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The Importance of Trend-Cycle Analysis for National Statistics Institutes

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ABSTRACT

Seasonal adjustment is a widely applied statistical method. National Statistics Institutes around the world apply seasonal adjustment methods, such as X-12-ARIMA or TRAMO-SEATS, on a regular basis to help users interpret movements in the time series and aid in decision making. The seasonal adjustment process decomposes the original time series into three main components: a trend-cycle, seasonal and irregular. By definition the seasonally adjusted estimates still contain a degree of volatility as they are just a combination of the trend-cycle and irregular. Typically, as an analytical product, the seasonally adjusted estimates are published alongside the time series of the original estimates. In most countries the trend-cycle estimates are not published. Some countries, such as Australia, regularly publish trend-cycle as additional analytical product alongside the original and seasonally adjusted estimates to inform users. This paper presents the case for the regular calculation and production of trend-cycle estimates at National Statistics Institutes to help inform and educate users about the longer term signals in the time series.

Keywords: Trend-Cycle, Statistical Dissemination, Seasonal Adjustment, National Statistics Institutes.

La importancia del análisis de ciclo-tendencia para los Institutos Nacionales de Estadística

RESUMEN

El ajuste estacional es un método estadístico muy extendido. En todo el mundo, los Institutos de Estadística recurren con frecuencia a métodos de ajuste estacional (como X-12-ARIMA o TRAMO-SEATS) para ayudar a los usuarios en la interpretación de los cambios en las series de tiempo y en la toma de decisiones. El ajuste estacional descompone la serie de tiempo original en tres componentes principales: ciclo-tendencia, estacional e irregular. Por su naturaleza, las estimaciones corregidas de estacionalidad mantienen un cierto grado de volatilidad ya que son una mezcla de ciclo-tendencia e irregularidades. A menudo, como un producto derivado, las estimaciones ajustadas estacionalmente se publican acompañando a las estimaciones originales de la serie de tiempo. En la mayoría de países, no se publican las estimaciones de ciclo-tendencia. No obstante, en algunos como Australia sí que se publican con regularidad como un producto adicional a las estimaciones originales y a las ajustadas estacionalmente y como información para los usuarios. Este artículo defiende la necesidad de calcular y publicar con regularidad las estimaciones de ciclo-tendencia por los Institutos Nacionales de Estadística con el objetivo de informar y educar a los usuarios sobre las señales a largo plazo en las series de tiempo.

Palabras clave: Ciclo-tendencia, difusión estadística, ajuste estacional, Institutos Nacionales de Estadística.

Clasificación JEL: C30, C32.

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1. INTRODUCTION

National Statistics Institutes (NSI) regularly collect and publish estimates of variables of interest. For example, monthly unemployment, retail sales activity, and measurement of activity in the economy are all important social and economic measures. This information is typically derived from a collection of observations of well-defined data items obtained through repeated measurements over time.

To enable comparisons between different periods, estimates of the variables of interest, y_t, are collected at regular periods which are typically monthly or quarterly, to produce a time series. We denote the collected data as the original estimates, $\mathbf{y} = (y_1, ..., y_t,..., y_N)$ which is a time series of length N where t is either a monthly or quarterly time period. Typically, these original estimates can be considered to comprise at least three different components at time t. For example, a regular seasonal component s_t, an underlying trend-cycle component T_t and an irregular component I_t. In mathematical terms the original estimate can be decomposed in a multiplicative way by

$$y_t = T_t \times s_t \times I_t$$

Alternative decompositions can be used, for example, where the different components are related in an additive way. Analysis techniques, such as seasonal adjustment, can then be used to estimate and extract the different components from the original estimates. X-12-ARIMA (Findley, et.al 1998) and TRAMO-SEATS (Gomez and Maravall, 1996) are widely used by NSIs to calculate seasonally adjusted estimates. The process of seasonal adjustment involves the estimation and removal of systematic calendar related effects from the original estimates. For example, a seasonally adjusted estimate is calculated by

$$SA_t = y_t / s_t = T_t \times I_t$$

This shows that, by definition, the seasonally adjusted estimates will contain an estimate of the underlying trend-cycle and the irregular components. The irregular component is defined to consist of short term fluctuations, neither systematic nor predictable. On occasions the degree of irregularity can be unusually large, resulting in extreme values that are reflected in both the original and seasonally adjusted estimates. Irregularity can be caused by real world events in relation to large economic, social events, or extreme weather effects such as the impact on travel or retail sales. The degree of irregularity in the series can mean that the seasonally adjusted estimates do not result in a stable or sustained growth indicator. Trend-cycle estimates can be considered an analytical by-product of the seasonal adjustment process. The process of seasonal adjustment provides users with two quality analytical indicators, the seasonally adjusted and trend-cycle estimates, that present different but complementary information derived from the original time series.

For over twenty years, the Australian Bureau of Statistics (ABS 1987, 1993, 2003) have regularly published the original, seasonally adjusted and trend estimates for different variables of interest but advocated that users of official statistics should focus on the use of trend-cycle estimates for the purpose of monitoring underlying trend to aid and assist in informed decision making. We draw on the experience of the ABS and present the case for the regular calculation and production of trend-cycle estimates at NSIs to help inform and educate users about the longer term signals in the time series.

2. DEFINING TREND-CYCLE ESTIMATES

A common criticism of trend-cycle estimates are that they are not uniquely defined. Commonly, the long-term trend is considered to be the long run persistent upward or downward movement that is observed. The cycle is considered to be a sequence of smooth fluctuations longer than a year which occur around the long-term trend and is characterized by alternating periods of expansion and contraction. Trend-cycle (now referred to as trend) is often referred as the combining of the long-term trend and cycle. In practice, different users will have different needs in term of measuring underlying activity. For example, economists may be interested in how the business cycle changes over many years or decades but may not necessarily agree how it should be defined. In practice there is no accepted or unique definition.

Kendall (1976), p. 29, "The essential idea of a trend is that it shall be smooth".

Harvey (1989), p. 284, "There is no fundamental reason why a trend should be smooth".

It is important to distinguish between the a concept of a trend, which is defined as the mid and long-term signal in a series, and a trend estimate, which is the estimated mid and long term signal. It may be analytically difficult to produce a good trend estimate which reflects the trend concept, and this can be due to a large distortion or outlier in the series, but the concept of a trend is still appropriate with respect to the mid and long-term signals in a time series.

For the purposes of seasonal adjustment, an estimate, or chosen model, of the trend is needed. We consider two approaches to seasonal adjustment that are widely used in NSIs.

Filter based seasonal adjustment approaches such as X-12-ARIMA use a ratio to moving average approach. The basic steps are: obtain an initial estimate the trend, remove the trend leaving the seasonal and irregular components, then estimate the seasonal component. This means that seasonality cannot be identified until the trend is known and an estimate of the trend cannot be found until the series has been seasonally adjusted. Under this framework an iterative approach is adopted, such as used with the X-11 methodology. For a full description of the X-11 process see Ladiray and Quenneville (2001). In this case the trend component is defined as having cycles that are longer than a certain length. This means the trend component is not uniquely defined and can be different based on the filter settings within X-11.

Model based approaches involve modelling the time series components by ARIMA models (Box and Jenkins, 1970) or state-space models (Harvey, 1989). These types of approaches are implemented in the TRAMO-SEATS programs and the STAMP program (Koopman et. al, 2000). In model based methods the unobserved trend, cycle, seasonal and irregular components of the original series are modelled separately. Parameter estimates for each of the components can be estimated simultaneously and the irregular component is assumed to be white noise. In the model based approach the trend component typically follows a local linear model form, but this can be determined by the user. So again, the trend component is not uniquely defined as for the same series a different user may invoke a different trend model.

To overcome the issue of non-uniqueness in trend definition, the ABS use a standard trend approach which is applied to all types of series in a consistent way (ABS, 1987). The ABS trend is defined by taking a modified version of the seasonally adjusted estimates, where known large irregular values are removed, and applying a Henderson filter (Henderson, 1916). For monthly series a 13 term Henderson filter is used and for quarterly series a 5 or 7 term Henderson filter is used. If a 13 term Henderson filter is used this means that in the middle of the series, a weighted average of 13 values is used to derive a trend estimate for a single time point. The Henderson filter was originally derived for use in actuarial work but is also used within X-12-ARIMA to de-trend the series for seasonal adjustment purposes. Alternative trend filters are widely available which could be used directly on the seasonally adjusted estimates.

The advantage of the ABS approach is that the definition and method used to calculate the trend estimate is transparent to the users of data. The ABS also regularly publish the original, seasonally adjusted, and trend estimates for each data set which provides transparency of the estimation process. The availability of the seasonally adjusted estimates allows more sophisticated users, such as Treasury and central banks, to construct their own trend-cycle estimates using their preferred estimation or filter methods.

An alternative approach is used at the Office for National Statistics (UK). In this case a simple weighted average of the most recent three months against the previous three months is calculated, and also the most recent three months against the same three months a year ago. However, in practice, because the averaging only happens over three monthly values, these estimates can be distorted by the single impact of large irregular values which are not removed in the calculation of the three monthly estimates. This can significantly distort this type of indicator as the large irregular value will remain in the calculation for up to six months before it is removed from the calculations. It would seem that there is clear benefit in averaging over more than just three time points as it means that the impact of large irregular values is reduced and the underlying direction of the series can be observed more clearly. Historically, trend estimates were published for some ONS publications, eg. Labour Market estimates and also Trade in Goods estimates. For Retail Sales estimates, special and supplementary background notes were produced by the ONS to highlight underlying trends in Retail Sales (ONS, 2008). The ONS trend estimates were calculated by applying a 13-term Henderson moving average, augmented by two stages of outlier detection and ARIMA modelling to remove the impact of large irregular values, to the published seasonally adjusted estimates.

In terms of statistical process, one approach to ensure consistency of the original and analytical estimates would be to use the trend estimates produced by the seasonal adjustment method rather than apply either simplistic (three month averages) or complicated external approaches directly to the seasonally adjusted estimates.

3. WHICH INDICATOR TO USE?

In practice many different estimates are available, for example the original y_t, the seasonally adjusted SA_t, and the trend-cycle T_t. Different indicators can then be constructed. ABS (2003) Chapter 3, extensively covers some of the most commonly applied smoothing techniques. We summarise the main points here. Common indicators are, period to period growth, moving annual sums and averages, annual growth rates, growth in the three months and annualised growth rates. In practice, these types of indicators can delay the changes in the behaviour of the series, distort the underlying shape of the series, and some of them can amplify the irregularity in the time series.

Monthly, quarterly and annual percentage changes can be calculated for original, seasonally adjusted and trend series but these measures can produce inconsistent and occasionally contradictory signals about developments in the underlying direction of a series. As a result of these inconsistent signals users may be confused about the direction of the series or which series they should be using for their purposes. The benefits and disadvantages of the various measures of movement are summarised below.

3.1. Benefits and disadvantages of the original estimates

When using a month to month or quarter to quarter percentage change in the original estimates there are no benefits in using this measure as the seasonal influence is likely to be the dominating factor in the variation in the original estimates. While the original estimates are useful in understanding the actual number of movements for a given period of time, due to the presence of seasonal and irregular factors they have little value for the purpose of understanding underlying activity. For year-on-year percentage change this measure essentially performs a crude seasonal adjustment when applied to the original estimates as it reduces the impact of constant yearly seasonal influences. However, in practice these effects are rarely completely eliminated due to trading day influences (changes in calendar), changing patterns in seasonality, and moving holidays. The year-on-year percentage change will also not cope well with seasonal effects that evolve with the level of the series by maintaining a proportional relationship.

The year-on-year percentage change measure may also be highly affected by irregular influences. This measure should only be used if seasonally adjusted or trend estimates do not exist for a given series and there is no evidence of seasonality. In such cases great caution must be applied. Also, even if the irregular and seasonal influences are minimal, the through the year measure will rarely detect turning points in a timely way and in practice will actually lag turning points by around six months.

3.2. Benefits and disadvantages of the seasonally adjusted estimates

In practice, analysts often focus on the period to period movements of the seasonally adjusted series. The problem with using this approach is that the seasonally adjusted estimates include both the trend and the irregular component. The period to period movements of the seasonally adjusted series are influenced by the behaviour of these irregular fluctuations. In many instances, the irregular component dominates the overall movement in seasonally adjusted estimates. The period-on-period movement can be shown mathematically to actual amplify the irregular component, so for example, a month-on-month or quarter-on-quarter movement estimate is really just looking at the amplified irregulars.

For the seasonally adjusted estimates and using a month to month or quarter to quarter percentage change there are some benefits as this is a reasonably good measure for the short-term variation (i.e. impact of one-off events) in the original estimates. This measure may also provide supplementary information to assess future trend estimates. Caution must be applied when interpreting the underlying direction for the most recent period(s) which may be subject to revisions due to revisions in the original data and/or due to additional original data becoming available. For year-on-year percentage change, this measure should not be used because of the potentially high contribution of the irregular factor to the seasonally adjusted estimate in either the current observation or the 'base' observation 12 months earlier, thus masking the underlying behaviour. More importantly, the through the year measure will lag turning points by around six months even if irregular influences are minimal.

3.3. Benefits and disadvantages of the trend estimates

This is the best measure of the underlying, longer-term direction of a series. This measure provides a smoothed historical perspective of the underlying pattern of behaviour without the impact of calendar related or irregular influences. Users can use this indicator to monitor the level and shape of turning points over time, which can aid timely and informed decision making.

However, caution must be applied when interpreting the trend estimates for recent periods. Revisions to the trend series at the current end will occur due to additional original estimates becoming available as the underlying direction will be continually reassessed as new information be comes available. For instance, in order to confirm the presence of a turning point in the underlying direction at the current end, approximately three additional observations of the trend will be required.

For a year-on-year percentage change, this measure provides an approximation of the average trend movement over the year. In this case, the measure of change may not reflect the most recent or current trend movement or pattern of behaviour. For instance, key turning points that occurred during the previous year will be picked up with a lag.

3.4. Revisions of estimates

Revisions are a natural part of the statistical and analytical process and will effect all indicators and measures. Data collection means that respondents may provide data late, or provide updated data based on new information, and methodological changes and updates in international classifications can occur. Revisions from data sources will impact the original estimates and hence the seasonally adjusted and trend estimates. A common criticism of trend estimates, particularly at the current end of the series, are that they can be revised at the current end as more data becomes available. It needs to be recognised that revisions are not limited to trend estimates. Revised estimates for the original, seasonally adjusted and trend estimates ensure that users have the most up-to-date set of estimates available at any given point of time.

The source of revisions in seasonally adjusted and trend estimates is due to a wide combination of factors such as the updating of the original estimates but in part, due to the imperfection of the forecasts produced by the implied models as part of the seasonal adjustment process. Once real data replaces the forecast values then a revision occurs. In general, revisions to the seasonally adjusted estimates are relatively small in magnitude but last longer; while revisions to the trend-cycle estimates are relatively larger in magnitude but last for a shorter time period. For filter based seasonal adjustment approaches, revisions to the seasonally adjusted estimates can last between three to seven years. For example, the estimate of seasonality for this years July will also impact July estimates in previous years. Under a filter based approach, revisions to trend estimates typically reduce after the addition of three additional time periods (Linacre and Zarb, 1991). Under model based approaches, if the model used in the seasonal adjustment is changed once additional or new information is available, or the model used is unstable, this can also lead to significant revisions in the decomposition of the components.

A large amount of work on revisions of estimates is available. For example, the OECD have a publically available revisions database and detailed guidelines on revisions OECD (2008). See also a paper related to a Eurostat task force on revisions analysis (McKenzie, 2007). Many approaches have been used to reduce revisions of the seasonally adjusted and trend estimates, for example, the use of ARIMA modelling methods as part of the X-11-ARIMA process (Dagum 1980, 1988) and alternative approaches to extrapolating the trend estimates (Dagum, 1996).

In practice revisions for the original, seasonally adjusted and trend estimates can be actively managed by using a revision policy framework to reduce the concern of revisions. This can be different between NSIs and also within an organisation depending on the subject area. For example, the ONS provide detailed information on the revision policies of different statistics. A Code of Practice for statistics within the UK is used (ONS 2004 and UKSA 2009) to provide guidance on communicating revisions. For example, the revision policy for the Retail Sales data from ONS is described in ONS (2007) and lets the seasonally adjusted estimates be revised along the length of the series and revision analysis is included in the publication and available on the website each month. However, for National Accounts estimates at the ONS, these are typically managed in a way to ensure that a balanced set of accounts is available, so in practice, revisions are limited within the most recent quarters or year until an open revision period is applied once a year where revisions and data sources are updated (Wroe, 1993).

4. WHY SHOULD A NSI CALCULATE AND MAKE TREND-CYCLE ESTIMATES AVAILABLE?

Many National Statistics Institutes continue to actively debate the merits of calculating and publishing trend estimates. We assert that there are three main reasons to calculate and make available trend-cycle estimates alongside the original and seasonally adjusted estimates.

1. Reduce risk of key users, such as media and policy makers, drawing inappropriate conclusions based on irregular (or noise) movements.
2. Enable appropriate comparison over time by reducing the impact of one off events.
3. Improve understanding and detection of turning points.

The seasonally adjusted estimates, by definition, contain a combination of the trend-cycle and irregular component and can be heavily influenced by the irregular component. It is not enough to focus on the original and the seasonally adjusted estimates as this does not give a complete picture. We suggest that the seasonally adjusted and trend estimates can provide complimentary information about the activity with a time series. For producers of statistics, we suggest that a balanced commentary on the seasonally adjusted and trend estimates is needed because these two analytical products provide complementary information. Trend estimates are needed to complete the picture.

For users of these analytical estimates there are often competing priorities. Often, the public perception of official estimates comes from the media. In a practical sense, there is a clear bias by the media towards finding a story in the published estimates. This means that the media and commentators will often focus on the one-off events and comment on the month-on-month movements in the estimates. We have discussed that this is equivalent to commenting on the irregular component. For policy makers, there is a danger that they too will focus on one-off events. To reduce this risk, an approach is to publish the original, seasonally adjusted and trend estimates together to give users a choice in which estimate to use. However, the choice of which estimate to use needs to be informed. For example, at the ABS this has involved a continuous education campaign on the relative merits of the different estimates and different indicators over twenty years. However, a recent media article in Australia highlighted why this approach is important and is a continuous process (The Australian, 2010). The article cites a range of examples from Unemployment to Retail Trade where the movement between the seasonally adjusted estimates is different to the trend estimates and hence giving a different story and interpretation and ultimately media headline. The article states that: "But 'irregular' influences make seasonally adjusted monthly statistics notoriously volatile and unreliable".

Change in the underlying direction of a series is another area of focus for policy makers. For example, when the economy has returned to growth. In the same article it also mentions that "Sophisticated users of statistics, such as the Reserve Bank, focus on trend numbers: that's why it raised the cash rate on Tuesday, despite recent 'negative' seasonally adjusted numbers.". This is an example of focusing on the trend estimates rather than single or one-off seasonally adjusted estimates. In effect this is trying to identifying turning points in activity. In undertaking turning point analysis it is important to consider both the seasonally adjusted and trend series. The emphasis should be on using the trend estimates if the purpose is for monitoring the underlying direction (e.g. turning points and business cycles). However, it is not enough just look the trend estimates. Seasonally adjusted estimates can provide earlier (but often unreliable) indications of the future trend direction. There is a trade-off between picking up a change in trend faster and getting more false turning points. While seasonally adjusted series cannot be relied upon exclusively to detect a turning point because of the influence of the irregular component, seasonally adjusted series can provide supplementary information necessary to evaluate the reliability of the provisional trend estimates and the magnitude of the corresponding estimate of the irregular component. Consequently, users may glean more information, especially with respect to the presence of turning points at the current end of the series, from the analysis of seasonally adjusted series in conjunction with the trend estimates. Menezes et. al (2006) looked closely at this issue and compared the relative merits of the seasonally adjusted and trend estimates. They concluded that turning points are generally detected in a more timely fashion and with a lower incidence of falsely detected turning points for trend rather than seasonally adjusted estimates. The nature of the volatility of the time series is important to consider in assessing the reliability of the detection of turning points as this will directly impact the seasonally adjusted estimates. A graphical example of how to highlight a change in the direction of the underlying direction through the use of seasonally adjusted and trend estimates and using the impact and direction of the irregular component is given in Section 5.2.

5. EXPERIENCES AT THE AUSTRALIAN BUREAU OF STATISTICS

For over twenty years, the ABS has regularly published a complimentary set of indicators: the original estimate and then two analytical products of the seasonally adjusted and trend estimates. The following sections describes examples of how the ABS has managed the use of trend estimates. The ABS uses an X-11 based approach for seasonal adjustment.

5.1. Impact of unusual values on trend estimates

Unusual real world events, such as the financial crisis or significant government economic interventions, will affect the original, seasonally adjusted and trend estimates. If an appropriate methodological intervention is not applied to the seasonally adjusted and trend estimation methods in a timely way, or is applied inappropriately, then users may be misled when interpreting the seasonally adjusted and trend estimates. The accuracy of these analytical products needs to be preserved but to do so means that methodological decisions are required to ensure that a high quality seasonal adjustment process is maintained. This section describes approaches used at the ABS and draws heavily on ABS (2009).

Unusual events can be grouped into two categories according to their causes:

1. Methodological changes (such as changes to classification, scope, coverage).
2. Real world effects (unusual events with significant impact, such as the financial crisis). Examples of real world effects include the introduction of a different taxes, one-off sporting events such as the Olympics and football World Cup.

Real world changes need to be reflected in the estimates, but the impacts of methodological changes should be removed.

Real world events impact on time series analytical products, such as seasonally adjusted and trend estimates, and can be minimised if reliable information is available for estimating the statistical impact. However, this information is often unavailable and estimates are used to gauge the extent of the effect on the original series.

For the estimation of the seasonal factors, s_t, the X-11 process is relatively robust as it will automatically discount 'extreme' irregular values so that the seasonal factors are not distorted in the short-term. For example, for series with low volatility, any extreme irregular value larger than 1.5 times the standard deviation will be automatically ignored, and the seasonal adjustment process will treat the occurrence of the extreme irregular as an outlier to avoid its profound impact, and automatically replace it with a more representative value for the purpose of estimating the seasonal factors. Due to the robustness of the seasonal factor estimation, the accuracy of the seasonally adjusted estimates will generally not be compromised by the occurrence of a single extreme irregular. However, this does not mean that this accurately reflects the underlying long-term movement of the series, especially when the unusual events have a lasting impact. Distortion of the trend estimate will also occur in the presence of an unusual event, and if no correction for the impact is introduced, then the trend estimate can be misleading. A sequence of unusual events with an unknown quantifiable nature can also occur in reality. Under these circumstances, a judgment needs to be made on whether to apply any methodological intervention and to provide a warning to users indicating the potential impact, or to apply appropriate methodological interventions with the best information at the time and avoid misinterpretation of the analytical products. Revised versions of the trend and seasonally adjusted estimates are then published when more information becomes available.

A common practical criticism of the use of trend estimates, is how to deal with the impact of large outlier values. If a consistent application of policy is followed this can be managed.

In practice there are four major approaches which can be taken.

1. Make no correction to the seasonal adjustment estimation procedure, and to allow trend estimates and seasonal factors to continue their natural course. This approach may be most appropriate when there is very little or no information available to indicate how long an unusual event may persist.
2. Make a correction for the extreme estimate after one additional original estimate becomes available. In other words, no correction to the estimation procedure is made at the time of the occurrence of the unusual event, but a correction is inserted in the next publication of the series.
3. A trend break correction may be introduced after three or more periods following the occurrence of the unusual event. The trend estimates may not be published in the period prior to introducing such a correction. In practice, the trend series could be suspended from the publication pending the collection of additional data to enable the identification of appropriate treatments for trend estimates. In cases like this, if the trend estimates are continued to be published then they could provide a misleading signal to users.

4. A seasonal break correction may be introduced after three or more years of additional original estimates become available. Until then, the trend and seasonally adjusted estimates can continue to be calculated without methodological intervention provided there is not an abrupt change to the seasonal pattern.

The choice of approach can depend on a number of other factors. These include the measurability of an impact; data frequency (higher frequency time series are generally more greatly impacted by a particular distortion or outlier); different impacts on different parts of the economy (an impact on some variables of interest may not be observed, or may be observed differently); and consistency (the need to consider related indicator time series which have similar underlying concepts when applying treatments or interventions to seasonally adjusted and trend estimates).

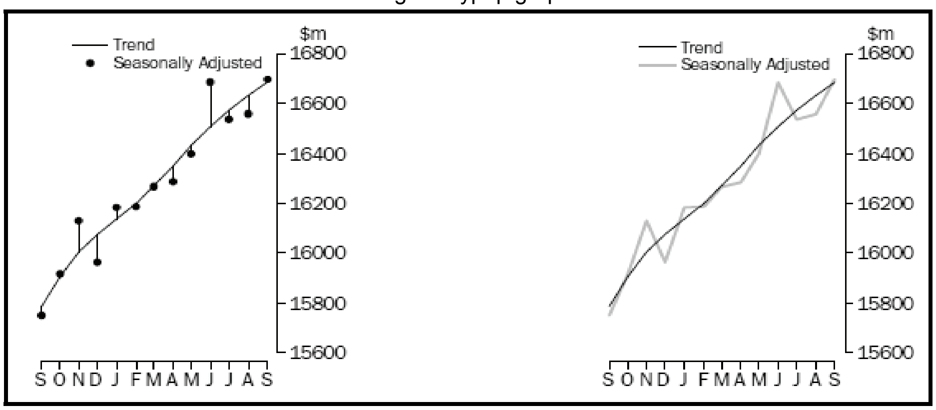
5.2. Presenting time series estimates

Traditionally, the ABS has presented time series information in statistical releases with a focus on the trend estimates. For example, presenting commentary on trend estimates first, then seasonally adjusted estimates, and then the original estimates (where applicable). All ABS outputs typically follow an internal publication policy. For example, graphs are restricted in size and generally confined to displaying the most recent behaviour of the seasonally adjusted and trend estimates. Line graphs of levels or bar charts of movements are the most common treatments of the estimates. In either case, the time span will be limited to about one year of monthly observations, or longer in the case of quarterly data. The trend estimates should be plotted together with the seasonally adjusted series from which it was derived. This means that the graph then shows the size and direction of the irregular factors present in the seasonally adjusted series. The irregular component is then clearly shown about the trend path and this assists in monitoring extreme irregular behaviour that can distort trend estimates.

In practice, the trend estimates should not normally be plotted with the original (seasonal) series. This is because the difference between the two series cannot be interpreted as being either a "seasonal" or an irregular effect alone, but a mixture of both. In such a graph this could lead to situations where the trend behaviour may look quite out of step with the original series movements, and confuse the user.

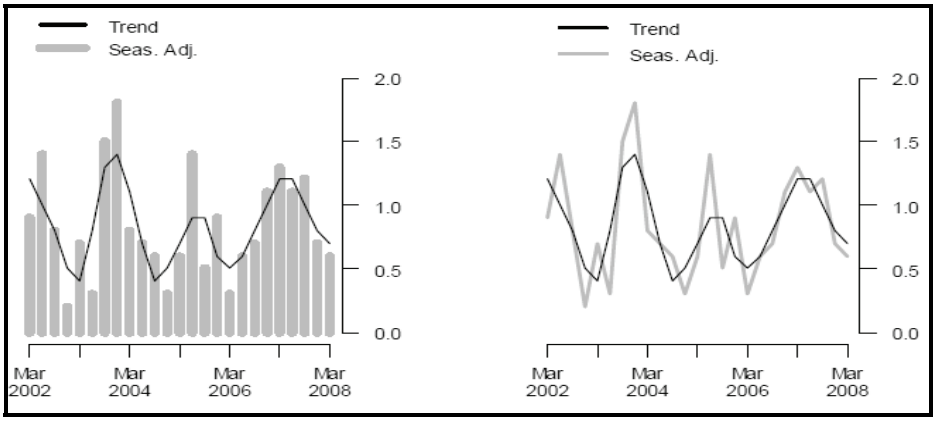
The multiple line graphs traditionally used to present trend and seasonally adjusted estimates can obscure the influence of the irregularity in the seasonally adjusted estimates on the trend estimates. This inhibits analysis, especially with regards to the identification of turning points in the series. An alternative approach to presenting the seasonally adjusted and trend estimate can be used to clearly show the impact of the irregular. The ABS has considered alternative presentational approaches, for example, a "lollipop chart" which presents the trend and seasonally adjusted series together but also places emphasis on the degree of irregularity in the series. Figure 1 shows an example of a lollipop graph (left hand side) and the traditional approach (right hand side). The emphasis of the lollypop chart is on the trend estimates. One benefit of this type of chart is that it can help highlight turning points if three irregular values occur on the same side of the trend this can be considered a possible start of a turning point and change in underlying direction.

FIGURE 1
Example of alternative representation of seasonally and trend estimates using a lollypop graph.



Percentage movements (growth rates) are useful for the interpretation of the short term direction of a time series. In practice, line graphs can be used in this capacity. A more appropriate approach is to use a bar-line graph for simultaneously presenting trend and seasonally adjusted movements. The main advantage of the bar-line movement graph is that emphasis is placed on the trend movements. The motivation behind using bars for seasonally adjusted movements and lines for trend movements is simple: the irregularity contained in the seasonally adjusted estimates means that the seasonally adjusted movements will also contain a high degree of irregularity. Joining seasonally adjusted movements with a line can provide the inappropriate impression that the movement is in a continuous fashion rather than being a discrete short term change. The bar plot crossing at zero provides a no-growth reference line and gives readers a perspective of growth direction against volatility. The joined line for trend movements gives a clear direction and an indication of the phase of the cyclical behaviours of the series.

FIGURE 2
Example of alternative representation of movements in seasonally adjusted and trend estimates.



Note that the use of purely web based statistical releases provides opportunities for users to interact with time series data. For example, the user could use interactive applications to plot selected variables of interest on a single graph.

5.3. Using trend estimates to influence survey design and reduce costs

The use of trend estimates can provide opportunities in terms of influencing the survey and sample design. Traditionally, the design of surveys has focused on minimising the variance of the movements in the original estimates, eg. year-on-year change in the original estimates. However, as users may focus on obtaining improved estimates of movement for the seasonally adjusted or the trend estimates, this traditional assumption may not be relevant.

A practical example of how the trend estimates can influence the survey design is covered by ABS (2008b). This describes a significant change to the monthly Australian Retail Trade survey. A monthly indicator makes it possible to detect changes in a timely manner. However, monthly surveys can be expensive to run and within the ABS, the Retail Trade survey was assessed for a reduction in sample size while still aiming to meet user needs. As this was used within the quarterly National Accounts, a design feature was required so that it could produce good quarterly estimates and provide good trend and trend movement estimates on a monthly basis.

For the survey design, many different approaches of contacting the respondents are available and a balance needs to be made between minimising respondent burden and cost. For example, businesses could remain in the survey for 36 months and each month a proportion of the businesses are rotated out and a new selection rotated in. This in-for-a total selected number of months approach is ideal for a traditional approach of obtaining good estimates of month-to-month movement in the original or seasonally adjusted series but it can be shown that it is not ideal to obtain good estimates of level or changes in trend. An alternative approach which can provide good estimates of trend or changes in trend is the use of selections which keep businesses in for one month, out for two months and back in for one month for an arbitrary number of months. See for example, McLaren and Steel (1997) and Steel and McLaren (2000). In practice, this means that to obtain the same degree of reliability of quarterly estimates a significant cut in the monthly sample size could be achieved. In the ABS example, they achieved a significant 59% reduction in the monthly retail sample relative to the June 2008 sample size when this was introduced in the July 2008 Retail Sales publication. This resulted in significant cost savings by focusing on the trend estimates as the primary output. Only trend data (level, percentage change from previous month and percentage change from same month in the previous year) for total aggregates was produced in the publication. For analytical purposes, the seasonally adjusted and original estimates were made available, however, they were noted to be of limited use for measuring month-to-month estimates because of the increased volatility in these series due to the smaller sample size and the effect of having a different third of the sample reporting each month. This release was published for five months from July 2008 until November 2008 until the full sample was reinstated to help measure the impact of the financial crisis.

This example highlights how the trend estimates can be used to influence the survey design and significantly reduce survey costs.

6. DISCUSSION

It is clear that different estimates and indicators based on those estimates have properties which are beneficial in different situations. The systematic calendar related variations (eg. seasonality etc.) and one-off irregular events in the original estimates mask underlying movements in the data. That is why it is important to use analysis methods, such as seasonal adjustment, to derive analytical products from the original estimates. Commonly, the seasonally adjusted estimates are regularly calculated, disseminated and widely used as headline estimates. However, as a by-product of the seasonal adjustment process a trend is also calculated. Many National Statistics Institutes continue to actively debate the merits of calculating and publishing trend estimates. We believe that it is important that all indicators of time series activity are available and assessed appropriately.

In practice, NSIs have a duty to provide users with estimates and indicators which enable them to make unbiased and informed decisions. In terms of analytical output, this means the availability of the original, seasonally adjusted and trend estimates. The approach of regularly calculating and publishing the original, seasonally adjusted and trend estimates is crucial to informed decision making as their are strengths and weaknesses inherent in the different estimates. In practice, the seasonally adjusted or original estimates should not be used in isolation. The trend estimates, as an analytical by-product, are an important tool for users and analysts to assist in informed decision making as they reduce the impact of the volatility in the original and seasonally adjusted estimates. It is important to note that neither the trend nor seasonally adjusted series are of inherently more value or importance than the other, but they should be used in a complimentary way with users educated on the appropriate use and limitations of each estimate and indicator.

The United Kingdom Statistics Authority, an independent authoritative body which monitors the use of statistics within the United Kingdom, also noted the risks associated with a focus on month to month changes in the seasonally adjusted estimates. They stated (UKSA, 2008) that "... we believe that some users place too much reliance on month to month changes; in a highly volatile situation such monthly estimates are not good guides to longer term trends.'.

The availability of complimentary information, such as trend estimates, and continued education and leadership by NSIs on appropriate indicators, can help fulfill the requirement that users are in a position to make informed decisions.

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