Managing the Impact of Floods in Eastern Australia on Australian Official Statistics

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Abstract

The 2010-2011 floods and following cyclone in eastern Australia caused extensive damage and devastation across a large area of the country, leading to significant disruption to both data collection and operational activities of the Australian Bureau of Statistics (ABS). Suspension of data collection activities affected non-response rates to varying degrees in many surveys. Moreover, impacts of the natural disasters on reported data had the potential to affect the trend and seasonally adjusted estimates across many ABS collections. This paper describes the response taken by the Methodology Division of the ABS. A Methodology task force was set up to evaluate potential impact to ABS statistics, monitor impacts across survey cycles and to ensure a consistent and coordinated response to flood impacts in ABS surveys. An ABS-wide forum was established to facilitate communication between Methodology and ABS collection areas. The extent of possible non-response bias and the appropriateness of current imputation techniques were investigated across key business and household collections. Imputation and estimation processes were examined closely to identify potential issues due to the increased amounts of imputation required and, where possible, impact assessments were carried out. Potential impacts on time series and possible solutions were explored to stabilise seasonal factors and prevent biased trend estimates. Quality assurance tools were developed to manage the high volume of monthly and quarterly time series requiring flood impact assessment. Decisions to intervene in time series were based on existing ABS time series intervention principles and were made in close consultation with collection areas. Over the following six month period, 1500+ series were evaluated each month and, where necessary, technical updates were supplied for inclusion in ABS publications.

Key Words: estimating seasonality and trend, imputation bias, non-response bias, real-world shocks to time series

1. Introduction

The 2010-2011 floods and following cyclone in eastern Australia caused extensive damage and devastation across a large area of the country, leading to significant disruption to both data collection and operational activities of the Australian Bureau of Statistics (ABS). Early action was taken to prepare resources and develop solutions for expected impacts. Organisation of an ABS-wide coordinated response to disaster impacts ensured the continued release of high quality statistics throughout the affected period.

2. Impacts of the floods on official statistics

In December 2010, high intensity heavy rainfall led to severe flooding in large areas of Queensland. By early January 2011 flood waters covered an area the size of France and Germany combined, with dozens of towns and cities in Queensland inundated by flood waters (Queensland Floods Commission of Inquiry, 2012). Transportation channels were severely impacted by flood waters. Several of the major sea ports and regional airports were shut down. Large sections of the rail network was either closed or damaged and hundreds of roads, including major highways, were closed. By mid-

January the Queensland capital, Brisbane, had been struck by floods and many buildings in the central business district needed to be evacuated. Heavy rains also led to flooding in northern NSW in addition to western and central parts of Victoria in January 2011. Around the same time, Melbourne was impacted by flood waters with flash flooding closing off roads across the city.

In late-January 2011 northern Queensland was hit by Cyclone Yasi, leading to further destruction across the state. The torrential rains and damaging winds resulting from the cyclone caused further flooding in northern South Australia.

The unexpected nature of the disasters and the wide spread extent of the impact lead to significant disruptions in ABS' data collection and operational activities. The Queensland office of the ABS was shut down due to major flooding in Brisbane and surrounding areas. Extensive flooding across Queensland also had a major impact on the operations of ABS Population Survey interviewers in the state.

With the start of flooding ABS initiated its disaster response strategy and suspended contact with all flood affected postal codes in Queensland. Once the safety of ABS staff and interviewers was assured, the disaster situation was regularly reviewed to narrow down the list of geographic areas impacted by floods in Queensland and NSW. Recovery efforts in impacted areas was closely monitored and contact with businesses in recovering areas recommenced with caution. For household surveys, enumeration was suspended in impacted areas until selected dwellings were either confirmed to be undamaged or repaired to a degree where enumeration could resume. In all cases contact with flood impacted businesses and households was made with due sensitivity to their circumstances.

Impacts of the floods and cyclone were expected in most ABS collections to differing degrees both at the state and national level. Depending on the timing of the collections and survey cycles, two types of impacts were anticipated: The real world, economic, impact due to businesses and household activities being affected by the disasters and the statistical impact due to measurement error mainly through non-response.

The floods and cyclone were also expected to impact the level and timing of activity measured by ABS collections. While disaster impacts were expected to be reflected in ABS statistics, these unusual, one-off events had the potential to affect the seasonally adjusted and trend estimates. The methodology for producing seasonally adjusted and trend estimates could lead to biased results when there are abrupt changes or extreme values in the level of activity being measured.

Higher levels of non-response could have potentially led to increased standard errors in survey estimates as well as higher imputation rates. Moreover, if business and household responses were not missing at random, that is, those that could not respond would have been reporting different to those that did, there was the risk of non-response and imputation biases arising in survey estimates.

3. Coordinating the ABS response to the impact of floods

A Methodology task force was set up to evaluate potential impact to ABS statistics, monitor impacts across survey cycles and to ensure a consistent and coordinated response to flood impacts in ABS surveys.

Early action was taken in close communication with collection areas to assess potential impacts expected in ABS collections and to explore possible solutions. A workshop, attended by methodologists, collection areas and the ABS corporate

communications team, was held to share information, discuss strategies in managing flood impacts and facilitate collaboration across the organisation. The importance of a consistent and coherent organisation-wide response to flood impacts was the main topic of discussion. Key issues relating to flood impacts in data collection, methodology, consistent treatment of statistical and real world impacts and, communications with stakeholders and ABS data users were discussed within a coordinated response framework. Additionally, communication and coordination strategies addressing the importance of consistency in methodological treatments as well as in external communications were developed during the workshop.

Following the workshop, a Flood Impacts Response Coordination Forum was established to facilitate ongoing communication across the organisation. Throughout regular forum meetings, updates on impacts observed in each collection area as well as management of impacts were communicated to all areas. In addition to ensuring consistent management of impacts across collections, the forum provided a platform for discussing and developing organisation-wide strategies on flood related issues as they arose.

4. Imputation, non-response bias and impact on estimates

Work was initiated by the Statistical Services Branch (SSB) of the Methodology Division to assess the impact of the natural disasters on ABS household and business survey estimates, particularly due to non-response and increased imputation requirements. In addition to evaluating the potential level of bias in ABS survey estimates, SSB also undertook assessment of the suitability of ABS imputation strategies for flood impacted data as well as carrying out impact assessments for a select number of surveys.

To measure the extent of non-response bias in business surveys, response rates were compared across disaster affected and non-affected areas to assess whether there were any significant differences in rates in disaster affected areas. Additionally, characteristics of non-responding units across affected areas were compared with non-responding units in non-affected areas. Results indicated the amount of non-response bias was not likely to be significant.

To measure the extent of non-response bias on the Labour Force Survey, respondents were matched between the December 2010 sample and the January 2011 sample where 7/8 of the sample is in common between the two months. The December sample was re-weighted after excluding people who lived in a flood-affected area, had responded in December and should have but did not respond in January. Differences in estimates from the two sets of weights for the state of Queensland were found to be much smaller than the Queensland standard errors, indicating any non-response bias was unlikely to be significant.

Suitability of current imputation techniques to handle higher rates of non-response than normal in business surveys was evaluated to see whether methodological modifications were required. Imputation classes were evaluated to determine whether there were sufficient contributors to provide stable imputes. The results revealed that, though response rates were lower than usual, the imputation and estimation methodology remained robust.

The level of imputation bias due to higher levels of imputation was investigated in selected business collections. Previous cycle’s survey data and estimates were used as a proxy for the flood impacted survey estimates for the state of Queensland. Responding units were randomly selected and their data replaced with an impute to

reflect the higher levels of non-response associated with the flood effects. These new estimates were compared to original historical estimates to attain an estimate of the bias. The process was replicated multiple times to derive confidence intervals for the estimate of bias. While there was some bias evident at the lower levels, the bias was not found to be significant at the Australia level, published industry level or the Queensland state level.

Impact assessments were carried out in several business collections to gain an approximate estimate of the real world disaster impacts. As a first step, flood affected responses and imputes were replaced by non-flood affected imputes. Then, the difference between the flood affected survey estimates and replacement non-flood affected survey estimates was calculated to arrive at a measure of the economic impact of the floods. Non-flood affected imputes were calculated using various methods depending on the imputation methods used in each survey and whether the units being imputed were continuing units, i.e., units that were also surveyed in previous survey cycles, or new units. Results of the assessments indicated the level of impact varied across different industries, with some industries showing minimal impact while others experiences greater effect.

5. Impact on seasonal factors and trend estimates

The Time Series Analysis (TSA) section (part of the Analytical Services Branch within the Methodology Division) took early action to manage the real world impacts from the natural disasters on seasonal factors and trend estimates. To ensure the 2500 monthly and quarterly seasonally adjusted series were treated consistently for flood impacts, TSA worked closely with collection areas in gathering information, planning resources, developing coordinated communication strategies and utilising quality assurance tools to assist in monitoring impacts across the large number of collections.

A central information repository on all ABS collections was established soon after flooding began. Information on whether impacts were expected and, if so, the expected magnitude and direction of impacts were gathered from collection areas. As flood impacts were expected to differ across collections depending on the type of economic activity being measured, timing and potential pattern of expected impacts were also noted. For some collections like Retail, the natural disasters were expected to have immediate short term impact while in others, such as Building Activity, the effects of the disasters were expected to be evident for longer periods. The repository enabled efficient allocation of resources for impact management over the coming months. It was updated regularly as collections were evaluated each survey cycle for impacts and enabled large amounts of information to be easily accessible and evaluated at short notice.

A major challenge for TSA was monitoring the large number of seasonally adjusted time series for flood impacts within tight deadlines while continuing to provide routine seasonal adjustment support to ABS collection areas, research into time series methods, infrastructure development and training services. Seasonally adjusted and trend estimates needed to be evaluated for over 2500 series each survey cycle for evidence of flood impacts. Existing diagnostic tools were further developed to construct new quality assurance tools enabling large number of series to be visually and diagnostically evaluated for flood impacts. Series flagged during this initial process were then individually analysed in-depth using ABS's seasonal adjustment software, SEASABS (McLaren et al., 2006).

If unusual values or patterns were observed in ABS time series, decisions were made on whether interventions would be applied to the series. If left uncorrected, extreme

values and sudden changes in the level and/or pattern of activity could lead to biased seasonally adjusted and trend estimates. If the qualitative nature of the impacts, such as the duration or pattern of impact, was known, time series intervention techniques could be applied to the series. However, incorrectly applied interventions due to the nature of impacts being unknown, could result in misleading or biased seasonally adjusted and trend estimates. To mitigate the risk of publishing biased and misleading estimates, decisions on whether interventions would be applied to impacted time series were based on an established set of ABS time series treatment principles and made in close collaboration with collection areas.

Developed by TSA to manage the impact of the Global Financial Crisis on ABS seasonally adjusted and trend estimates, ABS time series treatment principles provide a series of intervention options based on the amount of qualitative and quantitative information available regarding the nature of impacts as well as the benefits and risks of each option (ABS, 2009). For instance, if the collection area is confident about the short and longer term nature of the impact, then the principles of intervention recommend applying necessary corrections and including a publication note to advise users to interpret the estimates with caution. In addition to the principals of intervention, factors such as measurement error, data frequency, and existence of other real world event impacts were also taken into account throughout the intervention decision process for flood affected time series.

A key consideration in intervention decisions was the consistent treatment of conceptually related ABS data collections. Consistency issues may arise in several circumstances. Series may be related due to measuring similar underlying activities, such as the Quarterly Business Indicator Surveys measure of Sales in the Retails Industry and Retail Trade Survey's measure of sales. Alternatively, many ABS collections, such as business, retail, building construction and labour force participation surveys, serve as source series for the ABS National Accounts. Additionally, component series, such as state or industry level, or full-time/part-time series, need to be treated consistently across all components as well as the aggregated parent series. If consistency is not assured, related series could provide differing or contradictory information. In addition to already existing TSA consistency tools, the quality assurance tools developed for monitoring of impacts were also utilised in consistency checks to ensure consistency in related series was achieved.

ABS collections were continuously monitored for impacts for a six month period after the natural disasters. Collections were frequently assessed for continuing flood impacts and removed from intensive monitoring if impacts were no longer evident. While intervention was not necessary for most series, interventions were applied to *Hours Worked* in January 2011, *Coal Exports* in January, February and March 2011, including the corresponding *Quarterly Business Indicator* series in March 2011. Additionally, there were extreme value corrections applied to several Queensland and Australia level retail series in February 2011. In accordance with the ABS time series treatment principles, if there was little information regarding the nature of impact no interventions were applied. In addition to monitoring of flood impacts and ensuring consistent management of impacts, assistance was offered to collection areas in the writing of technical commentary in ABS publications.

6. Conclusion

The eastern Australia floods and ensuing cyclone presented a unique challenge for ABS, impacting the collection, estimation and release of ABS data. The Methodology Division played an integral role in the management of the natural disasters' impacts by

ensuring a coordinated response across the organisation in addition to resolving technical issues such as non-response and extreme values.

An ABS-wide response coordination forum was established to facilitate communication between Methodology and ABS collection areas through frequent updates and meetings.

Established methodologies across all collections were assessed for their ability to handle impacts from the natural disasters and found to be robust. Potential impacts on time series seasonality and trend were assessed with existing and new tools and techniques. After close consultation with collection areas a small number of interventions were applied.

Several measures led to the successful management of flood impacts in ABS official statistics. Action taken early on, assisted in the assessment of potential impacts and development of solution strategies as well as the allocation of resources to deal with flood impacts. An organisation-wide Methodology workshop and the Flood Impacts Response Coordination Forum played a key role in ensuring a coordinated ABS response to the natural disasters was initiated. The workshop and forum facilitated sharing information on flood impacts, discussing strategies in dealing with the impacts and developing a consistent and coordinated response as well as internal and external communication strategies. The ongoing communication and coordinated response across collection areas and Methodology Division ensured consistent methodological treatments of impacts across collections and the continued release of high quality statistics.

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