Australian Bureau of Statistics

METHODOLOGICAL NEWS

A QUARTERLY INFORMATION BULLETIN FROM THE METHODOLOGY AND DATA MANAGEMENT DIVISION
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Modelling the Relationships between Government Assistance, Innovation, R&D and Business Performance

The Analytical Services Unit (ASU) is currently involved in a collaborative work between ABS and the Department of Innovation, Industry, Science and Research (DIISR), on modelling the relationships between government assistance, innovation, R&D and business performance.

The study utilises four years of data from the ABS Business Longitudinal Database (BLD), which has detailed information on government assistance, business demographics, innovation activity, ICT usage, financial information, and many other variables relevant to the analysis.

The investigation aims to provide information on the modelled relationships between government assistance (in the form of grants, funding, subsidies, tax concessions or rebates) and innovation; the relationship between innovation and business performance (e.g. turnover, value added); the likelihood of innovation in the absence of government assistance; the changes in the relationship between government assistance and innovation over time; and the different factors that may be associated with the probability of a firm innovating, after receiving government support. Some of these factors include R&D, age of the firm, the industry where it operates, location, business size and ICT intensity.

ASU's approach to the analysis involves the testing of the usefulness of Propensity Score Matching (PSM), which is an applied technique used in policy evaluation settings. PSM matches participating firms, such as the firms that received government assistance, to firms which did not, but which have similar characteristics. It uses conditional probabilities to compute a score for each of the participating and non-participating firms, usually by using logistic or probit modelling. Once the scores are computed, a matching algorithm is used --such as nearest neighbour, radius/caliper, kernel or local linear-- to match the participating firms with the non-participants. The matched firms are then used in the analysis of the impact of a treatment (i.e. government assistance) on the outcome (e.g. innovation). The PSM is attractive in that it addresses the selection bias which is often a problem in non-experimental settings. Selection bias in this study refers to the difference between the counterfactual for participating firms and the observed outcome for non-participating firms. By implementing a PSM, ASU expects to get more statistically robust and accurate results.

For further information, please contact Franklin Soriano on (02) 6252 5933 or franklin.soriano@abs.gov.au

Major Review of TRYM

The TRYM model is a small macroeconomic model of the Australian economy developed by the Australian Treasury for policy and sensitivity analyses and forecasting at the macroeconomic level. While the model itself is maintained by the Treasury, the data used in the model is prepared by the Analytical Services Branch and published by ABS as a part of the Modellers' Database (cat.

no. 1364.0.14.003). The ABS also maintains subscriptions to TRYM by academic and industry users (cat. no. 1364.0.15.001).

The Treasury and ABS are currently collaborating in a major review and redevelopment of TRYM. An important aspect of the redevelopment is the updating of the operating environment of TRYM from TSP to the more popular EViews. Other changes include updating TRYM's equations (by Treasury), and reviewing its data inputs (jointly by the ABS and Treasury). A key goal of the review is to improve the transparency of series in the Modellers' Database.

For further details please contact Valentin Valdez at valentin.valdez@abs.gov.au, or James Savage at james.savage@treasury.gov.au.

Computer Audio Recorded Interviewing (CARI) Being Trialled as a Questionnaire Development Tool

The ABS widely uses Computer Assisted Personal Interviewing (CAPI) in the field to collect household survey data effectively and securely. Recent Blaise software developments now allow predetermined questions of the interview to be audio recorded on to the interviewer's laptop, without disturbing the interview process. This new feature is referred to as Computer Audio Recorded Interviewing (CARI) and gives methodologists and survey developers new evidence about how the questionnaire performs in the field.

Recordings of the verbal interactions between the interviewer and respondent are highly valuable, providing researchers with proof of pauses, interruptions, requests for clarification etc from respondents in the context of a real interview. Such naturalistic evidence complements the information gathered during Cognitive Interviewing, where questions are typically evaluated using a more artificial "laboratory" environment.

During analysis of CARI recordings, the research team uses behaviour coding to check off the number and type of deviations from the ideal question and answer format which may indicate problems with questions, across a sample of questions for each interview conducted. For example, it may become apparent that respondents are having difficulty comprehending questions, by asking the interviewer for clarification or providing irrelevant or incorrect responses. Survey developers can then make changes to the instrument based on this information to improve the accuracy and validity of the data being collected. Furthermore, evidence from CARI can be used to hone methodologists' understanding of sources of measurement errors and biases, reducing development time and increasing the quality of future questionnaires.

The ABS is currently trialling CARI, and recently used it in a dress rehearsal. With the respondents' consent, parts of the interview were recorded and stored confidentially. Ten predetermined questions were carefully decided upon to be recorded. Included were both new questions, and older questions that had a problematic history, in order to gain further evidence on their performance. Analysis of these recordings provided highly useful information, which assisted in the development and revision of these questions.

For more information about CARI as a questionnaire development tool, please contact Kate Wittman on (02) 6252 7649 or kate.wittman@abs.gov.au.

Use of Power Transformations in Seasonal Adjustment

In the ABS, seasonal adjustment of a time series is performed by first specifying an appropriate decomposition model. It is desirable to choose a decomposition model such that stable seasonal factors can be obtained. Common candidates for decomposition in the ABS include the multiplicative and additive models, where the

seasonal factors are constrained to average out to unity and zero respectively. Currently, the ABS is considering the use of Box-Cox models, which are a family of power transformations encompassing both the multiplicative and additive options. It is well established in literature that appropriate Box-Cox transformation of data can correct for heteroscedastic and non-normal residuals, and in the setting of seasonal adjustment of time series, this can potentially lead to more stable seasonal factor estimates.

The ABS has hence conducted preliminary studies on some volatile overseas arrivals and departures series which suggest the use of Box-Cox transformation as being advantageous over the multiplicative adjustment. This was based on a revisions analysis, in that the application of a power transformation resulted in reduced current end revisions to the concurrent seasonally adjusted series. Such results have motivated further studies, in that the ABS is now investigating when power transformations should be used, how they should be used, and of course, their performance against the original adjustment. This performance will be assessed using quality measures such as significance tests for residual seasonality, summary statistics for the stability of seasonal factors and revisions to concurrent seasonally adjusted estimates. Some existing methods in regards to selecting the power transform parameter are being examined, including that of maximum likelihood estimation and a time series variance stabilisation method. Results from these approaches will then be compared to those of when a simple grid search of the transform parameter is performed. The ABS is working towards presenting the findings in the Methodology Advisory Committee paper to be submitted and reviewed in June this year.

For more information on this project, please contact Leanne Chhay on (02) 9268 4720 or Leanne.chhay@abs.gov.au or Alex Stuckey on (08) 9360 5378 or alex.stuckey@abs.gov.au.

Automatic Allocation of Interviewer Work using Operations Research Approach

Population Survey Operations maintain a workforce of field interviewers to approach Australian householders to conduct surveys. Each month, PSO allocate each interviewer a "workload" of household locations for personal and/or telephone interviews. Household surveys can either be regular (Monthly Population Survey MPS) or irregular one-off and lasting for one or several months (Special Social Surveys SSS).

Interviewer workload allocation is subject to hard restrictions such as number of available interviewers, dates when interviewers are available for duty, geographical location of interviewers and workloads, training for particular surveys, and the horizon period within which a survey collection must occur, and soft restrictions such as giving an interviewer a sufficiently large workload to make it worth their while. Currently, a laborious and manual one-by-one allocation process is employed by well-practiced PSO staff. After the *first cut* allocation is set, there is also a *reallocation* task to be performed regularly when a condition changes (eg an interviewer drops out), as well as to allocate follow-up visits for non-respondents, until the collection period is finished. Some agencies such as Statistics Netherlands employ computer tools to aid officers doing manual allocation (e.g. the Address X Interviewer System - AXIS).

Operations Research and Process Improvement (ORPI), in partnership with Population Survey Operations, have developed a prototype Automatic Workload Allocation Tool (AWAT). Olena Gavriliouk (CSIRO) took an integer programming approach to minimise cost (distance travelled). Olena modelled the workload allocation procedure as a generalised assignment problem (GAP) with capacity constraints. AWAT currently contains three modules ("First Cut" FCWAP, "Reallocation" WRAP, and "Combined" WAM) which can be used for different types of workload allocation performed by PSO. Olena implemented AWAT in C++ and employs a commercial

optimizer Gurobi to find (near)-optimal workload allocations.

The AWAT has been tested on selected SSSs, with the resulting allocations being at least as cost-effective as manual allocations. The AWAT runs in seconds, or up to minutes for the highest-dimension cases involving the most interviewers and household locations. Manual allocations for surveys with smaller samples are already near-optimal, and so the major advantage of using AWAT is for speed. However, for larger surveys which are more complex to allocate efficiently, AWAT saves on the order of several thousand kilometres in aggregate distance travelled for "First Cut" allocations.

AWAT field trials will continue to test out additional features, such as indicating which interviewers to train for which survey, and test out complex situations where multiple different surveys are running concurrently. The field trials will establish impacts on business processes and uncover hidden benefits or costs, with a view to an automated workload allocation future.

If you would like more information about the AWAT and its modules, Gurobi, or field testing, please contact olena.gavriliouk@abs.gov.au or benedict.cusack@abs.gov.au

Time Series Analysis Section's Flood Response

The January floods in Queensland, NSW and Victoria created havoc and hardship for hundreds of thousands of local residents and flagged the beginning of a long clean-up process for people, governments and businesses alike. The floods have also caused difficulties for statisticians. The temporary suspension of collection activities at the peak of the inundation occurred along with a deferment of local government and commercial businesses activity.

The Time Series Analysis team (TSA) responded quickly in the hope of helping Subject Matter Areas of the ABS to maintain consistent and high quality time series over the period affected by the floods. Specifically, TSA wanted to ensure that time series collection areas undertook a consistent approach to analysis, treatment and description of the real impact of the flood, while minimising the impact of artifacts introduced by compromised statistical processes.

TSA established early contact with collection areas to gauge the likely impact of the floods on data. This focussed subject matter area attention on the quality of time series and helped TSA to anticipate the kinds of action required to stabilise seasonal factors and ensure the trend estimate behaved within expectations. As part of the process, TSA maintained centralised documentation about the floods and related statistical activities, including a flood events timeline, content of press releases, publication commentary and action taken for time series collections.

In order to encourage communication between collection areas (as well as communication between them, TSA and the Statistical Services Branch) TSA organised a half day workshop. The workshop, held March 15th and sponsored by Peter Harper and Ian Ewing, was designed to inform on issues perceived by TSA and encourage collaboration, rather than to problem solve. It was attended by representatives of most collection areas that publish time series. At the workshop is was agreed that the attendees would continue to constitute a semi-regular forum to discuss issues that have arisen and to further communication activities. Importantly for the ABS, the forum continues to grow in numbers.

For more information on TSA activity in this area, please contact Evrim Aydin Saher on (02) 6252 5659, Alex Stuckey on (08) 9360 5378 or Philip Carruthers on (02) 6252 5307. Email: evrim.aydin.saher@abs.gov.au, alex.stuckey@abs.gov.au, philip.carruthers@abs.gov.au.

How to Contact Us and Subscriber Emailing List

The Methodological Newsletter features articles and developments in relation to methodology work done within the ABS Methodology and Data Management Division. By its nature, the work of the Division brings it into contact with virtually every other area of the ABS. Because of this, the newsletter is a way of letting all areas of the ABS know of some of the issues we are working on and help information flow. We hope the Methodological Newsletter is useful and we welcome comments.

If you would like to be placed on our electronic mailing list, please contact:

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