

## **Information Paper**

# **Introduction of Concurrent Seasonal Adjustment into the Retail Trade Series**



New  
Issue

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# **Introduction of Concurrent Seasonal Adjustment into the Retail Trade Series**

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## INQUIRIES

- For further information about these and related statistics, contact Bernard Williams on 02 6252 5304, or Client Services in any ABS office as shown on the back cover of this publication.

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ABBREVIATIONS AND  
SYMBOLS

ABS	Australian Bureau of Statistics
All Retail	Australian Total Retail and Hospitality and services series
ANZSIC	Australian and New Zealand Standard Industrial Classification
L	Lower limit
U	Upper limit
%	Percentage

## SECTION 1

### INTRODUCTION

1.1 The ABS currently recalculates most seasonal and trading day factors on an annual basis. This paper summarises recent investigations into the benefits of revising the factors on a monthly rather than annual basis, and presents recommendations for implementing the change for the Retail Trade series. While the paper concentrates on the Retail Trade series, the implications for other ABS series are also discussed.

1.2 This paper assumes the reader has at least a basic understanding of the seasonal adjustment process. If an understanding of seasonal adjustment is required, the feature article 'A Time Series Decomposition of Retail Trade' in the August 1991 *Australian Economic Indicators* (Cat. no. 1350.0) should be consulted.

1.3 Estimates of retail turnover in this paper are obtained from the monthly Retail Business Survey which covers employing businesses in most retailing industries (the most notable exceptions being motor vehicles, boats and service stations). Full details of the industries included in the Retail Trade series are in the attachment. The two largest retailing industry groups, Food retailing and Hospitality and services, contribute over 50% of total retail turnover. The Household good retailing, Other retailing and Department stores groups contribute about another 30% to total turnover.

1.4 All employing businesses with at least one retail establishment are included in the scope of the survey.

## SECTION 2

### EXPLANATION OF CONCURRENT ADJUSTMENT AND FORWARD FACTORS

2.1 The relationship between the original, seasonally adjusted and trend series can be summarised as follows.

Original estimates are a combination of trend, seasonal influence, calendar (e.g. trading day) influence and irregular influence.

Seasonally adjusted estimates are a combination of trend and irregular influences and are obtained by excluding seasonal and calendar influences from the original series.

Trend estimates are obtained by excluding seasonal, calendar and irregular influences from the original series, or equivalently excluding irregular influences from the seasonally adjusted series.

2.2 The seasonal adjustment process uses factors to remove seasonal and calendar influences from the original series to obtain a seasonally adjusted series. Seasonal and trading day factors are derived by examining historical patterns to determine the significance and direction of these systematic influences. Because patterns change over time (e.g. with changes to Christmas shopping patterns or the introduction of Sunday trading) greater weight is given to more recent observations. However, older observations can not be discarded completely as a minimum of five observations of the same month in successive years are required to determine accurate factors for a monthly series.

2.3 There are two approaches to deriving seasonal and trading day factors. The first relies on an annual analysis of the latest available data to determine factors (known as forward factors) that will be applied in the forthcoming 12 months. Under this method, data up to the June 1999 reference month are used to calculate seasonal and trading day factors which will be used to obtain seasonally adjusted estimates for the July 1999 to June 2000 period. Data up to June 2000 are used to calculate seasonal and trading day factors for application to the July 2000 to June 2001 period, etc. Note that in June 2000, when forward factors for the period through to June 2001 are calculated, the factors for the previous five years (from July 1996 to June 2000) are also recalculated taking into account the latest years data. Thus each year, when this annual reanalysis takes place, the seasonally adjusted estimates for (at least) the preceding five years are subject to revision.



2.4 The second method uses the data available at each reference period (month for Retail) to estimate seasonal and trading day factors. Under this method data for the current month are used in estimating seasonal factors for the current and previous months. This method continually fine tunes the estimates of seasonal factors whenever new data are available. For example, data up to the July 2000 reference month are used in calculating seasonal and trading day factors which will be used to obtain seasonally adjusted estimates for the period up to July 2000; data up to and including the August reference month will be used to obtain seasonally adjusted estimates up to August 2000; and so on. This method is known as concurrent adjustment.

2.5 The forward factor method has been used on the Retail series since the late 1960s. Compared with the forward factor method, the concurrent adjustment method is a relatively computationally intensive seasonal adjustment method. However, technological advances have now made it possible to apply the concurrent adjustment method with little operational burden or cost and at considerable speed. Under concurrent adjustment, the seasonal factors will also be more responsive to underlying dynamic changes than forward factors.

## SECTION 3

### COMPARISON OF CONCURRENT ADJUSTMENT AND FORWARD FACTORS

3.1 The ABS compared the concurrent adjustment and forward factors methods to determine which produced the better quality seasonally adjusted and trend estimates. The criteria used in this comparison were which method:

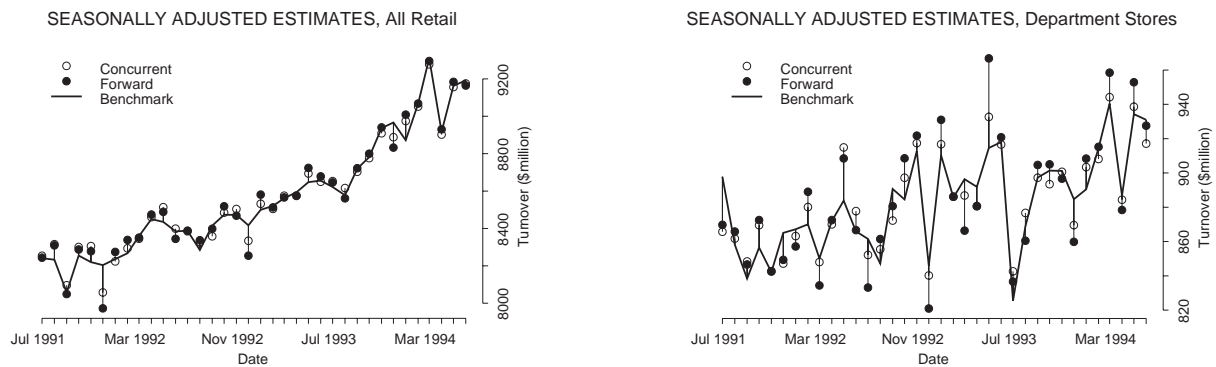
- 1 produces the most accurate initial seasonally adjusted and trend estimates;
- 2 produces the smallest level of revision to the seasonally adjusted and trend estimates; and
- 3 converges quickest to its 'benchmark' or final estimate.

3.2 To test the criteria it was necessary to have a suitable benchmark series. The 'Australian Total Retail and Hospitality and services' series and, a subset of this, the 'Australian Department stores' industry series were chosen. The Total Retail and Hospitality and services series is a 'well behaved' series, and is subject to significant public interest. The Department stores series was chosen because it has a history of volatility and was considered a good test case for addressing concerns that concurrent adjustment would be less reliable with a volatile series.

3.3 Seasonal and trading factors for a particular data point will stabilise after about five years. Therefore, a benchmark series can be produced based on the seasonal and trading factors estimated at a much later date. The benchmark series was derived by applying to the July 1991 to June 1994 data, the seasonal and trading day factors produced on the data up to June 1998. Both the forward factor and concurrent adjustment series used in the research were generated as they would have been during that period. Data that subsequently became available were not used.

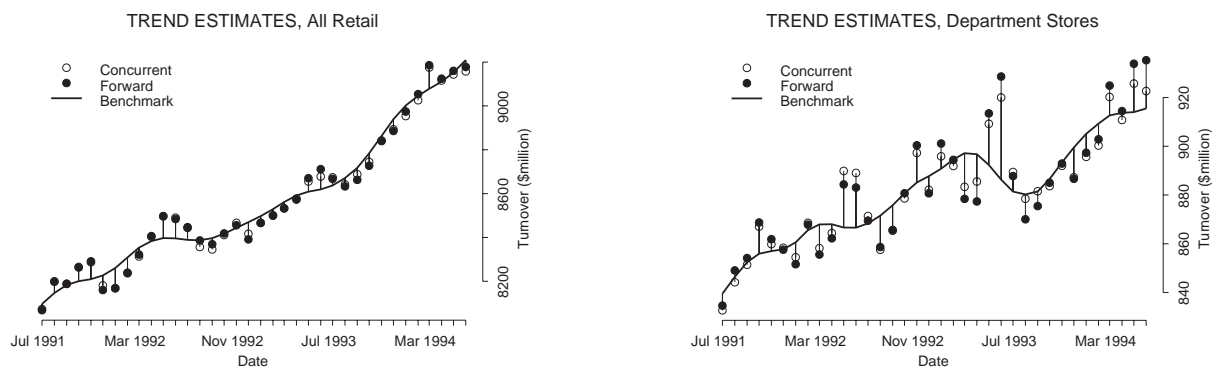
3.4 Figure 1 displays initial seasonally adjusted estimates and the benchmark series generated for the period under investigation for 'Australian Total Retail and Hospitality and services' (All Retail) and 'Australian Department stores'. The thick curve is the benchmark series, the circles are the initial concurrent estimates of the seasonally adjusted series, and the solid dots are the initial forward factor estimates of the adjusted series. The concurrent and forward factor seasonally adjusted methods displayed comparable patterns over time. Most of the time, initial concurrent seasonally adjusted estimates are closer to the benchmark series than the initial forward factor estimates.

Figure 1. Initial seasonally adjusted estimates



3.5 Figure 2 displays initial trend estimates and the benchmark series generated for the period under investigation. Again, the initial concurrent trend estimates are closer to the benchmark series than the initial forward factor estimates in the majority of cases.

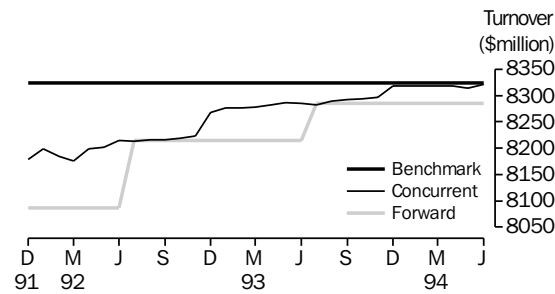
Figure 2: Initial trend estimates



3.6 Both seasonally adjusted and trend estimates from either the concurrent adjustment or forward factor methods are subject to revision after later data becomes available. The concurrent adjustment methodology was found to produce a smaller level of revision to the seasonally adjusted and trend estimates. For example, figure 3 shows the revision history of the December 1991 concurrent seasonally adjusted estimates and forward factor estimates. The thick straight line is the benchmark, the thin curve is the concurrent estimates and the grey line is the forward factor estimates for the December 1991 reference month over the period of December 1991 to June 1994. The graph highlights that concurrent estimates change each month as new observations become available. The graph also shows that the forward estimates remain fixed except when new forward factors are estimated (in July each year) and removed from the original series to produce a seasonally adjusted series.

Figure 3: Revision history of December 1991 seasonally adjusted estimates

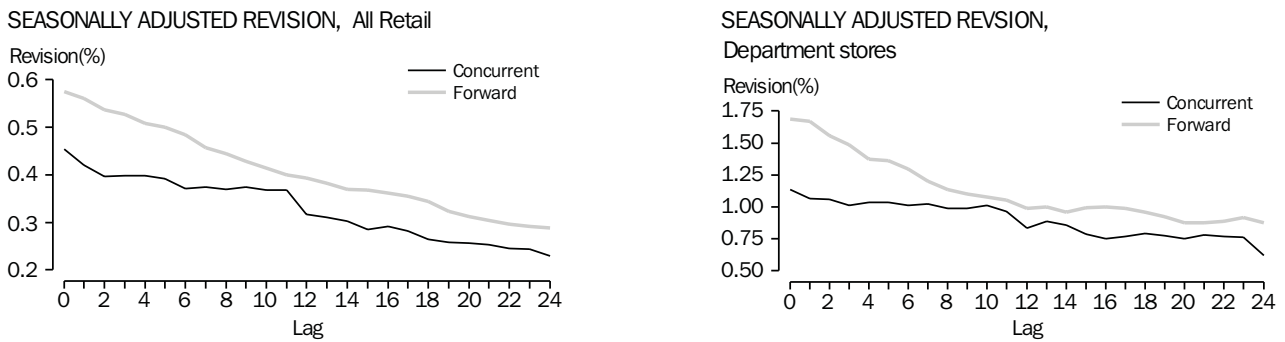
REVISION HISTORY, All Retail—December 1991



3.7 It can be seen that in December 1991, the initial concurrent estimate is underestimated whereas the initial forward factor estimate is even worse. For the forward factor method, the initial estimate was produced on the data up to December 1991 and the seasonal and trading factors estimated at the last annual reanalysis time in July 1990. The seasonally adjusted estimate for December 1991 was not revised until the next annual reanalysis time in July 1992, where a major revision took place. In July 1993, the forward estimates again jumped closer to the benchmark because this is when the next reanalysis was undertaken. The concurrent adjustment method tends to continuously improve the estimates, and these estimates converge to the benchmark quicker than the forward factor estimates.

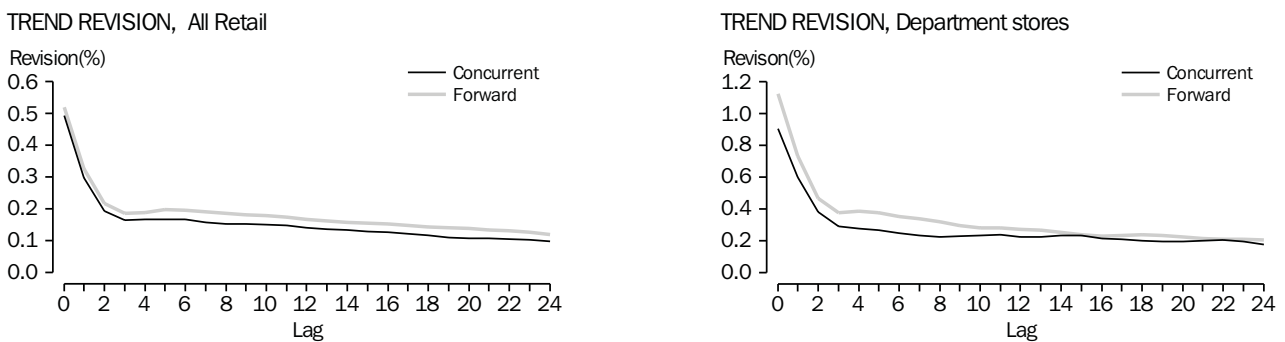
3.8 Whereas figure 3 shows the seasonally adjusted estimates for a particular point (December 1991), figure 4 shows the average of the absolute percent revisions against lagged seasonally adjusted estimates from both the concurrent and forward factor methods. The average of the absolute percent revisions against lagged estimates is a global measure of the revision size and convergence speed of the seasonally adjusted estimates. It is calculated using all estimates at a specific lag. For example, the lag zero (0) average of the absolute percent revision uses all initial estimates over the period under study. Lagged estimates are obtained by using available data at successive time points. For example, the lag zero December 1991 estimate is the initial estimate using data up to December 1991 and the lag 1 estimate is the second estimate of December 1991 using data up to January 1992. It is clear from figure 4 that on average, the concurrent seasonally adjusted estimates have less revision on each lagged estimate than the forward factor estimates and converge to the benchmark quicker.

Figure 4: Revision of seasonally adjusted series estimates



3.9 Similarly, figure 5 shows the average of absolute percent revision against lagged trend estimates from the concurrent and forward factor method. There is less difference between the trend revisions from the two methods. However, the concurrent method is always better than the annual forward method for trend estimates and it converges to the final trend value quicker.

Figure 5: Revision of trend estimates



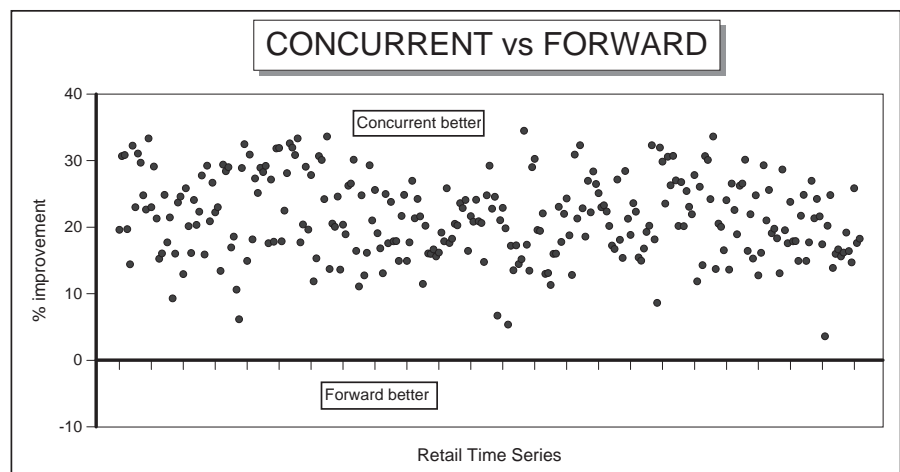
3.10 An important consideration in the research undertaken was the impact of outliers, or abnormal observations, on the seasonally adjusted and trend series. The research showed that when the original data displayed abnormal behaviour at a particular point in time, the concurrent method was not less accurate than the forward factor method. In the sense of a more accurate initial estimate and smaller revision size, the concurrent methodology will produce a better quality seasonally adjusted series when the outlier is indicating moving seasonality because the concurrent method uses all data available, including the outlier, to produce the seasonal factors. However, the concurrent method could produce distorted seasonally adjusted estimates when the outlier is truly abnormal and not indicating moving seasonality because the outlier may be given weight in the seasonal factor estimation process.

3.11 Outliers will affect ABS trend series under both concurrent and forward factor seasonal adjustment methods.

3.12 To summarise, criteria (see paragraph 3.1) were identified to assess if the quality of the seasonally adjusted and trend estimates were better under the concurrent adjustment method or the forward factor method. Figures 1 to 5 above demonstrate that for each criterion, concurrent adjustment performs better than forward factors for both the Australian Total Retail and Hospitality and services series and the Australian Department stores series.

3.13 Results of a simulation on over 200 Retail time series comparing the initial seasonally adjusted estimates to their 'final' seasonally adjusted estimate confirmed the gains shown in our investigations reported earlier. On average, the concurrent adjustment method produces seasonally adjusted estimates that are 21.5% closer to the final seasonally adjusted estimate. Only six series had improvements of less than 10%, the smallest improvement being 3.6% (Queensland Other recreational goods). Figure 6 shows the gains achieved from using the concurrent adjustment method for all Retail Trade series investigated.

Figure 6: Average revision of the initial seasonally adjusted estimates, compared for concurrent adjustment and forward factor method



## SECTION 4

### IMPLICATIONS OF INTRODUCING CONCURRENT ADJUSTMENT

#### REVISIONS POLICY

4.1 The previous Section confirmed the benefits of introducing concurrent adjustment for the Retail Trade series, however, this raises a number of issues that will impact on clients.

4.2 The current policy for Retail Trade is to introduce revisions to the original series only if the revisions are significant at a broad level. These revisions may be made to one or more previous months and may consequently result in some change to both the seasonally adjusted and trend estimates. No change is proposed to this policy for the original estimates.

4.3 Apart from changes resulting from amendments to the original estimates, the seasonally adjusted estimates are currently only amended once a year, in the July reference month following the annual seasonal reanalysis. Concurrent adjustment could result in the seasonally adjusted estimates being revised each month rather than only once a year.

4.4 Constant revision to the seasonally adjusted series is not desirable. ABS investigations found that with concurrent adjustment, significant revisions occurred for the previous one or two months in the case of the Retail series, as well as 12 months prior. One possibility is to limit the revisions to the seasonally adjusted series resulting from concurrent analysis to the previous two months and the same month one year ago e.g. if estimates for the August 2000 reference month were being released, the seasonally adjusted series will only be revised for June 2000, July 2000 and August 1999. The risk is, using this example, that the difference between May and June 2000 estimates could be accentuated because the May 2000 figure is not revised.

4.5 Trend series may be revised if there are changes in the seasonally adjusted series, either due to the seasonal adjustment process or due to changes in the original data. This is the same under both the forward factor and concurrent adjustment methods. Under the forward factor adjustment method, revisions to the trend series occur for up to six months as a result of the seasonal adjustment process. Revisions to the trend can occur after six months as a result of the concurrent seasonal adjustment process revising the seasonally adjusted series. Analysis has found that the largest revisions to the trend series under concurrent adjustment occur in the first two months after an estimate is first released and stabilise to small revisions after that time.

ANNUAL SEASONAL  
REANALYSIS

4.6 Even with concurrent adjustment it will still be necessary to undertake an annual reanalysis of the Retail Trade series. The objective of annual reanalysis for the concurrent method is to examine the changing seasonal and trading day factors and other factors, such as trend break, seasonal factor break and outliers at a detailed industry by state level. It is possible that some issues will only gradually emerge over a number of months and may not be as obvious when the focus is on concurrent adjustment for seasonal and trading day factors every month. The annual reanalysis will not normally result in significant changes as each data point in the 12 month back period will have already been revised at least twice as a result of concurrent adjustment (i.e. the initial estimate is revised when data for each of the next two months becomes available).

AVAILABILITY OF FORWARD  
FACTORS

4.7 Forward factors are currently available for purchase by ABS clients wishing to undertake their own seasonal adjustment and trend process. The concurrent adjustment process will also produce forward factors for the forthcoming year, but these will be revised each month after a concurrent adjustment takes place.

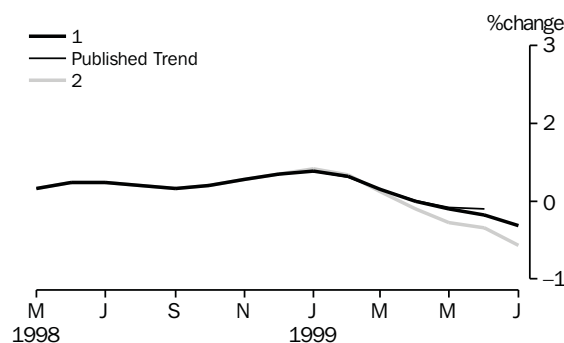
SENSITIVITY ANALYSIS

4.8 The Retail Trade publication currently includes on page 2 a sensitivity analysis that looks at how the trend would be revised if the seasonally adjusted series moves by a given amount. The analysis is intended to assist in understanding the trend series. It quantifies only those revisions which will result from the incorporation of new data in the trend estimation procedure. If there are other revisions affecting the trend data, the outcome will be different from that shown by the sensitivity analysis.

4.9 Figure 7 shows the 'What if?' sensitivity analysis for the June 1999 Retail Trade series. It displays how the trend estimates up to June 1999 will be affected if:

- 1 the July seasonally adjusted estimate of retail turnover is 1.0% higher than the June estimate; or
- 2 the July seasonally adjusted estimate of retail turnover is 1.0% lower than the June estimate.

Figure 7: WHAT IF?

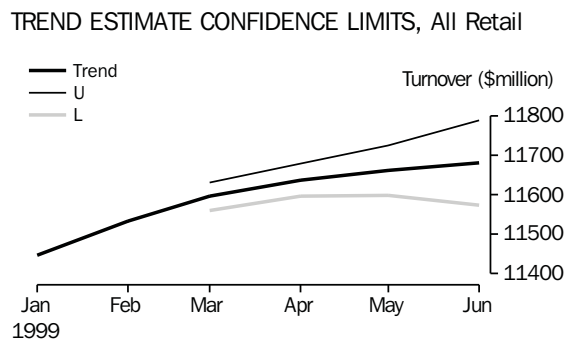




4.10 The analysis provides an indication of the potential reliability of the trend series. However, it assumes that no revisions will be made to the seasonally adjusted series which is not correct under the concurrent adjustment methodology.

4.11 It is still necessary to provide clients with an indication of the reliability of trend series and the quality of any turning points or inflexions the trend estimates are showing. It is proposed that revision confidence limits be generated for the last three trend estimates and graphically displayed on a subset of the trend series. These limits will indicate the expected range within which, based on past performance of the series, it is expected that trend estimates will fall around 90% of the time. The following (or similar) information will be provided each month:

Figure 8: Trend estimate confidence limits



4.12 The following table summarises the implications of replacing forward factors with concurrent adjustment.

Table 4.1: Comparison of forward factors and concurrent adjustment

Issue	Forward factors	Concurrent adjustment
Revisions policy for seasonally adjusted series (if no change in original series)	Revisions only made once a year.	Revisions may be made to at least the previous two months and same month last year each month. Annual revisions will still occur (but should not be significant).
Annual seasonal reanalysis	Uses latest data to revise factors and create forward factors. Used to examine series for outliers or unusual data.	Used to examine series for outliers or unusual data, changing seasonality and structural breaks.
Forward factors	The available factors are used in published estimates.	Forward factors will be available from an annual reanalysis, but will not be used in published estimates. Each month, they may become less indicative of the actual concurrent factor used in the published estimates.
Sensitivity analysis (as currently provided by 'What if' analysis)	Provides an indication of the potential reliability of the trend series but it assumes there will be no change to the seasonally adjusted series.	Not appropriate under the concurrent method. Empirical revision confidence limits is a feasible replacement.

## SECTION 5

### USE OF CONCURRENT ADJUSTMENT IN OTHER ABS SERIES

5.1 Many international time series experts have recommended the use of concurrent analysis over forward factors. Technological advances have made it possible to calculate seasonal factors and trading day factors relatively easily and with great speed. Timeliness is no longer a reason for relying on an annual reanalysis to produce seasonal and trading day factors for use over forthcoming months.

5.2 Most of the seasonal adjustments done by major statistical organisations such as the Bureau of the Census in the USA, Statistics Canada and the Office of National Statistics in the United Kingdom use concurrent adjustment.

5.3 Two ABS series, Sales of Wine and Brandy and Company Profits, have been using the concurrent adjustment method since late 1997 with little user reaction.

## SECTION 6

### SUMMARY

6.1 Concurrent seasonal adjustment methods are widely used by the international statistical community. Concurrent adjustment uses the latest available information to produce seasonally adjusted and trend estimates. They stabilise close to the final or benchmark series after only a few months and are more accurate than forward factor estimates. Outliers or abnormal observations can distort both concurrent and forward factor seasonally adjusted and trend estimates. On balance the ABS believes that the concurrent adjustment method will produce the best data for analysts to understand the behaviour of series with seasonal influences like the Retail data. The main argument against the use of concurrent seasonal adjustment is that the seasonally adjusted estimates will be revised monthly rather than annually.

6.2 In order to introduce concurrent adjustment the ABS must make appropriate changes to its systems and test these in parallel for some months. It is anticipated that concurrent adjustment will replace forward factors for the Retail Trade series from the April 2000 reference month onwards.

6.3 Initial investigations indicate that concurrent adjustment will prove more reliable than forward factors for most ABS seasonal series. However, the benefit of concurrent adjustment will be assessed in more detail on a series by series basis before any decision to change methodology is made. These assessments will be made progressively, probably as part of each series annual seasonal reanalysis.

6.4 Before the new methodology is introduced for the Retail Trade series, the ABS is interested in any comments from clients. In particular comments are sought on the issues of the revisions policy (paragraph 4.4), future use of forward factors (paragraph 4.7) and the revision confidence limits (paragraph 4.11).

6.5 Comments on any issues raised in this paper would be appreciated by 31 January 2000. Comments can be made:

in writing to:

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by e-mail [bernard.williams@abs.gov.au](mailto:bernard.williams@abs.gov.au)

The four digit codes used below are from the Australian and New Zealand Standard Industrial Classification (ANZSIC).

- Food retailing
  - Supermarket and Grocery Stores (ANZSIC 5110)
  - Takeaway Food Retailing (ANZSIC 5125)
  - Other Food Retailing comprising:
    - (a) Fresh meat, fish and poultry retailing (ANZSIC 5121);
    - (b) Fruit and vegetable retailing (ANZSIC 5122);
    - (c) Liquor retailing (ANZSIC 5123);
    - (d) Bread and cake retailing (ANZSIC 5124);
    - (e) Specialised food retailing n.e.c. (ANZSIC 5129).  
*Includes stores mainly engaged in retailing confectionery, smallgoods, health foods and tobacco.*
- Department stores
  - Department Stores (ANZSIC 5210)
- Clothing and soft good retailing
  - Clothing Retailing (ANZSIC 5221)
  - Other Clothing Related Retailing comprising:
    - (a) Footwear retailing (ANZSIC 5222);
    - (b) Fabrics and other soft good retailing (ANZSIC 5223).  
*Includes fabric, drapery, manchester, household textiles and curtain stores.*
- Household good retailing
  - Furniture and Floor covering stores comprising:
    - Furniture retailing (ANZSIC 5231)  
*Also includes retailers of blinds, mattresses and awnings.*
    - Floor covering retailing (ANZSIC 5232)  
*Excludes ceramic tiles retailing.*
  - Domestic Hardware and Houseware Retailing (ANZSIC 5233)  
*Includes retailers of household utensils, china, garden tools, glassware, lawn mowers and do-it-yourself materials. Excludes builders' hardware stores selling mainly to trade customers.*
  - Appliances and Recorded Music Retailing comprising:
    - (a) Domestic appliance retailing (ANZSIC 5234);
    - (b) Recorded music retailing (ANZSIC 5235).
- Recreational good retailing
  - Newspaper, Book and Stationery Retailing (ANZSIC 5243)  
*Also includes retailers of artists' supplies, greeting cards, magazines and religious goods.*
  - Other Recreational Good Retailing comprising:
    - (a) Sport and camping equipment retailing (ANZSIC 5241);  
*Excludes units mainly engaged in retailing sports clothing or footwear.*
    - (b) Toys and game retailing (ANZSIC 5242);
    - (c) Photographic equipment retailing (ANZSIC 5244).

- Other household good retailing
  - Pharmaceutical, Cosmetic and Toiletry Retailing (ANZSIC 5251)
  - Other Retailing comprising:
    - (a) Antique and used good retailing (ANZSIC 5252);
    - (b) Garden supplies retailing (ANZSIC 5253);
      - Excludes retailing of cut flowers or display foliage.*
    - (c) Flower retailing (ANZSIC 5254);
    - (d) Watch and jewellery retailing (ANZSIC 5255);
    - (e) Retailing n.e.c. (ANZSIC 5259).
      - Includes pet shops and retailers mainly selling leather goods, souvenirs, musical instruments and art works.*
- Hospitality and service industries
  - Hotels and Licensed Clubs comprising:
    - (a) Pubs, taverns and bars (ANZSIC 5720);
    - (b) Clubs (hospitality) (ANZSIC 5740);
  - Cafes and Restaurants (ANZSIC 5730).
  - Selected Services comprising:
    - (a) Video hire outlets (ANZSIC 9511);
    - (b) Hairdressing and beauty salons (ANZSIC 9526).

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