Census and Statistics Act* (1905).

The ABS has made micro data available for statistical purposes in the form of Confidentialised Unit Record Files (CURFs) since 1985. The ABS has a well-established program for producing and providing access to CURFs and continues to develop strategies to improve researcher access to, and use of, unit record data for such purposes. The ABS currently releases three types of micro data: Basic CURFs, Expanded CURFs and Specialist CURFs via three modes of access: CD-ROMs, the Remote Access Data Laboratory (RADL) and the on-site ABS Data Laboratory (ABSDL).[16]

However, given the pressures on government to maximise efficiency and effectiveness of business assistance programs, it is desirable to revisit and adjust perceptions about how value from ABS collections of *firm-level micro data* can be maximised. The challenge in the present context is to develop data access methods that strike the best balance between, data confidentiality, protecting privacy, maintaining data quality and making data accessible.

The ABS, in its November 2009 issue of *CURF Microdata News*, stated:

> 'Today there exists high user demand for the ABS to provide access to more detailed unit record data in a more flexible way, across a wider array of datasets (such as business data and longitudinal linked datasets). An inability to meet these demands will increasingly become a disadvantage to ABS core business, the relevance of the ABS and ultimately to the coherence of the NSS. This, along with a number of other drivers for change including the growing risk of identification, has led the ABS to propose a new strategy for accessing ABS microdata into the future.'

The proposed future strategy is to:

- continue to produce and release Basic CURFs for use in the user's environment;
- progressively replace RADL with a remote execution environment for micro data (REEM); and
- to increase the use of the ABSDL for complex analysis of micro data, including providing access to longitudinal and linked datasets.[17]

Clearly, the ABS is aware of the pressing need for enhancing data access, but currently, access improvements appear to be focussed more on social rather than economic data. Moreover, the

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[16] ABS. 1104.0 - CURF Microdata News, Nov 2009
http://www.abs.gov.au/AUSSTATS/abs@.nsf/allprimarymainfeatures/EE2DF58E7FCE7C4DCA2576D50016B1D5?opendocument#future.

[17] ABS. 1104.0 - CURF Microdata News, Nov 2009
http://www.abs.gov.au/AUSSTATS/abs@.nsf/allprimarymainfeatures/EE2DF58E7FCE7C4DCA2576D50016B1D5?opendocument#future.

ABS's ability to undertake these improvements is severely constrained by funding. Access to business longitudinal data has been mainly through a basic CURF CD ROM and through remote access 'Expanded on RADL.' However, these access methods have been problematic from the researchers' point of view in that they do not facilitate granular data manipulation required by econometric software. Without this ability, it is not feasible to conduct rigorous policy research that can isolate program impacts or handle the logic of cause and effect. As a consequence, Australian researchers, in their quest for publication in top-level policy research journals, rely heavily on firm-level data from other countries including the USA, UK and Canada. Enhancing ways to access the high-quality Australian firm-level data collected by the ABS could turn this situation around, creating a virtuous circle of more rigorous policy research effort directed towards assessing Australian industry and innovation policy and programs and gaining more world-wide recognition of Australian-specific research. We propose a way forward to build on access methods developed on the social statistics/data side of the ABS.

Best practice firm-level micro data provision

Given the importance of institutional arrangements, unique to each country, it is difficult to aspire to universal best practice for firm-level data access. Both the *Census and Statistics Act* (1905) and the *Australian Bureau of Statistics Act* (1975) impact on practices contemplated for adoption in Australia. Moreover, the ABS is involved in the development of data access methodologies and is active in international fora including a number of OECD committees and working parties (e.g. the OECD Committee of Statistics Experts Group).

However, lessons, appropriately adapted, can be gleaned from other countries' experiences as noted earlier. For example, The National Opinion Research Center (NORC), University of Chicago has developing a robust framework for develop data access methods that balance the often conflicting goals of data confidentiality, protecting privacy, maintaining data quality, and making data accessible.[18] The protocols and technological solutions being developed for both remote and physical (enclave) access could provide insights for strategic directions that could be taken by the ABS in handling the comparatively difficult area (than health data) of firm-level data access. Similarly, The US Census Bureau, with experience since 1975 of facilitating firm-level data access, should be tapped for insights.

Lessons about data access from the social statistics side of the ABS could also be tapped. REEM, which is now used for social data access, appropriately adapted, could be a useful avenue to explore for overcoming present firm-level data access issues. REEM facilitates better econometric software interrogation of the data before confidentiality is applied to analytical outputs. Moreover, ABSDL provides a further avenue for optimising access enhancement including, under strict conditions, secondment, given it provides physical access through ABS state office locations. Again, it would be a matter of funding as well as working carefully through access arrangement (tempered by confidentiality constraints) that could enable meaningful progress on this channel.

Governance considerations

Meaningful progression of improvements to firm-level data access and analysis for policy research requires careful consideration of how to bring together disparate stakeholders, ranging from data custodians, program policy officers, program delivery officers and academic policy researchers. Purposeful and focussed action, combined with ample opportunity for two-way communication between stakeholders would provide the highest likelihood of success. Moreover, appropriate

[18] Mulcahy, T. M., Lyons, R, Harris, K, Stodden, V, Dwork, C. 2012. How to Share Research Data: Views from Practitioners. National Opinion Research Center, University of Chicago. USA.

structures could provide a better means for the ABS to gain a deeper understanding of the policy research areas that cut across its vast array of relevant operational areas that produce firm-level statistics. Such structures could also facilitate an alternative means for government agencies to discuss with the ABS on data collection needs for policy research. Overall, the result would be better targetting of data collection across the government, resulting in better evidence-based policies.

c. Designing policy for evaluation

The history of the public sector is littered with examples of inefficient and inappropriate program evaluations. Most evaluations are conducted as *ex post* add-ons to programs that are largely completed. This typically means that data are not collected in a way that is accurate or will permit a rigorous estimation of the program effects. In extreme cases, only case studies are undertaken. While case studies may be useful in enabling program administrators to improve the design of a program, they do not give credible evidence on the impact of the program. Sadly, this situation has shown little sign of improvement over the past three decades.

In this section, we outline a possible time-line for identifying actions that should be taken for future evaluations. It is critical that the evaluation method and data collection framework is established at the same time the program is designed. The short tenure in many public service jobs can mean that the person who established the evaluation method is not available to complete the evaluation several years later. Consideration needs to be given to establishing a professional evaluation unit, with econometric skills, to build and sustain corporate memory in the field of program evaluation.

Below we outline a decision point flow chart for including critical policy evaluation data sets at the policy design stage that is consistent with current ANAO and DIISRTE industry policy frameworks and program development guidelines.

Establish long-term evaluation infrastructure in DIISRTE

Currently, DIISRTE, is a major player in policy development, design, delivery and evaluation of business-assistance programs. DIISRTE would be the logical point of contact for the strategic data and evaluation team – however the area responsible should be organisationally and geographically separate from the program areas in order to maintain independence. Three steps should be undertaken.

1. Establish a team of highly skilled industry evaluators. These people will have formal education in economics/econometrics and be seconded to the ABS to analyse the enterprise micro dataset.

2. Set up an evaluation infrastructure – cleaned large panel dataset based on an ABS micro dataset that can be used as a generic tool for evaluating different programs

3. Design a core set of questions for program participants. Must include ABN, ASX (if relevant), family structure, and basic economic data such as industry, employment, revenue, turnover, interest payments, expenditures on R&D, plant and equipment, training, advertising, exports etc. Depending on the objective of the program may also collect soft information on managerial methods, innovation activity, HRM, etc. Where possible use standard question wording from the ABS surveys.

Conduct specific evaluation

4. Design specific program and concurrently decide evaluation method for this program. The most desirable data collection method will depend on the program design and objectives.

5. Explore options for experimental implementation of pilot program (randomised trail; some locations only);

6. Collect baseline data on firms in treatment group and control (if an experimental control is possible) at time of application. If the program is competitive, collect this data for all applicants, whether successful or not. A condition of the application is the requirement to supply this data.

7. Collect this data yearly for same group of firms. Trace firms that move, deregister, close. If possible continue to collect data for unsuccessful applicants.

8. At the x year mark: (x= when the impact of the program should be felt) Create a synthetic control group from the ABS micro datasets (matching on size, location, industry).

9. Merge in data collected at 7 and 8.

10. Conduct the statistical evaluation using one of the methods specified above

V. CONCLUSIONS

Australian governments spend many hundreds of millions of dollars a year on industry programs, and make off-budget decisions that impact on Australia's production and general well-being. However, very few of these policies are based on objective evidence-based policy or are subject to rigorous evaluation. This situation should not continue given that ABS supports access to micro data subject to confidentiality constraints. Given the immense cost of collecting enterprise data, and the need to minimise the number of independent parties approaching businesses for data, it is most efficient for one party to be responsible for collecting the main or master dataset. Currently, this is done by the ABS in collaboration with the ATO. However, other government agencies also collect supplementary data in the course of their program administration. These data include intellectual property registrations or participation in grant, information, networking or training programs. To obtain full analytic value from this supplementary data, basic information on employment, sales, investment *inter alia* is also required. Rather than requiring the government agencies to collect this basic information (on top of the ABS collections) it is more efficient for the agency to be able to link their data into the ABS micro data collection. While this practice has and does occur, the ABS recognises these arrangements can and should be improved.

Linking the datasets will not deliver value to the Australian people per se. Direct access to the micro datasets by the not-for-profit research community (from government and university sectors) is also necessary. This must be done in a way that is legal, maintains the trust and confidence of the Australian reporting public and enables research to be conducted in a cost effective manner. At present, the few instances where researchers have been able to use the MURFs have proven to be slow, exceedingly expensive and difficult to negotiate. A streamlined way to access the data will deliver considerable benefits to governments needing to make policy decisions. Governments will be able to compare the impacts across different program types and be able to make an informed decision about which program to expand or contract.

Compared with alternatives methods for making decisions in the public interest, evidence-based policy is not perfect but is the best we have. Evidence cannot help solve every problem or fix every program, but it can illuminate the path to more effective public policy.

Appendix A: Estimating the counterfactual

Heckman et al. (1999) summarises three widely-used estimators of the impact of treatment on the treated. Let Y_0 and Y_1 denote the potential outcomes under the untreated and treated states respectively for each person regardless of program participation status. Let X denote the conditioning factors that need to be controlled for to ensure that we are evaluating comparable people and D denote the actual program participation status with a value of one to indicate program participant and zero otherwise. Then the impact of treatment on the treated can be expressed as $E(Y_1 - Y_0 \mid X, D = 1)$. In other words, we compare the impact of the program on a person who participated in the program ($E(Y_1 \mid X, D = 1)$) to comparable person(s) or the counterfactuals ($E(Y_0 \mid X, D = 1)$).

So it is clear that to find the appropriate comparison groups or the counterfactuals is crucial. Three widely used approaches have been proposed as a solution: before-and-after estimator, difference-in-differences estimator, and cross-section estimator. The first estimator requires longitudinal data and exploits the idea that the same persons can be in both 'treated' and 'untreated' states at different time and thus provide their own comparison group.[19] The second estimator requires either longitudinal data or, at least, repeated cross-section data on non-participants in two different periods before and after. Finally, the cross-section estimator compares the outcomes of participants and non-participants at a single period. Because a person cannot be in both states at the same time, this estimator assumes non-participants have the same non-treatment outcomes as participants do, on average (that is, $E(Y_0 \mid X, D = 1) = E(Y_0 \mid D = 0)$). To summarise, all of the three estimators described above exploit different principles to represent the proper counterfactuals in order to adjust the simple mean differences.

Another solution to policy evaluation problem is randomisation (Heckman, et al., 1999). This experimental design approach has been increasingly utilised to evaluate government programs in North American, Europe and developing countries. The attractiveness of this approach lies on its simplicity to estimate policy impacts and to understand the estimates (see, e.g., Burtless, 1995 as cited in Heckman, et al., 1999). Because of this, evidence from social experiments has influenced the design of, for example, many US welfare and training programs. In this case, the essential assumption required to identify the mean effect of treatment on the treated is that $E(Y_1^* - Y_0^* \mid X, D^* = 1) = E(Y_1 - Y_0 \mid X, D = 1)$ where $(Y_1^*, Y_0^* D^*)$ denotes outcomes and program participation status under the random assignment and $(Y_1, Y_0 D)$ when the program operates normally without randomization. It should be noted that this assumption may be violated if program participation probabilities are affected by the interaction between the randomization and the conditioning factors (X). Another important limitation of social experiments is that due to the self-selected nature of the samples they produced, their data are not ideal to estimate structural parameters of behavioural models. In other words, their findings are more difficult to generalise and less useful for identifying the policy-invariant structural parameters required for econometric policy evaluation.

Appendix B: Data access policies for researchers (as at July 2012)

New Zealand

Statistics New Zealand

[19] Literally speaking, longitudinal data are not required to identify the means effect (Heckman and Robb, 1985).

How do researchers access unit record data? There are two access points; CD-Rom and in person at Statistics New Zealand's Data Lab.

CD-Rom: Researchers can access Confidentialised unit record files (CURF's – these protect the identity of respondents) via CD-Rom. Researchers must apply to receive a CURF and must keep the data secure throughout its use, once the researcher is finished with the data the CD-Rom must be destroyed.

Access to SURF's is by application and applicants must have a history of research and have the support of an organisation that employees them (university, government department, private research organisation). The criteria and application process is published here.

All CURF's cost $495 + GST.

Data Lab: Statistics New Zealand maintains a Data Lab where researchers can access unit record data that has not been anonymised. The Data Lab operates on a cost recovery basis and a typical project will cost between $5000 and $15000. Researchers are provided with a terminal and must be experienced in analytical tools and statistical software.

The application process is different for government departments and all other applications. Non-government departments must be conducting research which is of significant public interest and must fit with the purpose of Statistics New Zealand.

Full details of the application process are available here. At the top of this page is the Data Lab application form and the Microdata Laboratory Output Guide.

Germany
Statistisches Bundesamt

How do researchers access unit record data? The German NSO has four ways of accessing the data.

Public Use files (PUFs): Anonymised microdata which are available to everyone, either locally or abroad. PUF's must be ordered and are free for teaching purposes at universities. They can be used offsite.

Scientific Use Files (SIFs): SUF's are defacto anonymised microdata. They have more detailed information than the PUF's. They can be used off-site by research institutions governed by German Law, whereas institutions not governed by German Law can only access them via remote execution or in SAFE Centers in the statistical offices.

SAFE Centers (SCs): Data accessed in the SCs are still anonymised and access to data is controlled. Data access in the SCs can contain much more detailed information than the SUFs.

Remote Execution (RE): This is the only form of access which permits the analysis of formally anonymised original data; however, users do not have access to the data. Users receive dummy files and can then prepare syntax scripts using SPSS, SAS or STATA which are used by the statistical office to analyse the original data. After a confidentiality check, users will receive the results of that analysis.

Norway
Statistics Norway

How do researchers access unit record data? Statistics Norway only supplies anonymous or de-identified data. De-identified individual data is normally only available to researchers in Norway. However other NSO's can apply to access this data where their confidentiality regulations correspond to those in Norway.

Data can be accessed over the internet or on disk/CD-rom depending on what type of data needs to be accessed. There are no further details provided.

USA
USA Census Bureau

How do researchers access unit record data? Public use data is available online through the bureau's website, however all micro data must be accessed in person.

Researchers can access micro data at Secure RDC Research Environments (data labs). Access is by application and researchers must swear to protect the privacy of the information for life.

The USCB publish the restricted-use micro data which is available and the in depth list of Economic Data includes Enterprise data sets.

France
National Institute of Statistics and Economic Studies (NISEE)

How do researchers access unit record data? NISEE publish anonymised micro data files on their website in French. They are free to access and can be used for commercial purposes without royalty or licence fees.

See CIS for non-anonymised data.

Spain
Instituto National de Estadistica (INDE)

How do researchers access unit record data? INDE publish anonymised micro data files on their website in English. They are free to access but there is little enterprise data.

See CIS for non-anonymised data.

Eurostat EU Community Innovation Surveys (CISs)
Eurostat

How do researchers access unit record data? Anonymised data is available by CD-Rom for researchers (universities, governments, research institutes, central banks) by application. To access these CD-Roms, a research contract must be granted and numerous privacy conditions must be met, details can be found here.

Research can access Non-anonymised data in the Eurostat SAFE centre in Luxembourg and follows the same application process as the CD-Roms. CIS includes lots of enterprise data.

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