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SEASONAL ADJUSTMENT OF ECONOMIC TIME SERIES

Singapore Department of Statistics
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SEASONAL ADJUSTMENT OF ECONOMIC TIME SERIES

I   Introduction

1.   Economic time series generally have a recurring seasonal pattern that obscures their underlying behaviour and trends. Seasonal adjustment is the process of estimating and removing the varying seasonal effects from a time series so as to show more clearly its underlying trend and short-term movements.   The seasonally adjusted time series facilitate a better assessment of their recent movements, including the timely identification of turning points.

2.   This paper provides an overview of seasonal adjustment and presents the methodology adopted by the Singapore Department of Statistics (DOS). The seasonal and other characteristics of some important economic time series are presented and discussed.

II   Time Series Characteristics

(A)   Decomposition of Time Series

3.   A time series can generally be decomposed into three basic components:

a) a *trend-cycle* (TC) component, which is the combined long-term and growth cycle movement of the time series;

b) a *seasonal* (S) component, which is the systematic variations of the time series; and

c) an *irregular* (I) component, which comprises the random fluctuations of short-term movements of the time series.

4.   The seasonal component can be further broken into *seasonality* and *calendar effects*.

a) Seasonality is the intra-year periodic variation that repeats in the same month or quarter every year. For example, visitor arrivals tend to be higher in August and December during the peak travel season.

b) Calendar effects refer to the variation due to the composition of the calendar. There are two main calendar effects:

i) *Moving-holiday* effect occurs when a holiday or festive period falls in different months or quarters in different years, arising mainly

because of different calendar systems. Moving-holidays in Singapore include Chinese New Year[1] and Hari Raya Puasa[2].

    ii) *Trading-day* effect arises because the compositions of the months vary over the years. For example, January 2005 comprises 10 weekends (Saturdays & Sundays) and 21 weekdays, while January 2007 comprises 8 weekends and 23 weekdays. As most Singaporeans prefer to shop on weekends, retail sales in Singapore can be expected to be higher in months with more weekends giving rise to a trading-day effect.

5.   Figure 1 illustrates the decomposition of a time series. The *seasonally adjusted* (SA) time series (i.e. with the seasonal effects removed) comprises the *trend-cycle* (long-term trend) and *irregular* (short-term movement) components.

(B)   Structural Breaks

6.   In addition to seasonal variations, economic time series may also be subjected to structural changes such as *seasonal breaks* and *trend breaks*.

    a) A *seasonal break* occurs when the usual seasonal activity level of a particular month is changed in subsequent years. An example is the shift in the commencement of the academic year for Junior Colleges (from January to March) and Polytechnics (from July to April).

    b) A *trend break* occurs when the trend in a data series is lowered or raised for a prolonged period, either temporarily or permanently. Trend breaks may arise from changes in government policies, administrative policies or the reclassification of the components that make up a data series. For example, the reduction of the cess rate from 4% to 1% from April 1994 resulted in a trend break for the monthly time series on food and beverage cess collected (Chart 1).

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[1] Chinese New Year (CNY), which follows the Chinese Lunar Calendar, always falls between 21 January and 21 February of the Gregorian calendar every year. CNY does not cause any moving-holiday effect in quarterly time series, since it always falls in the first quarter of the Gregorian calendar.
[2] Hari Raya Puasa (HR), which follows the Islamic Lunar Calendar, can fall in any month of the Gregorian calendar, and can potentially affect both monthly and quarterly time series.

Figure 1
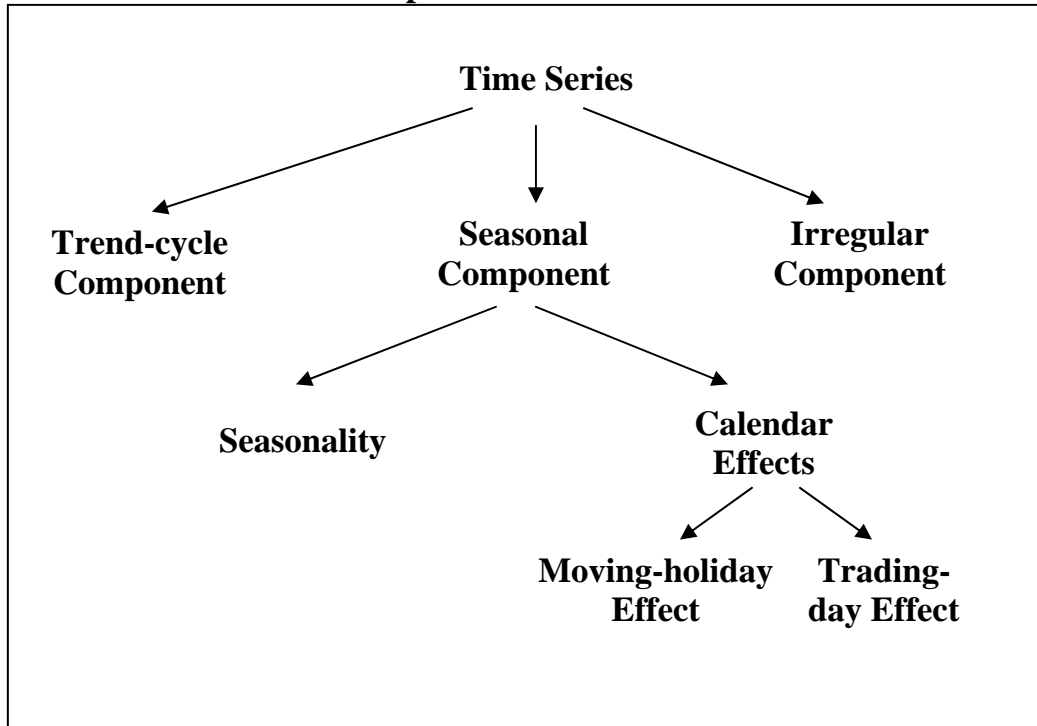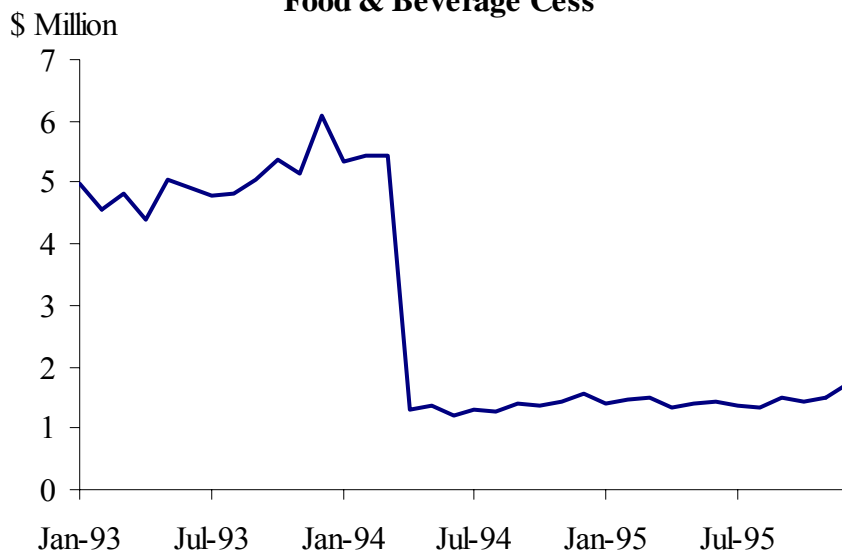**Decomposition of Time Series**

Chart 1
Food & Beverage Cess

7. A good way to identify seasonal and trend breaks is through the use of time plots, as illustrated in Chart 1. It is important to identify and pre-adjust for structural breaks before carrying out a seasonal adjustment, as the presence of structural breaks can give rise to severe distortions in the estimation of the seasonal effects.

(C) Decomposition Models

8. Let X_t, TC_t, S_t and I_t denote respectively the original non-seasonally adjusted (NSA) series, the trend-cycle component, the seasonal component and the irregular component in period t. The decomposition of X_t can be carried out using either a *multiplicative* model or an *additive* model.

   a) In a multiplicative model, the original time series X_t can be expressed as $X_t = TC_t * S_t * I_t$. Under this model, the absolute variation due to the seasonal component increases as the underlying trend rises. Empirical studies show that this is typical of most macroeconomic time series. However, a multiplicative model cannot be applied to series with negative or zero values.

   b) In an additive model, the original time series X_t can be expressed as $X_t = TC_t + S_t + I_t$. Under this model, the absolute variation due to the seasonal component is independent of the level of the underlying trend.
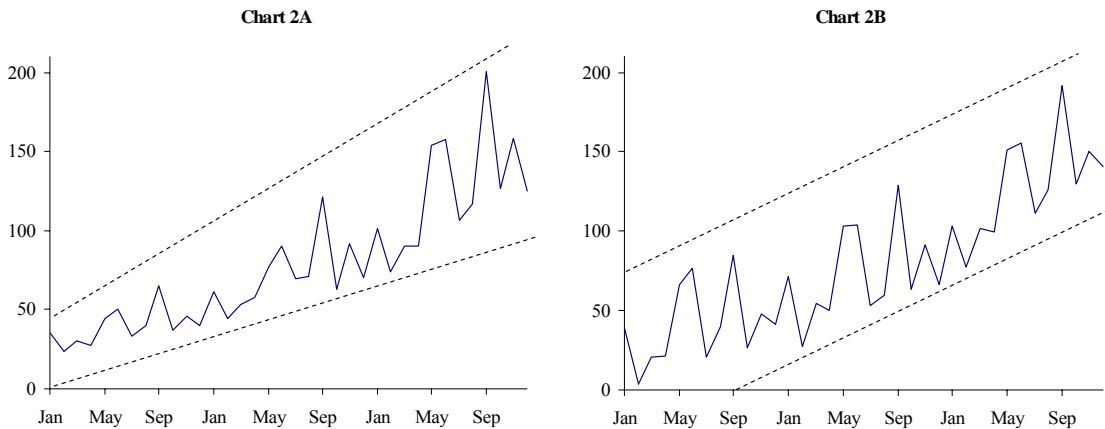
Chart 2A   Chart 2B

9. The series in Chart 2A shows increasing seasonal variation as the trend rises, while the series in Chart 2B shows a constant seasonal variation as the trend rises. The multiplicative model is more appropriate for the former series, while the additive model is more appropriate for the latter series. DOS generally adopts the multiplicative model, although the additive model is applied to certain time series.

III   Seasonal Adjustment Methodologies

10. DOS has since 2004 used the X12-ARIMA procedure in carrying out seasonal adjustments, an improvement from the X11 procedure previously used. The X12-ARIMA procedure, which was developed by the US Census

Bureau[3], is widely used among national statistical offices (e.g. Office of National Statistics UK, Statistics New Zealand and Statistics Denmark) and international agencies (e.g. OECD and The World Bank).

11. X12-ARIMA is an enhanced version of X11 methodology, with modifications to address limitations in the modelling and diagnostic capabilities of X11. New features have also been added to improve the seasonal adjustment procedure. For example, a major improvement is the incorporation of a regARIMA[4] modelling capability that enable users to pre-adjust for several calendar effects such as trading-day and leap year effects. Additional statistical diagnostics for assessing the appropriateness of the model selected are also included.

12. Similar to X11, the X12-ARIMA procedure carries out the seasonal adjustment iteratively, alternately estimating the trend-cycle and seasonal components using various moving-average filters, before deriving the final estimates of the seasonally adjusted series.

(A)   Concurrent versus Forward Factors

13. The seasonally adjusted value of a new data point can be arrived at using either *concurrent* or *forward* seasonal factors. For concurrent adjustment to be carried out, the entire data series would have to be re-analysed and adjusted for seasonal effects as and when a new data point becomes available. While it makes use of all data points, in particular, the most recent data points, it has the disadvantage of resulting revisions to the entire historical data series each time a new data point is added.

14. Forward adjustment, on the other hand, requires only the availability of forward factors derived from the seasonal analysis of the data series up to the most recently completed year. For forward adjustment to be carried out, seasonal analysis needs to be carried out only annually, i.e. once the data for the last period of the year (i.e. December or 4th Quarter) becomes available. The seasonal factors for the 12 months or 4 quarters ahead are estimated using the X12-ARIMA procedure. When a new data point becomes available during the year, the SA value of that data point is then obtained by dividing it by the appropriate forward factor (or subtracting from it the appropriate forward factor if the underlying model is additive).

15. As explained above, concurrent adjustment makes use of all available data points in the analysis, and often results in smaller but more frequent data revisions. Forward adjustment has the advantage that revisions to historical data series during the year are not necessary although the revisions arising from the annual seasonal analysis could be larger than those resulting from concurrent adjustment.

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[3] For a detailed description of X12-ARIMA procedure, refer to http://www.census.gov
[4] Regression models for time series with non-stationary ARIMA residuals.

16.   Like most national statistical offices, DOS uses both the concurrent and forward adjustment approaches. The appropriate approach to adopt in a particular case depends on the nature of the time series and its underlying components. While, as noted above, concurrent adjustment is intuitively appealing in its use of all available data points for seasonal adjustment, its performance depends on the stability of the seasonal component[5], the volatility of the irregular component[6], as well as whether there are frequent and substantial revisions to the NSA series[7].

17.   In general, DOS adopts forward adjustment for monthly time series so as to avoid potential distortions caused by fluctuations in the irregular component and revisions to past years' seasonally adjusted series. Concurrent adjustment is generally adopted for quarterly data series. However, as frequent revisions to the historical data series for closely monitored economic statistics or indicators such as quarterly Gross Domestic Product (GDP) estimates are undesirable, their seasonal adjustment is carried out using forward adjustment factors.

(B)   Direct versus Indirect Adjustment of Aggregate Series

18.   Aggregate series are series that are derived from their components, usually by direct summation or weighted average. Examples include *Total Tourist Arrivals* which is the sum of tourist arrivals from different countries, and *Overall Consumer Price Index* (CPI) which is a weighted average of the consumer price indices of its components. Seasonal adjustments of aggregate series can be derived *directly* or *indirectly*. In direct seasonal adjustment, the NSA aggregate series is analyzed and seasonally adjusted directly. In indirect seasonal adjustment, the NSA components are seasonally adjusted and the SA aggregate series is derived from the SA components by summation (or weighted average). Both approaches result in different SA estimates for the aggregate series. The difference can be significant in some cases.

19.   There are advantages and weaknesses to either approach of seasonally adjusting aggregate series. In some cases, indirect adjustment is preferred to direct adjustment method. Indirect adjustment preserves additivity, i.e. the SA aggregate is the sum of SA components. For example, the indirect adjustment of overall GDP ensures that the SA GDP is the sum of its SA components. In addition, empirical studies suggest that when the components have different seasonal patterns, indirect adjustment is preferable as the presence of one highly irregular non-seasonal component can mask the seasonality of the other components. As both these reasons

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[5] A stable seasonal component suggests that little additional information can be gained from concurrent adjustment.
[6] A highly volatile irregular component may provide false information when using concurrent adjustment.
[7] Substantial revisions to the NSA series imply that information gathered from the latest data points in concurrent adjustment may be false or incomplete.

are applicable to the quarterly GDP estimates, the seasonal adjustment of aggregate GDP is carried out indirectly, i.e. aggregate SA GDP is obtained as the sum of its SA components.

20. Notwithstanding the above, direct seasonal adjustment does have its advantages, and so is generally applied where the preservation of additivity is less important. Indeed, when the component series are highly irregular but have similar seasonal patterns[8], aggregating often cancels out the noise which improves the performance of carrying out the seasonal adjustment directly at the aggregate level. One example for which direct adjustment of the aggregate is carried out is the CPI.

21. When an aggregate series may be arrived at by summing up different components, direct adjustment is preferred as indirect adjustment using one set of components will yield results different from that using another set of components. This can be illustrated using tourist arrivals which can be viewed as the sum of arrivals from different countries, or alternatively as the sum of arrivals via different modes (i.e. land, sea and air). While the unadjusted total is the same regardless of how it is arrived at, the same is not true of the SA total as the sum of the SA series of visitor arrivals from different countries will not be the same as the sum of the SA series of visitor arrivals by modes of travel.

22. In view of the above, DOS generally seasonally adjusts aggregate time series directly except in cases where the preservation of additivity is important (e.g. GDP).

(C) Estimation of Moving-Holiday Effects

23. Moving holiday effects are estimated by linear regression. During each iteration in the X12-ARIMA program, the tentative irregular component is regressed on the holiday regressors. The X12-ARIMA program developed by the US Census Bureau, which have been incorporated into most statistical software programs, have predefined holiday regressor for Easter holiday[9]. However, holiday regressors for Chinese New Year (CNY) and Hari Raya Puasa (HR), which are more relevant in Singapore's context, are generally not included in these programs.

24. DOS estimates and adjusts for CNY and HR effects by incorporating user-defined regressors for these effects in the X12-ARIMA procedure. Typically, the economy experiences a surge in activity level in the period *before* the holiday, a decline *during* the holiday period itself, and rises back

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[8] Very often, component series do have similar seasonal patterns. For example, tourist arrivals from most countries peak at around the same period (usually August and December).

[9] Easter holiday falls in March or April every year. While retail sales typically experience a sudden surge during the days leading to Easter in many western nations, the phenomenon is not observed in most Asian countries, including Singapore. As such, it is not necessary to adjust for Easter holiday when carrying out seasonal adjustment for the major economic time series.

some time *after* the holiday. As such, three user-defined regressors are used to estimate the before, during and after effects of moving holidays. The technical details are provided in Appendix I.

25.   Chart 3 shows Singapore's retail sales index (RSI) for food & beverage for the years 1995 – 2005. The series shows a significant CNY effect, with sales rising sharply a week or two before CNY as most Chinese families stock up on food and beverages, and Chinese goodies during the pre-holiday period. Most Chinese-owned retailers are also closed during the CNY holidays, sometimes for as long as a week, causing RSI to decline during the holiday period. Table 1 compares the RSI for food & beverage in January and February for the years 1995 – 2005. For years where CNY falls in mid-February (1996, 1999 and 2002), the increase in sales in early February more than offsets the decline experienced during the holiday period, resulting in typically high RSI in February. The January RSI for these years are generally lower, as they are unaffected by CNY. For years where CNY falls in late January or early February (1995, 1998 and 2003), sales is greatly boosted in January and depressed in February, resulting in stark contrasts in January and February's RSI values. The seasonally adjusted RSI is shown in Chart 4, together with the original unadjusted series.

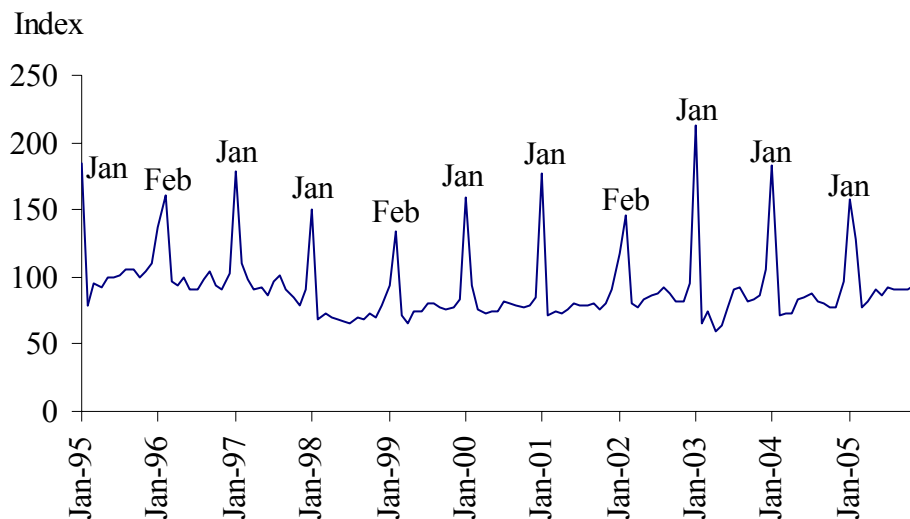**Chart 3**
Retail Sales Index -- Food & Beverage

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Table 1
Retail Sales Index – Food & Beverage

Year	January	February	CNY Date
1995	183.8	79.3	31 Jan
1996	137.5	161.0	19 Feb
1997	179.0	110.8	07 Feb
1998	149.8	68.5	28 Jan
1999	94.5	134.0	16 Feb
2000	159.8	93.6	05 Feb
2001	177.5	71.7	24 Jan
2002	118.2	145.6	12 Feb
2003	213.1	65.9	01 Feb
2004	183.4	70.9	22 Jan
2005	157.7	127.4	09 Feb

Chart 4
Retail Sales Index -- Food & Beverage

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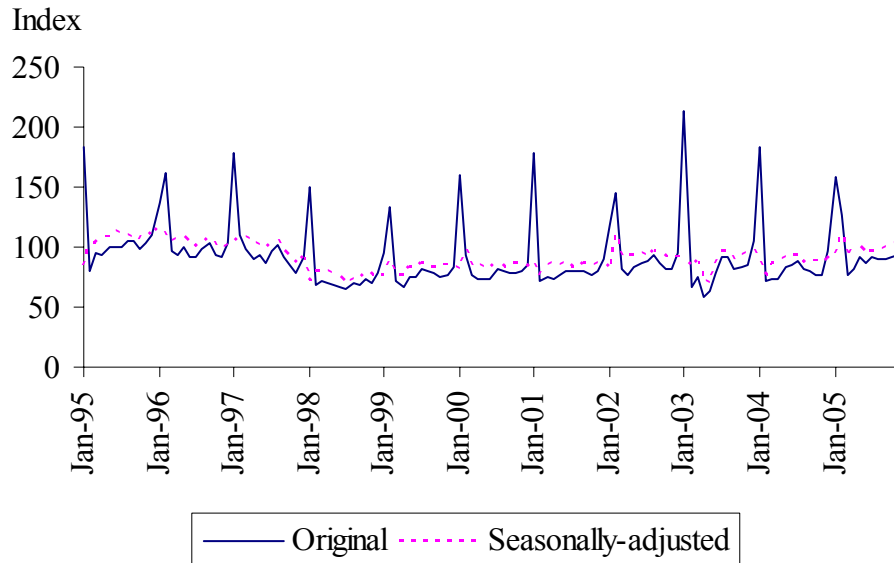
IV   Uses of Seasonally Adjusted Data

26.   Growth rates can be computed either year-on-year or period-on-period (i.e. month-on-month or quarter-on-quarter). The year-on-year growth rate is computed as the percentage change with respect to the corresponding month (or quarter) in the preceding year, while the period-on-period growth rate is computed as the percentage change with respect to the preceding period[10].

27.   With the original non-seasonally adjusted data, it is often difficult to discern the underlying trend. Using the retail sales index for food & beverage as an example (see Chart 3), it is unclear whether an increase in sales in a particular January was due solely to seasonal effect. An easy way to remove the seasonal effect is to use year-on-year growth rates. However, such growth rates are slow in detecting trend changes, and remain affected by calendar effects.

28.   Period-on-period growth rates computed using seasonally adjusted series provide a more meaningful comparison over a shorter time frame, and have the advantage of being able to detect trend changes much earlier. Chart 5a shows the number of civil aircraft landings in Singapore for the period 2002 – 2004. The number of civil aircraft landings nose-dived in April 2003 when Singapore was badly hit by the Severe Acute Respiratory Syndrome (SARS) outbreak. With fear and uncertainty of the then-unknown disease lingering, demand for air travel in the region declined and many airlines drastically cut down the number of flights to Singapore. Flights to Singapore started to resume gradually after Singapore was officially declared SARS free by the World Health Organization on 31 May 2003. Charts 5b and 5c show respectively the year-on-year and month-on-month growth rates. Both charts are able to capture the sudden shock to the aviation industry immediately in April 2003. However, the month-on-month growth rate based on the seasonally adjusted series was able to detect a reversal to the declining trend in June 2003, while the year-on-year growth rate could only do so nearly a year later in April 2004.

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[10] Mathematically, for a monthly time series, $\Delta_t = (X_t - X_{t-12}) / X_{t-12} * 100\%$ represents the year-on-year growth rate while $\Delta_t = (X_t - X_{t-1}) / X_{t-1} * 100\%$ represents the month-on-month growth rate for period t.
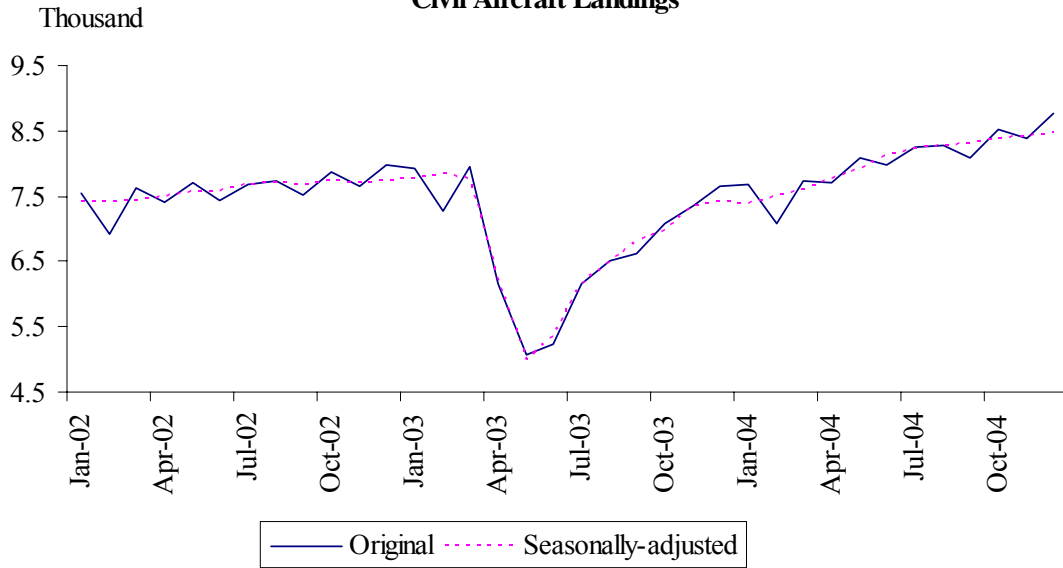
Chart 5a
Civil Aircraft Landings

Thousand

Original ——— Seasonally-adjusted ·····

Chart 5b
Year-on-year Growth Rate (NSA)
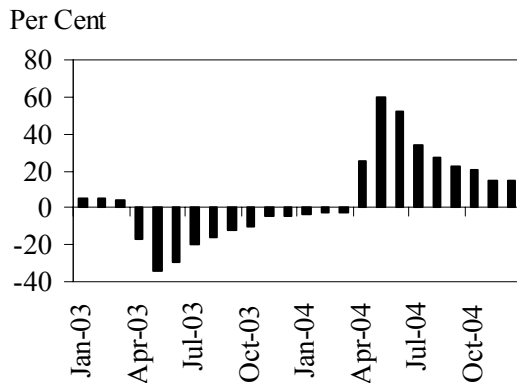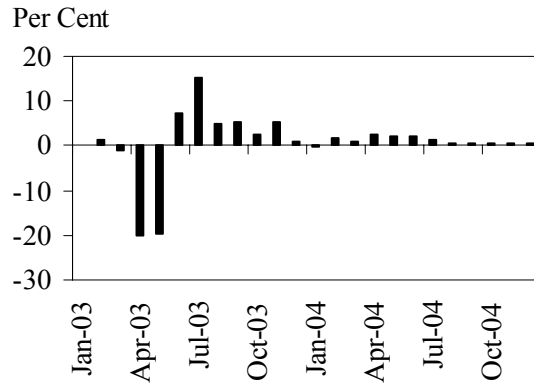
Per Cent

Chart 5c
Month-on-month Growth Rate (SA)

Per Cent

29.   As the period-on-period growth rates are typically small and of a different order of magnitude from annual rates, these growth rates are often *annualized*[11] (by assuming the same growth rate to persist for the rest of the year) to facilitate comparison with year-on-year growth rates.

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[11] The annualized period-on-period growth rate for period *t* is $[(X_t / X_{t-1})^p - 1] * 100\%$, where $p = 12$ or 4 for monthly or quarterly data respectively.

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V   Seasonal Adjustment of Key Economic Indicators

30.   The seasonal characteristics of some key economic indicators are presented in Appendix II, which illustrates the application of both concurrent and forward adjustment as well as the use of direct and indirect adjustment for aggregate time series.

VI   Conclusion

31.   Seasonal adjustment is an essential procedure to provide a clearer picture of the time series by removing seasonality effects, leaving behind underlying trend and random fluctuations. They supplement the non seasonally-adjusted data in providing another dimension for economic analysis of the underlying trend.

32.   Seasonally adjusted time series of the major economic statistics or indicators are available in the department's Singstat Time Series (STS) Online. Enquiry on seasonal adjustment and feedback can be sent to Info@singstat.gov.sg

Singapore Department of Statistics
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APPENDIX

Moving Holiday Regressors

1. Predefined regressors for Easter, Labour Day and Thanksgiving holidays are available in the X12-ARIMA program developed by the US Census Bureau. The holidays are assumed to affect the economy for w days, and the effect is assumed to be the same for each of the w days[1]. Let w_t denote the number of the w days that fall in month t. Then the regressor, which measures the proportion of the w days that fall in month t, can be defined as

$$H(w,t) = \frac{w_t}{w}.$$

2. For example, if $w=8$ and since Easter falls between 22 March and 25 April each year, the regressor is only nonzero for March and April. During each iteration in the X12-ARIMA algorithm, the estimated tentative irregular is regressed on the holiday regressor to estimate the moving holiday effect.

3. Moving holidays that have significant impact on economic activity in Singapore include Chinese New Year and Hari Raya Puasa. Typically, economic activity rises before the holiday, declines during the holiday period, before returning to normal some time after the holiday. Assuming that the w_b days before the holiday, w_d days starting from the holiday, and w_a days subsequently are affected similarly within the same interval but differently across the three intervals, then 3 different regressors $H_b(w_b, t)$, $H_d(w_d, t)$ and $H_a(w_a, t)$ are used to test for the *before*, *during* and *after* effects of the moving holiday. Only statistically significant regressors (usually 1 or 2) will be used to adjust for the moving holiday effect.

4. The choice of the parameters w_b, w_d and w_a depend on the series, but are kept to the range 5 to 20 for w_b and w_a, and 3 to 7 for w_d.

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[1] The effect can range from 1 to 25 days before Labour/Easter Day until the day before the holiday. For Thanksgiving, the effect ranges from 17 days before to 8 days after Thanksgiving through 24 December. The number of w days is determined by empirical testing. For more info, please refer to Soukup, R. J. , and Findley D. F. (2000), "Detection and Modeling for Moving Holidays" at http://www.census.gov

Seasonal Characteristics of Key Economic Indicators

A) Output-based Gross Domestic Product (GDP) Estimates at 2000 Market Prices

To preserve additivity, aggregate or overall GDP is seasonally adjusted indirectly by summing up the seasonally adjusted component series. The component series in the current year are seasonally adjusted using forward factors, to avoid making frequent revisions to the historical data series. At the end of the year, the entire series will be re-analysed and revised.

Table 2 shows the seasonal characteristics of the component series. It is observed that seasonality is not present in four of the component series. These non-seasonal component series are not seasonally adjusted, i.e. the SA series are the same as the NSA series.

Table 2
Seasonal Characteristics for Components of GDP

Industries	Seasonality Present?
Manufacturing	Yes
Construction	Yes
Utilities	Yes
Other Goods Industries	Yes
Wholesale & Retail Trade	Yes
Hotels & Restaurants	Yes
Transport & Communications	Yes
Financial Services	No
Business Services	No
Other Services Industries	Yes
Ownership of Dwellings	No
FISIM*	No
Taxes on Products	Yes

* FISIM: Financial Intermediation Services Indirectly Measured

The NSA data shows that GDP is seasonally lower in the first quarter of each year since many firms close during the Chinese New Year holidays, resulting in lower output during this period. GDP is seasonally higher in the fourth quarter when production is stepped up to meet year end festive demand. Seasonal adjustment removes these quarterly seasonal variations or seasonal effects (Chart 6).

Chart 6
Gross Domestic Product at 2000 Market Prices

$ Billion
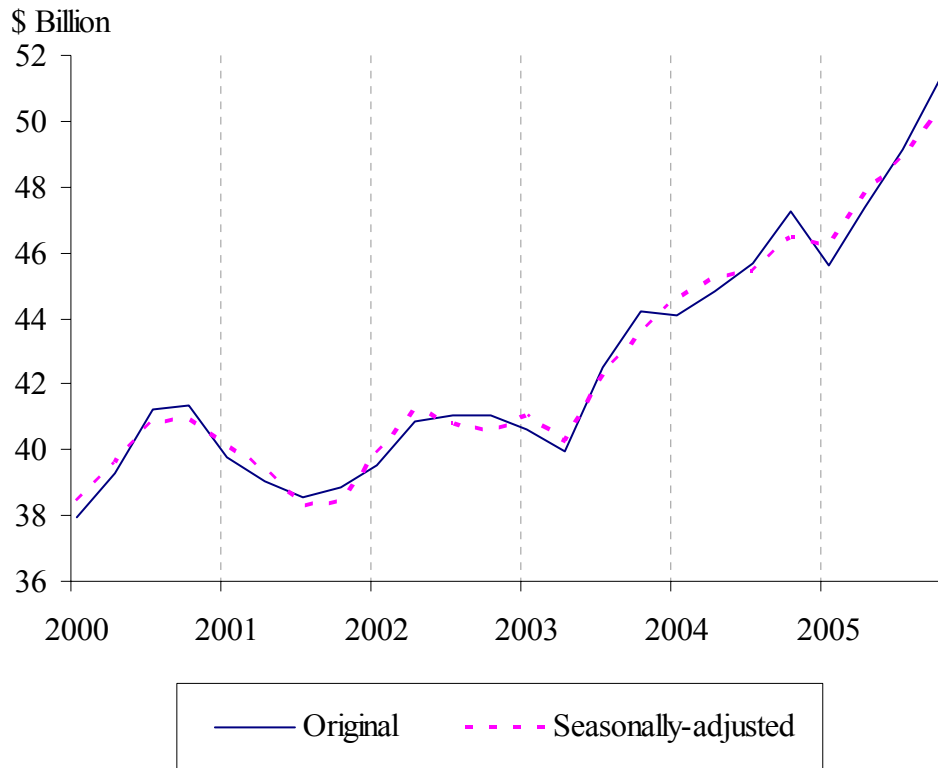
B)   Expenditure on Gross Domestic Product (GDE) at 2000 Market Prices

GDP can also be measured using the expenditure approach, as the sum of private consumption expenditure, government consumption expenditure, gross fixed capital formation, change in inventories and the net exports of goods and services. However, due to different, diverse and independent data sources used in their compilation, output- and expenditure-based GDP can differ. As output-based GDP is the main approach, a *statistical discrepancy* term is introduced in the expenditure-based GDP. Mathematically,

GDP (Production)   = GDP (Expenditure)
                     = Private Consumption Expenditure
                     + Government Consumption Expenditure
                     + Gross Fixed Capital Formation
                     + Change in Inventories
                     + Net Exports of Goods & Services
   + Statistical Discrepancy.

Hence, seasonally adjusted expenditure-based GDP is set to equal the seasonally adjusted production-based GDP.

Private consumption expenditure, government consumption expenditure, gross fixed capital formation and the net exports of goods & services are, however, analyzed independently and found to exhibit seasonal variations. Chart 7 shows the original and seasonally adjusted series of some of the components.

Table 3
Seasonal Characteristics for Components of GDP

Industries	Seasonality Present?
Private Consumption Expenditure	Yes
Government Consumption Expenditure	Yes
Gross Fixed Capital Formation	Yes
Exports of Goods & Services	Yes
Imports of Goods & Services	Yes

Chart 7
Expenditure on GDP at 2000 Market Prices

Private Consumption Expenditure

$ Billion

Government Consumption Expenditure

$ Billion

### Gross Fixed Capital Formation

$ Billion
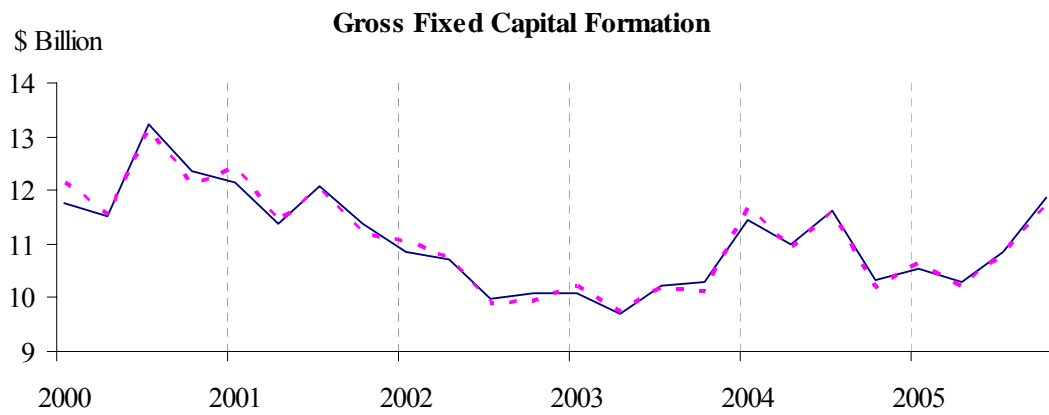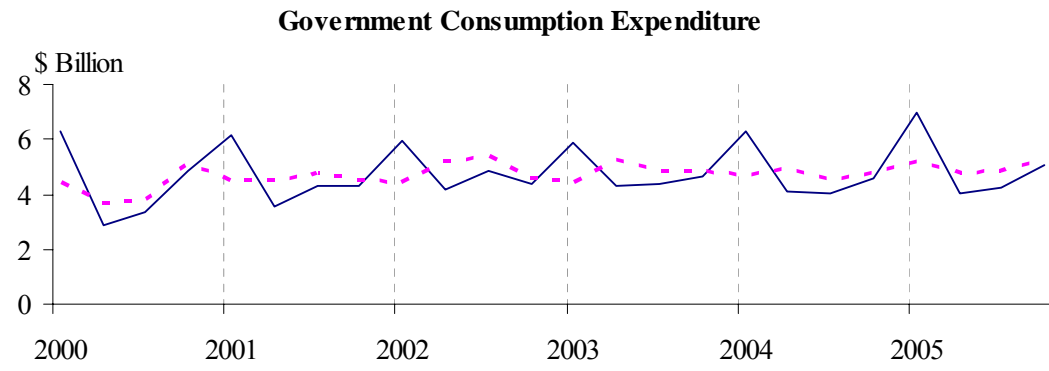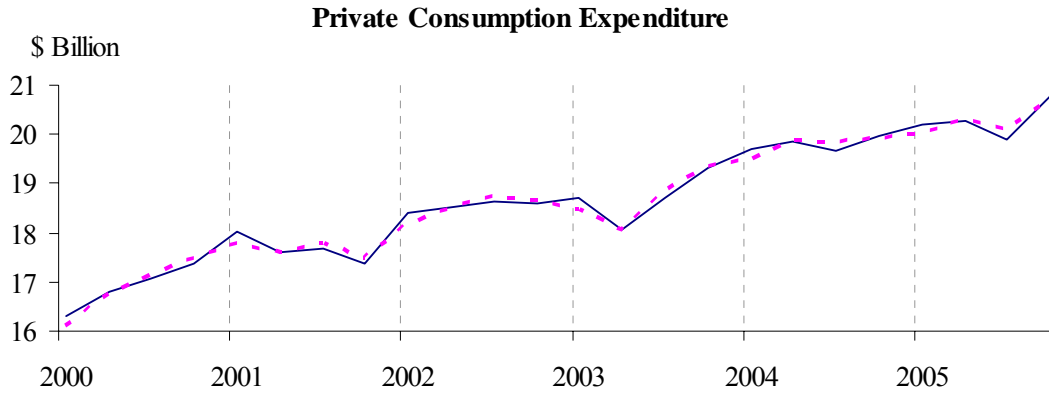
C)   **Business Expectations for the Manufacturing Sector**

The Survey of Business Expectations of Manufacturing Sector (BEM) is conducted by the Economic Development Board on a quarterly basis.

The business expectation six months ahead is used as a short-term indicator of business sentiments. The respondents are asked to provide their opinions on whether general business activities in their industries six months ahead will improve, remain the same or deteriorate compared to current activities. Their confidence level is quantified by the net balance, which is the percentage which responded "improve" minus the percentage which responded "deteriorate".

In view of the presence of negative values in the net balance, an additive model is used to seasonally adjust the series. Business expectations tend to be high in the first quarter, during which production is seasonally lower due to Chinese New Year holidays, as output is expected to improve in the later half of the year. On the other hand, expectations tend to be less positive during the later half of the year, as production is expected to slow down after the turn of the year.

Chart 8
**Business Expectations of the Manufacturing Sector**
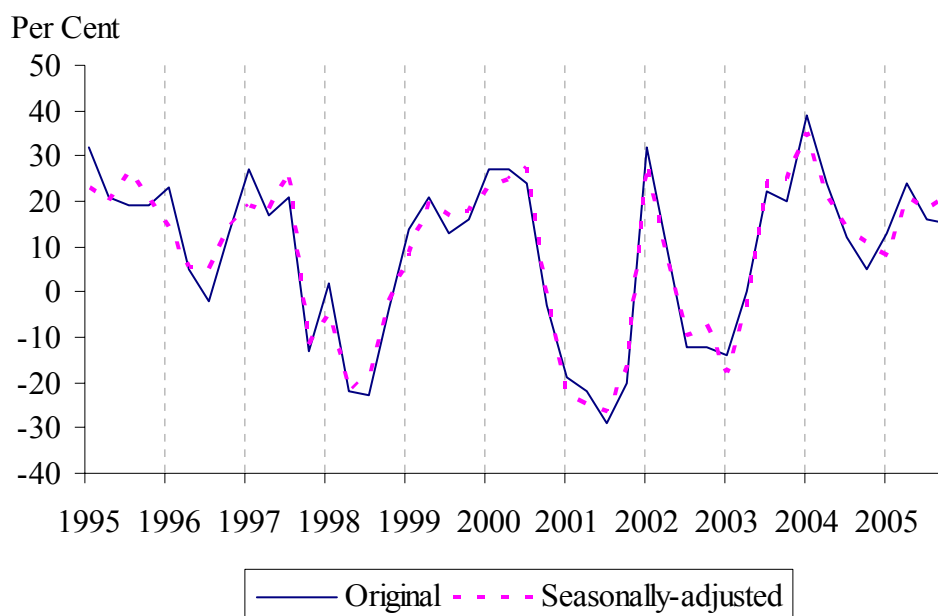
D)   Business Expectations for the Services Sector

Similarly, DOS conducts the Business Expectations Survey for the services sector on a quarterly basis.

Industries covered include wholesale and retail trade, hotels and catering, transport and communications, financial services, real estate and business services. Seasonality is present in the general business outlook for the next 6 months of wholesale and retail trade, hotels and catering, as well as transport and communications. These industries tend to see a surge in activities during the first and fourth quarters. As such, firms' business expectations made during these 2 quarters for the coming 6 months are generally weaker in anticipation of declining activity levels ahead. The seasonally adjusted series on business expectations remove such seasonal variations to better reveal the underlying trends.

Direct seasonal adjustment is carried out for the business expectations of the overall services sector as measured by the net balance of firms (Chart 9).

Chart 9
General Business Outlook for the Next 6 Months
(Net Balance* of Firms)
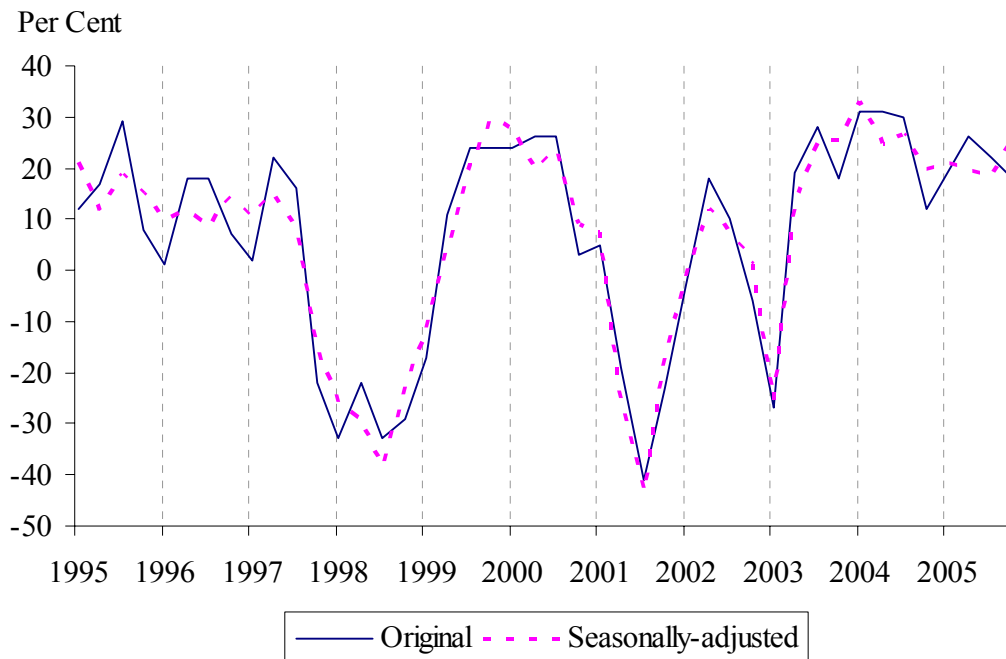
*A plus sign in the net balance indicates net upward trend and a minus sign denotes a net downward trend.

E)   Index of Industrial Production (2003=100)

The Index of Industrial Production (IIP), which measures manufacturing output, is compiled by the Economic Development Board (EDB) on a monthly basis. Table 4 shows the types of seasonal effect observed and adjusted for in each of the six manufacturing clusters.

Table 4
Seasonal Effects at Cluster Level

Description	S	CNY	TD
Overall IIP	✓	✓	✓
Electronics	✓	✓	✓
Chemicals	✓	✓	
Biomedical Manufacturing			
Precision Engineering	✓	✓	✓
Transport Engineering	✓		
General Manufacturing Industries	✓	✓	✓

S: Seasonality   CNY: Chinese New Year   TD: Trading Day

The overall IIP exhibits strong and stable seasonal patterns. Troughs are frequently observed in January or February, as most firms are closed during the Chinese New Year holidays, resulting in low output. Trading day effect is also evident in the series. The overall IIP is directly seasonally adjusted to remove such seasonal variations (Chart 10).

Chart 10
Overall IIP (2003=100)
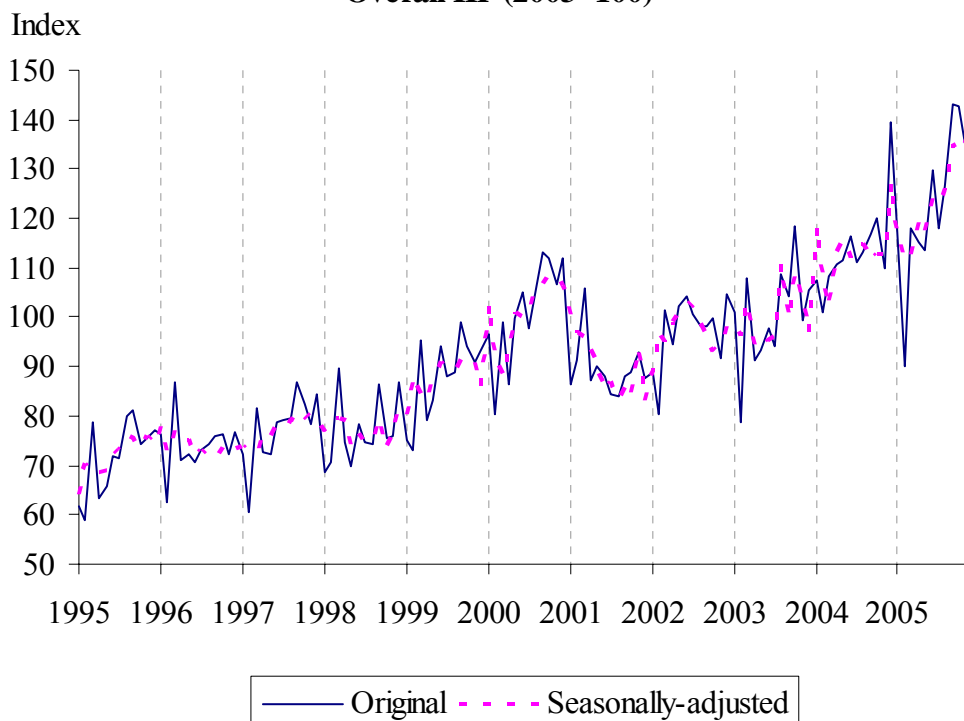
F)   Total Trade at Current Prices

Singapore's external trade statistics at current prices and at 2000 prices are compiled on a monthly basis by International Enterprise Singapore (IE Singapore).

The main trade statistics include total trade, total imports, total exports, total domestic exports and total re-exports. These statistics are further broken into oil and non-oil components. Besides total trade, non-oil domestic exports (NODX) is also widely used to gauge the performance of the economy. As there are several ways of aggregating trade data (e.g. by commodity or by country), and the seasonal patterns of the component series are highly similar, direct seasonal adjustments are applied to aggregate trade data series.

The seasonal effects observed in various trade statistics are summarized in Table 5. Trading day and moving holiday effects are evident in the main trade statistics, which display consistent dips during the holiday periods when trading activities are generally low.

Table 5
Seasonal Effects of Selected Trade Statistics (at Current Price)

| Description	S	CNY	HR	TD
Total Trade	✓	✓	✓	✓
Total Imports	✓	✓		✓
Total Exports	✓	✓	✓	✓
Total Domestic Exports	✓	✓		✓
Total Re-exports	✓	✓	✓	✓
Non-Oil Domestic Exports (NODX)	✓	✓		✓

S: Seasonality   CNY: Chinese New Year   HR: Hari Raya Puasa   TD: Trading Day

Chart 11 shows Singapore's total trade and non-oil domestic exports at current prices for the period 2000 – 2005. As trade data prior to 2003 does not include Singapore's trade with Indonesia, prior adjustments have to be made to account for the trend break between Dec 2002 and Jan 2003 before carrying out the seasonal adjustment. This will ensure that the seasonal factors are not distorted by the trend break.

Chart 11
Total Trade at Current Prices*

$ Billion

Non-Oil Domestic Exports at Current Prices*

$ Billion

Original - - - Seasonally-adjusted
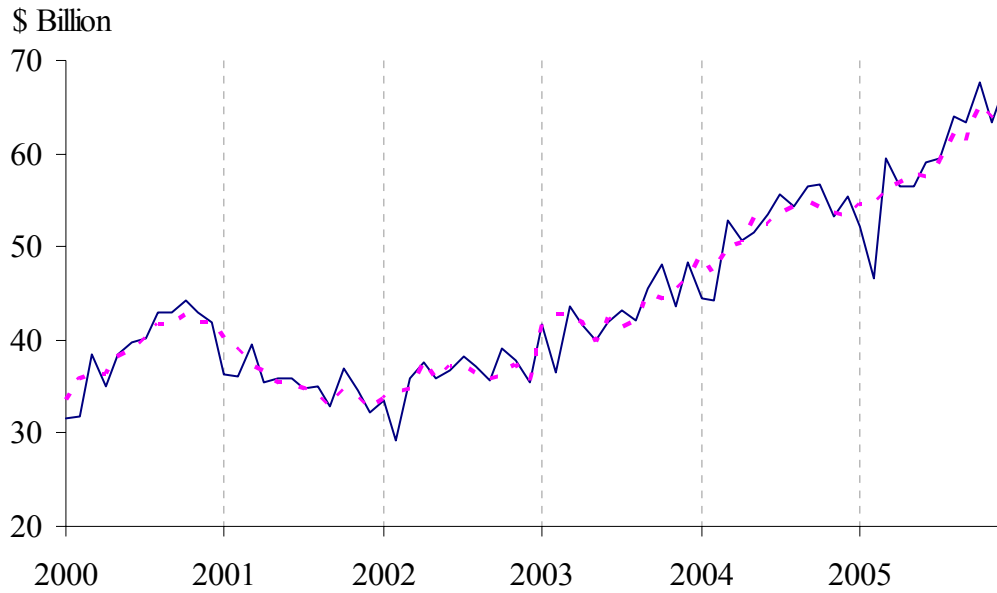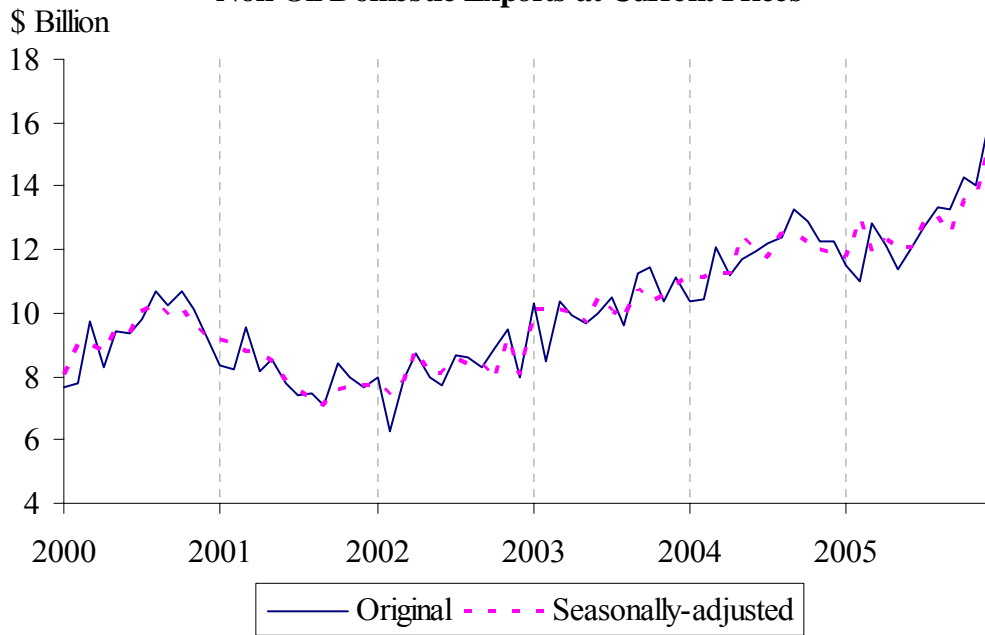
*Prior to January 2003, trade data excludes Singapore's trade with Indonesia.

G) Retail Sales Index (1997=100)

The Retail Sales Index (RSI) measures the performance of the retail industry. Data for the compilation of the RSI is obtained from the results of the monthly surveys of retail establishments. The index is compiled by DOS on a monthly basis.

All the RSI series exhibit strong and stable seasonality. Besides seasonality, some of the RSI series also exhibit variations due to other calendar effects. The types of adjustments performed are summarized in Table 6.

Table 6
Seasonal Effects of Retail Sales Indices at Current Prices*

Description	S	CNY	HR	TD
Total	✓	✓	✓	
Total (exclude Motor Vehicles)	✓	✓	✓	
Department Stores	✓	✓	✓	✓
Supermarkets	✓	✓		✓
Provision & Sundry Shops	✓	✓		✓
Food & Beverages	✓	✓		
Motor Vehicles	✓	✓		
Petrol Service Stations	✓	✓		✓
Medical Goods & Toiletries	✓	✓		
Wearing Apparel & Footwear	✓	✓	✓	✓
Furniture & Household Equipment	✓	✓	✓	
Recreational Goods	✓			
Watches & Jewellery	✓			✓
Telecommunication Apparatus & Computers	✓			
Optical Goods & Books	✓	✓		
Others	✓	✓		

S: Seasonality   CNY: Chinese New Year   HR: Hari Raya Puasa   TD: Trading Day
* RSI at Constant Prices exhibit similar seasonal effects.

Most of the component series have similar seasonal patterns, rising sharply in December and peaking in January during the Christmas and New Year festive season. Because of the similar and stable seasonal patterns, direct seasonal adjustment of the Total RSI is preferred.

Total RSI and Wearing Apparel & Footwear, together with their seasonally adjusted series are shown in Chart 12. Besides the seasonal effects listed in Table 6, the RSI for wearing apparel & footwear also exhibit a downward spike for the months April and May in year 2003 during the SARS outbreak[1]. Temporary prior adjustments are made before seasonal adjustment is performed in order not to distort the seasonal factors.

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[1] Total RSI, however, is not significantly affected by SARS outbreak (See Chart 12).

The seasonally adjusted RSI series are significantly less volatile. By removing the seasonal and calendar effects, the index for consecutive months are comparable, allowing meaningful interpretation of month-on-month growth rates which are used to monitor the short-term performance of the retail sector.

Chart 12
Total Retail Sales Index

Wearing Apparel & Footwear
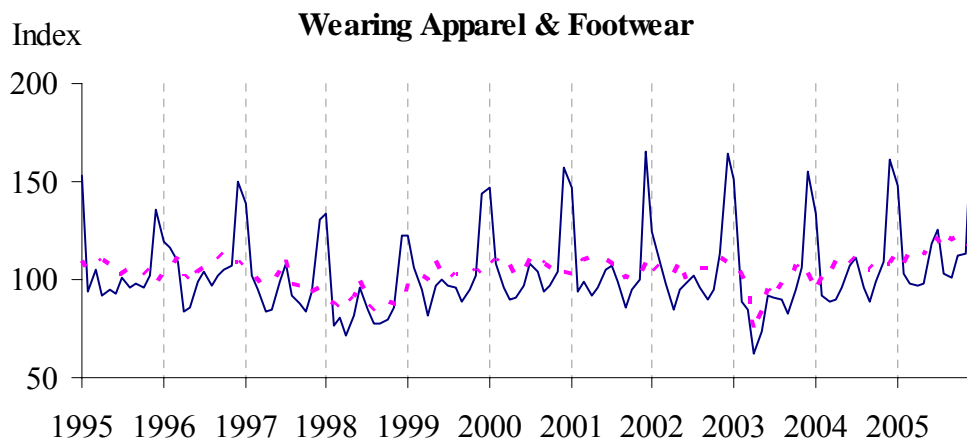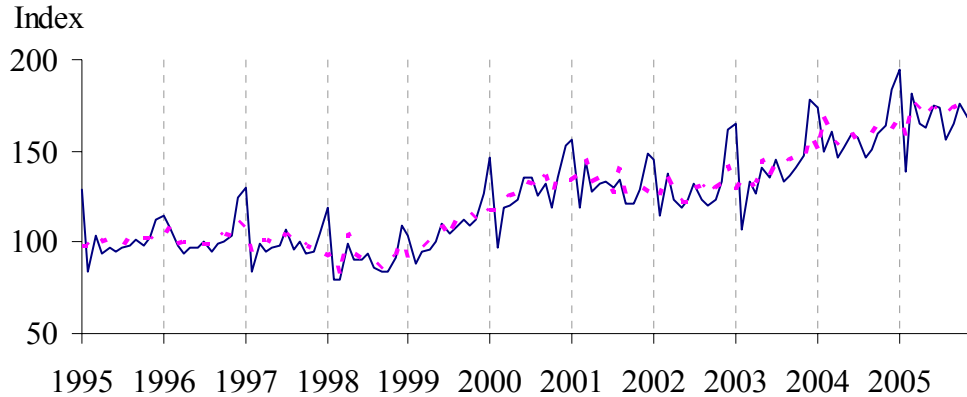

Original - - - Seasonally-adjusted

H)   Consumer Price Index

The Consumer Price Index (CPI) measures the change in the price of a fixed basket of goods and services commonly purchased by the majority of households over time. It is one of the most useful indicators of inflation. The CPI is compiled by DOS on a monthly basis, and is rebased once in every five years to reflect changes in the consumption pattern of private households.

The CPI components are relatively stable series. Many of the CPI components are not seasonal in nature, as their price fluctuations are mainly attributed to changes in demand and supply, which may not follow a fixed pattern every year. For series that exhibit seasonality, the seasonal variations are generally mild. Only a few CPI component series exhibit variations due to CNY effects – for example, seafood and restaurant food prices tend to increase during the festive period.

The overall CPI is directly seasonally adjusted. The combined weight of the CPI components, which display apparent seasonality, is much smaller than the weight of those components whose seasonal effects are mild. Consequently, the seasonal effects on the overall CPI are mild, and no calendar (trading day and moving holiday) effects have been detected (Chart 13).

Chart 13
**Overall Consumer Price Index (2004=100)**
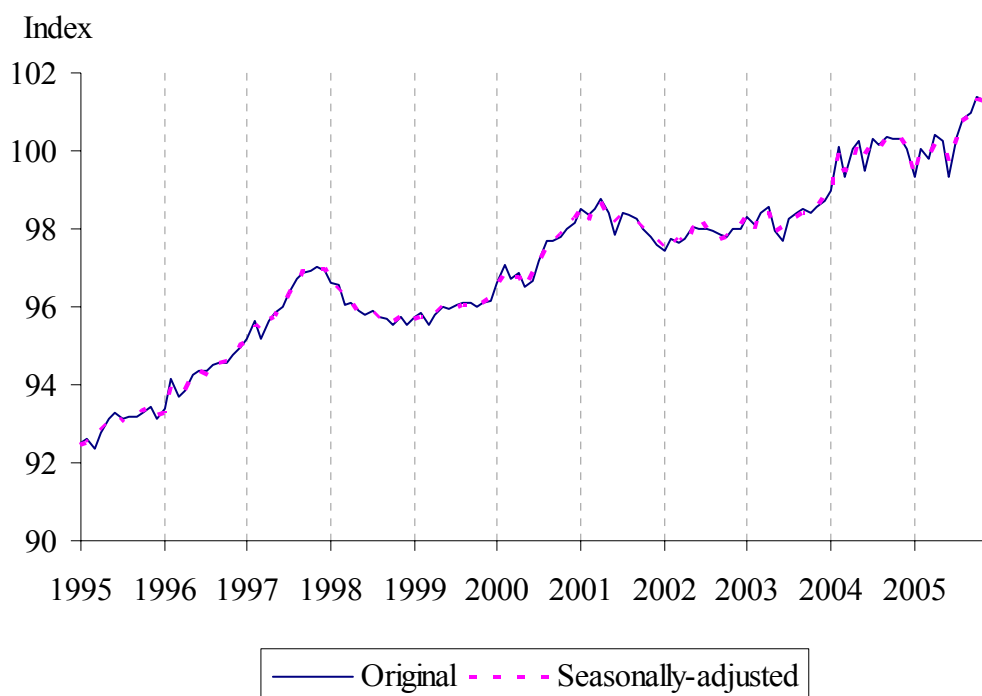
I)   Visitor Arrivals

Visitor arrival statistics are compiled by the Singapore Tourism Board on a monthly basis. The data are obtained from the embarkation/disembarkation cards completed by visitors at various immigration check-points.

Data on visitor arrivals are classified by country of residence. For most of the series, the seasonal variations are strong and stable. Trading day effects are generally not detected and are rarely adjusted for. Calendar effects due to Hari Raya Puasa are present in predominantly Muslim countries, such as Malaysia and Indonesia, while Chinese New Year effects are clearly evident for China, Hong Kong and Taiwan, where arrivals surge during the CNY holiday period.

Visitor arrivals to Singapore tend to peak in March, July, August and December. Total visitor arrival is directly seasonally adjusted, removing variations caused by seasonality and moving holiday effects - Chinese New Year and Hari Raya Puasa (Chart 14). The sharp decline in visitor arrivals from April to June 2003 was due to the SARS outbreak. Temporary adjustments are made prior to seasonal adjustments in order not to skew the estimation of the seasonal factors. As the decline is a one-time phenomenon, it is not seasonal in nature. Hence, the effect is not removed by seasonal adjustment.

Chart 14
Visitor Arrivals (Total)
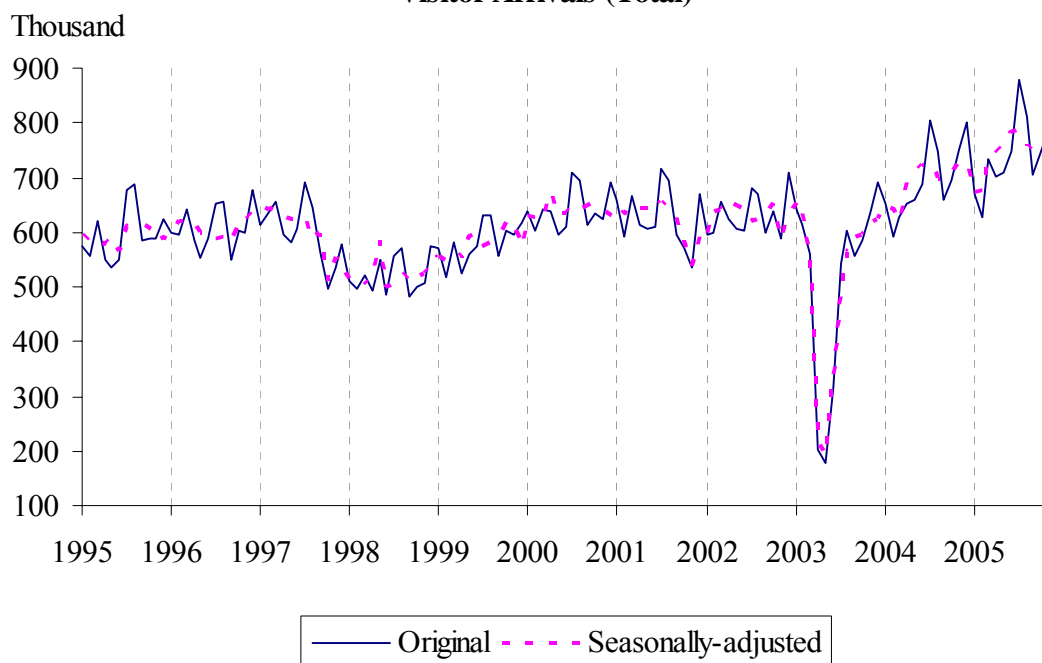
SINGAPORE DEPARTMENT OF STATISTICS
INFORMATION DISSEMINATION SERVICES

Statistics Singapore Website

The Statistics Singapore Website was launched by the Singapore Department of Statistics in January 1995. Internet users can access the website by connecting to:

http://www.singstat.gov.sg

Providing key Singapore statistics :

♦   Latest Data / KeyStats
which provide key data on Singapore's economy and population.

♦   Media Releases
which cover the Performance of Singapore Economy, the Consumer Price Index, the Wholesale Trade Index, Business Receipts Index for Service Industries, Retail Sales and Catering Trade Indices, Manufacturing Performance, Singapore External Trade, Tourism Sector Performance, Real Estate Information and Employment Situation.

♦   Papers and Analyses
which provide papers on economic and social topics.

Providing information on statistical resources :

♦   Online Publication Catalogue
which lists the latest editions of publications released by the Singapore Department of Statistics at http://www.singstat.gov.sg/pdtsvc/catalog.html. More publications will progressively be made available for access without charge.

♦   Advance Release Calendar
which covers key Singapore economic indicators.

Providing a convenient gateway to international statistical websites :

♦   Guide to International Statistics
which covers international databases, classifications and links, and statistical terms and definitions.

♦   IMF Dissemination Standards Bulletin Board
which provides metadata about Singapore's key indicators in the real, fiscal, financial and external sectors, including dissemination practices and information about pre-release access of current indicators.

SingStat Express

SingStat Express is a personalised data delivery service which sends the latest press releases, notices of publication, newsletter, occasional and information papers to subscribers via email. The Monthly Digest of Statistics (softcopy) and more than 50 key indicators and statistical indices are included for subscription at a nominal fee.

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Key Singapore Data on Palm OS Devices

The pdf version of "Singapore in Brief 2006" for Palm OS devices is available for downloading from the Statistics Singapore Website.

SingStat Time Series (STS) Online System

The SingStat Time Series (STS) Online System is an internet-accessible time series retrieval system. The STS includes some 6,000 historical data series on Singapore society and economy from several domains, including national accounts, balance of payments, investments, finance, labour, prices, business expectations, trade, manufacturing, tourism, demography, health and education.

Besides the usual monthly, quarterly and annual data, STS includes also seasonally adjusted data series for key economic indicators providing for a better analysis and understanding of current economic trends. The STS also offers:

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- "Bookmark" features that enable users to save and organise links in their personalised portals.

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E-survey

The E-survey enables business organisations to complete and submit their survey forms through the internet. Using secured encryption protocols, the E-survey ensures that the information transmitted through the net is secured and protected. The system features online helps and validation checks to assist respondents in completing their survey forms. With the E-survey, respondents do away with the tedious paper work and manual tasks of mailing or faxing their survey returns to the Department.

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- Call us   at   **Tel: 1800-3238118* (local callers)**
           (65) 6332-7738 (overseas callers)

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