

Information Paper



**Seasonal Adjustment of Australia's
Monthly Balance of Payments
Statistics**

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NEW ISSUE

SEASONAL ADJUSTMENT OF AUSTRALIA'S MONTHLY BALANCE OF PAYMENTS STATISTICS

IAN CASTLES
Australian Statistician

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PHONE INQUIRIES	• for more information about these changes to balance of payments statistics – contact Joseph Dalglish on Canberra (062) 52 5540. • for information about <i>ABS seasonal adjustment and trend estimation</i> – contact the Supervisor, Time Series Analysis Section, on Canberra (062) 52 6103. • for copies of this and other ABS publications – contact Information Services on Canberra (062) 52 6627, 52 5402, 52 6007 or any ABS State Office.
MAIL INQUIRIES	• write to – Information Services, Australian Bureau of Statistics, PO Box 10, Belconnen ACT 2616 or any ABS State Office.
ELECTRONIC SERVICES	• on VIATEL – key *656#. • on AUSSTATS – phone (062)526017. • on TELESTATS – phone(062)525404

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INTRODUCTION

The purpose of this paper is to provide information about the additional monthly seasonally adjusted and trend estimates of the current account which were introduced into monthly balance of payments statistics on 18 July 1989. The paper will provide:

- an overview of the seasonal adjustment technique used by the ABS;
- an explanation of direct and indirect seasonal adjustment methods;
- an outline of the methods of adjustment of monthly balance of payments series;
- comment on the reliability of monthly seasonal adjustment and the relationship with quarterly seasonal adjustment; and
- a discussion of the reliability of trend estimates.

2. For many years, quarterly seasonally adjusted estimates have been published for the whole balance of payments current account at a detailed level and monthly seasonally adjusted and trend estimates have been published for merchandise trade (total exports, total imports and balance).

3. In response to requests from users of balance of payments statistics, and to improve the analytic content of the monthly balance of payments publication, the ABS has investigated the feasibility of providing a satisfactory seasonal adjustment of the remaining monthly current account series. Investigations were also undertaken to assess the reliability of the first published values of the last two or three trend estimates of total merchandise exports and total merchandise imports.

4. As a result of these investigations, the ABS has increased the number of monthly seasonally adjusted and trend series published in *Balance of Payments, Australia* (Catalogue No. 5301.0), commencing from the June 1989 issue released on 18 July 1989. The new series published are:

- seasonally adjusted estimates for –
 - services credits
 - services debits
 - net services
 - balance on goods and services
 - income credits
 - income debits
 - net income
 - unrequited transfers credits
 - unrequited transfers debits
 - net unrequited transfers
 - balance on current account
- trend estimates for –
 - balance on goods and services
 - balance on current account

5. With the introduction of the new series, the latest three estimates in each trend series were suppressed as the ABS considers that they do not provide a sufficiently reliable indication of the trend behaviour at turning points.

6. Also, in response to user requests, the feasibility of producing a monthly series of seasonally adjusted endogenous imports was investigated. It has not been possible to derive a reliable monthly adjustment of these imports. Consequently, the ABS has decided not to publish monthly seasonally adjusted endogenous imports estimates.

7. The following parts of this information paper summarise the results of each of the above investigations.

SEASONAL ADJUSTMENT TECHNIQUE

8. Seasonal adjustment is a complex and extensive subject, made no simpler by the fact that there are a number of different seasonal adjustment methods. The ABS method is based on X-11, the nearest thing to a worldwide standard seasonal adjustment method.

9. Data contained in balance of payments publications are generally presented in the form of time series. A particular observation in a time series (O) is considered to be the net result of four notional influences, each interacting with the other and having its own distinguishing character. These four influences are:

- the trend (T) which reflects the fundamental and long term direction of the series,
- the seasonal pattern (S) which reflects the systematically recurring rise (fall) of the months,
- the 'trading-day' pattern (D) which reflects how the series systematically varies with changes in the composition of the months,
- the residual/irregular influences (R) which reflect the short-term erratic factors in the series.

10. The X-11 procedure used for many monthly ABS time series generally involves a multiplicative model where the seasonality is proportional to the trend and the original series is the product of the above four influences:

$$O = T \times S \times D \times R$$

11. The X-11 procedure used by the ABS is too complex to describe in this overview paper; however, the following paragraph provides a brief description of the principal methods employed.

12. The procedure uses various moving averages and

linear regression techniques to iteratively obtain the time series components mentioned above. At each estimation stage the adverse effects of "extreme" movements are reduced so as to minimise distortions to these estimates. Final estimates of the seasonal and trading-day influences are combined and divided into the original data to produce the seasonally adjusted series. A 13-term Henderson-weighted moving average is then applied to the published seasonally adjusted series to obtain trend estimates.

13. The factors used to obtain seasonally adjusted estimates for inclusion in the monthly balance of payments publication are the combined factors referred to above; they represent the net effects of seasonal and trading-day factors.

14. The X-11 procedure used for quarterly balance of payments series follows the same basic steps; however, because it is dealing with four observations each year rather than twelve observations, it uses different moving averages for the successive estimates of the time series components. The X-11 procedure also does not attempt to identify any trading day effects in quarterly data as such effects are likely to be insignificant. Consequently, the seasonal adjustment factors provided for quarterly balance of payments data do not incorporate estimates of trading-day influences.

15. There is an important consequence of the statistical differences between the monthly and quarterly X-11 procedures: if the same series were analysed using the X-11 procedure on both monthly and quarterly timespans, the sum of the three seasonally adjusted months would not necessarily equal the seasonally adjusted quarter for the same period.

DIRECT AND INDIRECT SEASONAL ADJUSTMENT

16. In balance of payments publications the seasonally adjusted data for total merchandise exports and imports are obtained in two ways. In the monthly publication (5301.0), total exports and total imports are seasonally adjusted directly; that is, the analysis of the seasonality in the series is undertaken at the aggregate level.

17. In the quarterly publication, Balance of Payments, Australia (Catalogue No. 5302.0), total seasonally adjusted exports and imports are obtained indirectly by seasonally adjusting the commodity group components and then aggregating them.

18. The choice between direct and indirect seasonal adjustment of a time series is generally made on both qualitative and quantitative grounds.

19. The qualitative grounds generally reflect the reasons why seasonal adjustment is attempted. Where the main focus of interest is in the detailed components, direct adjustment of these components and indirect adjustment of higher level aggregates would be regarded as preferable. If the main interest is in the behaviour of an aggregate series, then direct adjustment of that aggregate may be all that is necessary.

20. The ABS uses many quantitative measures to determine whether direct or indirect seasonal adjustment should be employed on a time series. In general these measures describe the seasonal properties of a time series in order to assess its reliability in seasonally adjusted form. A reliable seasonal adjustment is one where the seasonal factors are stable and not significantly affected by the volatility of the series with regard to its trend and irregular components.

21. This is illustrated in the two graphs on pages 4 and 5 which plot the historical seasonal and residual/irregular influences for each calendar month for total merchandise imports and endogenous imports.

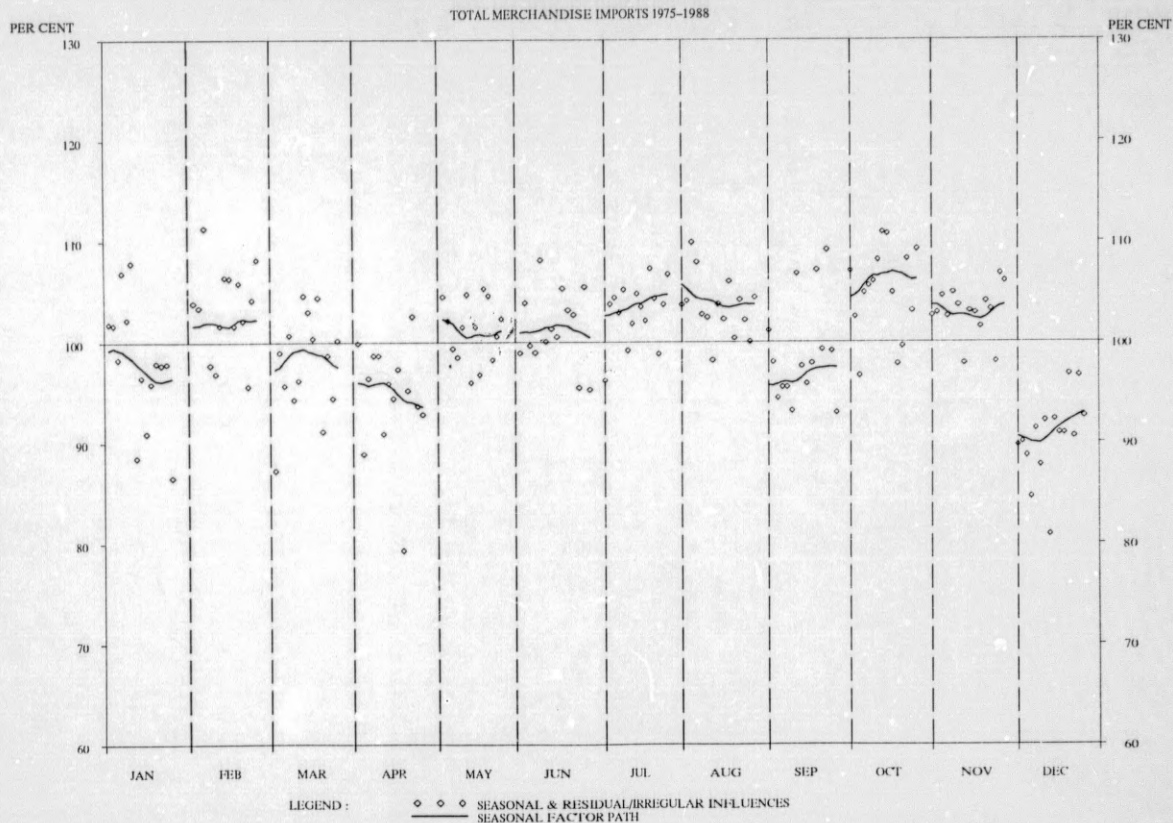
22. The changing strength of the seasonal component of monthly merchandise imports is illustrated in Graph 1. The solid lines represent the seasonal factor path. A seasonally high month will be plotted above the neutral line, while seasonally low months appear below the neutral line. The magnitude of the seasonality is represented by the vertical distance from the neutral line: moving seasonality is evidenced by changes in this vertical displacement from year to year for a particular month. Thus, the month of February is the seasonally most stable month, while December, the seasonally

lowest month, shows a movement towards less pronounced multiplicative seasonality. The scattered points represent the combined seasonal and residual/irregular influences relative to the underlying trend and trading day components. The residual/irregular component alone is represented by the vertical displacement of the scatter points from the seasonal factor path; hence the extent of the scatter represents the significance of this volatile component in relation to the identified seasonality. The closer these points are to the seasonal factor path, the less significant is the effect of the irregulars on the estimation of the seasonal factors. For example, the month of May is the least irregular month, while January is one of the most irregular months.

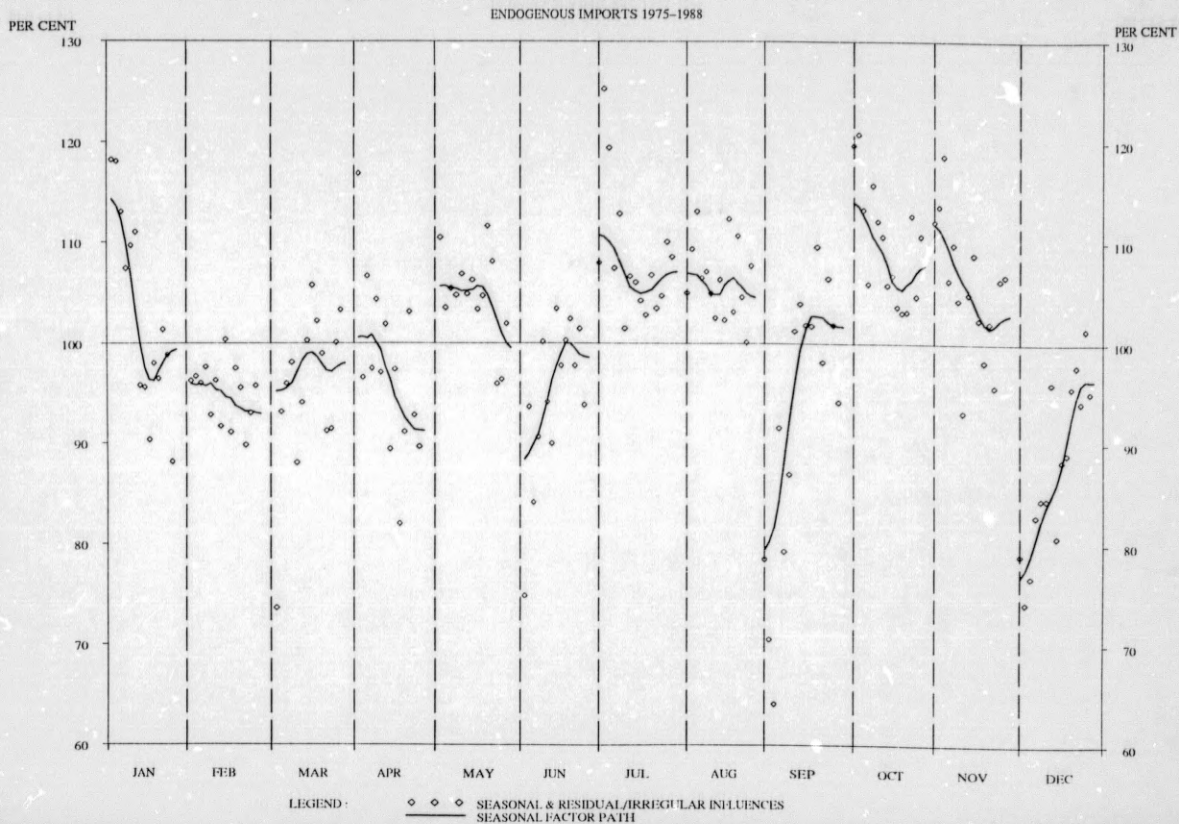
23. Graph 2 plots similar information for endogenous imports. It is immediately apparent from a comparison of Graphs 1 and 2 that the endogenous imports series contains rapidly changing seasonality and much stronger residual/irregular influences than the total imports series. The widespread seasonal and residual/irregular influences cause the estimated seasonal factors to move rapidly, in some cases such as September from a seasonally very low month to a seasonally high month. The moving seasonality in all months is pronounced, indicating relative unreliability of the seasonal factors compared to those of the total imports series. The distribution of the seasonal influences differs between the two series: for example, in May, June and September the endogenous imports series is showing seasonal lows whilst the total merchandise imports series shows seasonal highs. This difference in seasonal characteristics is attributable to the seasonality of exogenous imports. Although not shown here, the exogenous imports series exhibits even more relative irregularity than endogenous imports and some unstable seasonality.

24. Graph 2 clearly shows that the seasonal adjustment of endogenous imports is inferior to that of total merchandise imports. Furthermore, the endogenous imports seasonal adjustment factors are unreliable, as are the factors for exogenous imports. Consequently, if indirect seasonal adjustment of the total imports series were to be obtained from the sum of the seasonally adjusted exogenous imports and seasonally adjusted endogenous imports series, the resulting adjustment would be far less reliable than the direct adjustment of total imports. As a consequence, the ABS has decided not to publish a seasonally adjusted endogenous imports series.

GRAPH 1. MONTHLY COMPARISON OF SEASONAL & RESIDUAL/IRREGULAR INFLUENCES AND SEASONAL FACTOR PATH



GRAPH 2. MONTHLY COMPARISON OF SEASONAL & RESIDUAL/IRREGULAR INFLUENCES AND SEASONAL FACTOR PATH



METHODS OF ADJUSTMENT OF MONTHLY BALANCE OF PAYMENTS SERIES

25. The investigations undertaken by the ABS into the seasonal adjustment of the monthly balance of payments data were designed to optimise the amount of detail provided for analysis while maximising the reliability of the adjustment and minimising the difference between aggregated monthly and quarterly results.

26. Based on the outcome of the investigations, the ABS has decided to use direct seasonal adjustment for services credits, services debits, unrequited transfers credits and unrequited transfers debits; this method provides a much more reliable adjustment of these monthly series. For income credits and debits the ABS has decided to use indirect adjustment because this method not only results in a reliable adjustment but also minimises the differences between aggregated monthly and quarterly results.

27. For the directly adjusted components, monthly seasonal adjustment factors for 1989 are provided in the Appendix. The seasonal factors applied to the various components of the income credits and debits series are not provided because these component series are not shown separately in published monthly balance of payments statistics. Approximate factors for seasonal adjustment of income credits and income debits series for 1989 may be obtained by using implicit factors which are

derived from historical data by dividing the seasonally adjusted series into the original series.

28. There are only a few income series for which monthly data are collected. For most income series, data are collected quarterly (or annually) and monthly estimates are made by evenly distributing the quarterly (or annual) data across the months. The seasonally adjusted income series are derived by aggregating the three categories below:

- (i) series which are based on monthly collections of data and which are directly adjusted;
- (ii) series which are based on an even distribution of quarterly data and which are adjusted by the quarterly seasonal factor (this is the best estimate of the seasonality of such series); and
- (iii) all remaining series, which are unadjusted. For these series, which may be based on monthly, quarterly or annual data collections, no reliable seasonal adjustment can be provided.

29. The table below shows which income series have been adjusted as described in categories (i) and (ii) above.

Income credits	Income debits
	Category (i)
Labour and other income	Official investment income
-Earnings abroad	-Interest on general government borrowing domiciled abroad
	Labour and other income
	-Labour income
	Category (ii)
Non-official direct investment income	Official investment income
-Dividends	-Interest on general government borrowing domiciled in Australia
Non-official Portfolio and other investment income	Non-official direct investment income
-Dividends	-Dividends
	-Interest
	Non-official portfolio and other investment income
	-Dividends
	-Public sector interest
	-Private sector interest

30. As mentioned in Paragraph 15, monthly and quarterly seasonal adjustment methods are mathematically different and should not be expected to produce the same result when three months' data are aggregated to the quarterly level for any given series. This equality would only hold if the quarterly adjustment were obtained by temporally aggregating monthly adjusted data.

31. This procedure is not followed for balance of payments time series for two reasons. First, temporal aggregation at the level of detail presently provided in monthly seasonally adjusted data would result in a significant loss of detail in quarterly seasonally adjusted data. Second, a reliable seasonal adjustment generally can not be produced for monthly data at the level of detail presently provided in quarterly seasonally adjusted data. This is because the monthly commodity group series for merchandise trade are generally too volatile to obtain a

reliable monthly adjustment, and a significant proportion of the monthly services, income and unrequited transfers series are even distributions of quarterly data for which no intra-quarter seasonality exists. As a result, it is only possible to obtain a reliable seasonal adjustment of these component series on a quarterly basis.

32. In summary, the ABS considers that seasonally adjusted quarterly data should continue to be published using present procedures because these provide more reliable seasonally adjusted data and in greater detail than can be obtained using monthly seasonal adjustment procedures. It is, therefore, inevitable that some differences will exist between the sum of three monthly seasonally adjusted observations and the corresponding quarterly seasonally adjusted observations.

RELIABILITY OF MONTHLY SEASONALLY ADJUSTED SERIES

33. An annual reanalysis of all seasonally adjusted series is carried out in January each year to incorporate the most recent year's data in the derivation of seasonal factors. As a result, some revisions will always be made to seasonal factors for at least the last two or three years, although the impact of such revisions on published series may often be marginal.

34. With the exception of unrequited transfers debits, the new seasonally adjusted series are generally more reliable than the seasonally adjusted merchandise exports series that has been published for many years. Although the unrequited transfers debits series is not quite as reliable as the merchandise exports series, it has less impact on the balance on current account than most of the other series and it would not be possible to produce a seasonally adjusted monthly balance on current account without it. The following table ranks the directly adjusted series in relation to their relative reliability:

Rank	Series
1	Services credits
2	Services debits
3	Merchandise imports
4	Unrequited transfers Credits
5	Merchandise exports
6	Unrequited transfers debits

35. Note that the lower-ranked series are not considered unreliable, but their seasonal factors are more likely to be

subject to greater revision than the seasonal factors of higher-ranked series. It is not possible to rank the indirectly adjusted income credits and income debits series in relation to the directly adjusted series; however, the directly adjusted labour income credits component would rank above unrequited transfers credits and the labour income debits component would rank above merchandise exports.

36. Overall, it is expected that revisions to seasonal factors for the services, income and unrequited transfers series will have less impact on the seasonally adjusted current account balance than revisions to the seasonal factors for merchandise exports and imports.

37. As explained earlier, the sum of three months seasonally adjusted data will not necessarily equal the quarterly seasonally adjusted result. A comparison was made between the seasonally adjusted monthly balance on current account and the seasonally adjusted quarterly balance on current account for the ten years from 1978 to 1987. Based on these data, the sum of three months seasonally adjusted estimates can be expected to provide a reasonable approximation of the seasonally adjusted quarterly balance, in most cases falling within the 95 per cent to 105 per cent range around the quarterly result. The seasonally adjusted monthly estimates can also be expected to correctly predict the direction of movement in the quarterly balance on 7 out of 8 occasions.

38. For the component series, similar confidence can be placed in the temporal aggregation of the seasonally adjusted monthly estimates and similar expectations may be held about their direction of movement when compared to the quarterly results.

RELIABILITY OF MONTHLY TREND ESTIMATES

39. Investigations have been undertaken into the reliability of the trend estimates for monthly merchandise exports and imports.

40. The reliability of the trend estimates was judged in terms of how well the initial trend estimates correctly identified the turning points in the series.

41. The published trend estimates are obtained by applying a 13-term Henderson-weighted moving average (13Hma) to the seasonally adjusted series. With the exception of the last six estimates, each estimate in the trend series is compiled by applying symmetric weights to the six previous and six following seasonally adjusted observations. For the last six estimates, the absence of data at the forward end of the series requires the use of different weights to approximate the 13Hma weights. Therefore, the trend estimate for the latest observation in

a series has to be derived, using a shorter moving average, to approximate the 13Hma. As a result, that estimate has more chance of being revised when subsequent data become available because it lacks six of the thirteen observations which will eventually be used to calculate it. This is generally referred to as the "end point" problem. It creates revisions to the latest trend estimates independently from any revisions to the seasonally adjusted data.

42. Over the period from July 1985 to June 1988 there were two turning points in the exports series and four turning points in the imports series. These turning points are given in the table below. The table also identifies whether each turning point was a maximum or minimum point and shows how long it took before the turning point was correctly identified in the successive trend estimate iterations.

 Month of turning point

 Month in which identified

Merchandise exports

May 1986 (minimum)

September 1986 (5th iteration)

February 1988 (maximum)

June 1988 (4th iteration)

Merchandise imports

May 1986 (minimum)

September 1986 (5th iteration)

November 1986 (maximum)

February 1987 (3rd iteration)

March 1987 (minimum)

June 1987 (3rd iteration)

February 1988 (maximum)

June 1988 (4th iteration)

43. It is clear from the above table that the trend estimates published in the past have not provided evidence of turning points in the series until at least three months after the turning point has occurred. In the case of the imports turning point in February 1988, the third iteration released in the May 1988 monthly publication indicated a turning point had occurred in April 1988. This was revised to February 1988 in the following month's publication.

44. In the light of these findings, further investigations

were undertaken to determine whether the trend estimates for the latest observations in a series could be presented in a way that gave some indication of their reliability. Both the initial and revised trend estimates were analysed for each month for the ten years from January 1979 to December 1988. The purpose of the analysis was to specify a revisions range around the initial trend estimate within which it would be reasonable to expect the final trend estimate to fall in 95 cases out of 100.

45. The analysis was based on identifying the variation in

the residual/irregular component of the seasonally adjusted series. In the multiplicative X-11 adjustment procedure, the residual/irregular factor tends to behave as a random variable, with an expected long term value of 1. It is possible to calculate the standard deviation of the residual/irregular factor for each calendar month in an adjusted series. If it is assumed that the irregulars are normally distributed, then 95 per cent of the irregulars could be expected to fall within the range 1 ± 2 standard deviations.

46. For a given trend estimate for the latest observation in a series, a seasonally adjusted value was calculated for the next month such that the current month's trend estimate would remain unchanged. Applying the assumption of normally distributed irregulars, an upper and lower limit for the next month's seasonally adjusted value was calculated based on ± 2 standard deviations of the irregulars. Trend estimates were then recalculated using these upper and lower limits, which produced a possible revisions range for the trend estimates for the

current month.

47. It was found that the revised trend estimates fell within the derived revisions range in approximately 67 per cent of the months tested. This rose to approximately 81 per cent where the revisions range was widened to ± 3 standard deviations of the irregulars.

48. Taking these results together with the known delays in identifying turning points, the ABS considers that the latest three trend estimates are not sufficiently reliable to publish without an indication of the likely range of revision. Presently it is not possible to provide such an indication.

49. Accordingly, the latest three trend estimates for balance of payments series have been suppressed from the June 1989 issue of the monthly balance of payments publication (5301.0). However the ABS will continue to look at ways of presenting additional information which might permit the reinstatement of these trend estimates.

SUMMARY

50. Monthly seasonally adjusted and trend estimates covering the whole balance of payments current account were published for the first time in the June 1989 issue of the monthly balance of payments publication (5301.0) on 18 July 1989.

51. In the investigations leading up to this development, the possibility of seasonally adjusting monthly endogenous imports was also considered. It was found that the adjusted series would be unreliable compared to the present seasonally adjusted total merchandise imports series. Consequently, the ABS has decided against publishing seasonally adjusted endogenous imports data.

52. The ABS uses the X-11 procedure to derive monthly seasonal adjustment factors. This procedure has been used in the past and will continue to be used to directly adjust merchandise exports and imports for inclusion in the monthly balance of payments publication. It is also being used now to directly adjust services credits, services debits, unrequited transfers credits and unrequited transfers debits. Income credits and debits are adjusted indirectly by aggregation of component series.

53. Most of the new seasonally adjusted series are expected to be more reliable than the seasonally adjusted merchandise exports series that has been published for many years. The exception is unrequited transfers debits. However, it is not expected that revisions to the seasonal factors for this series, or for any of the new seasonally adjusted series, will have a greater impact on the

seasonally adjusted balance on current account than revisions to the seasonal factors for merchandise exports or imports.

54. The monthly seasonally adjusted balance on current account estimates, when aggregated by quarters, can be expected to provide a reasonable approximation of the quarterly seasonally adjusted balance on current account estimates. A comparison of both sets of estimates across a ten year span from 1978 to 1987, found that the aggregated monthly data fell, in most cases, within the 95 per cent to 105 per cent range around the quarterly data. The monthly data can also be expected to correctly predict the direction of movement in the quarterly series on 7 out of 8 occasions.

55. Trend estimates for the latest three months are being suppressed in the monthly balance of payments publication from the June 1989 issue. Investigations into the reliability of the "end point" in the trend series published in the past for merchandise exports and imports indicated that some three or four months usually elapse before a turning point is identified and that the latest estimates may be quite misleading until the extra three or four months data are incorporated into the calculations. However, the ABS plans to further investigate ways of presenting additional information about the likely range of revisions to trend estimates for the latest observations in a series. This may eventually enable the latest trend estimates to be reinstated in the monthly publication.

APPENDIX: 1989 MONTHLY SEASONAL ADJUSTMENT FACTORS (a)

Seasonally adjusted merchandise exports, merchandise imports, services credits, services debits, unrequited transfers credits and unrequited transfers debits have been, or are expected to be, obtained during 1989 by dividing the unadjusted estimates for each month by the factors given below.

Month	<u>Merchandise</u>		<u>Services</u>		<u>Unrequited Transfers</u>	
	Exports	Imports	Credits	Debits	Credits	Debits
Jan	0.94985	0.99269	1.06680	1.04973	1.04527	1.18538
Feb	0.93623	0.94160	1.01862	0.87639	0.97160	1.09665
Mar	1.01335	1.01118	1.05300	0.97455	0.98987	0.92851
Apr	0.96375	0.88464	0.96068	0.94565	0.99747	0.99428
May	1.06701	1.05415	0.98976	0.99901	1.00711	1.06506
Jun	1.05253	1.00494	0.92445	1.02397	1.01592	1.45701
Jul	0.95541	1.02555	0.93091	1.02842	0.98513	0.82133
Aug	1.00821	1.09735	0.98594	1.05425	0.99164	0.84558
Sep	0.97656	0.93136	0.90732	1.06051	0.93868	0.89670
Oct	0.97529	1.09278	0.99839	1.05569	1.02950	0.90452
Nov	1.03415	1.04282	1.07069	0.96790	1.01044	0.85276
Dec	1.03567	0.91107	1.07460	0.96044	0.99851	0.95344

(a) Combined seasonal and trading day factors.

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