SEASONALITY IN THE EXCHANGE FUND *

The balance sheet of the Exchange Fund exhibits seasonality, or a regular pattern dependent on the calendar. In particular, fiscal reserves and Certificates of Indebtedness show strong seasonality while the Exchange Fund Bills and Notes outstanding and Accumulated Surplus tend not to display seasonal variations.

The balance sheet of the Exchange Fund, like any other balance sheet, is a snapshot representation of the accounts of the Fund at a given point in time. The information is static, and merely shows how the assets and liabilities are related at the point at which the balance sheet was drawn up. In particular, a balance sheet is concerned with *stocks*, and does not show any information on *flows* such as profits and losses over a period. Nor does a single balance sheet give any indication as to how the component parts have changed over time.

A succession of balance sheets can, however, be used to derive flow-type information and trends in the components. By comparing successive balance sheets, flow information for the period from the earlier dated balance sheet to the later dated one can be derived[1]. And by recording the values of the components of the balance sheet for a number of consecutive balance sheet dates, time series for the various components can be constructed which allow analysis of such characteristics as trends and seasonality in those components.

Seasonality of the Total Exchange Fund

It may seem natural to start an analysis of seasonality in the Exchange Fund with the headline Total Assets or total size of the Fund. This is after all the figure that is most widely quoted and most referred to in public. But statisticians investigating a series of data for seasonality usually prefer to look at the components or building blocks of the series, not the overall total figures, the reason being that any one seasonal factor is more likely to affect a few or even just one component of the overall series, and it is therefore easier to identify these factors by looking at just the components they affect. With this in mind we can disaggregate the Total Assets of the Exchange Fund in the first instance as follows:

Total Assets = Total Liabilities *plus* Accumulated Surplus

and any seasonality in the Total Assets will then be generated by seasonality in one of the two components on the right hand side of the identity.

Taking the Accumulated Surplus first, changes in this data series over time reflect the investment performance of the Exchange Fund. It is difficult to see any theoretical reason why there should be any pronounced seasonality in the investment performance; if there was, it could only arise either from seasonal elements in the Hong Kong Monetary Authority's management of the Fund, which we are not conscious of and which cannot be detected in the figures[2], or in the markets as a whole. Even if markets do show some apparent seasonality for a number of years, the effects are likely to be transitory and minor[3], and they are unlikely to have any significant impact on a fund such as the Exchange Fund which is mostly invested in US dollars and almost entirely in debt securities.

* This article is primarily the work of John Nugée, the former Executive Director of the Reserves Management Department. Cynthia Leung of the Economic Division assisted with the statistical analysis.

1 For example, the Accumulated Surplus of the Exchange Fund is a stock-type data item. It is derived at any given moment by the identity

Accumulated Surplus = Total Assets *less* Total Liabilities

In contrast, the Surplus for any given period is a flow-type data item, and is derived by the identity

Surplus for period = Accumulated Surplus at end of period *less* Accumulated Surplus at start of period

2 Some commentators looking at investment performance of fund managers in general claim to detect a minor "end-of-year" effect, as fund managers "bank their profits" and take on fewer risk positions at the end of their reporting year, and as markets become less active and liquid. However, these effects, if they exist at all, are generally very small, even in the Japanese market where the end of the financial year at the end of March can produce considerable market changes, and in any event it is hard to detect a consistent effect. The HKMA's management of the Exchange Fund is not dictated by the calendar or the approach of year-end and there is no detectable seasonal factor in the investment returns.

3 Apart from such old sayings as "Sell in May and go away" (a reference to an old tendency for weakness in the London Stock Market in the summer), perhaps the most often-quoted such seasonal effect in modern times has been the observed weakness of the Deutschemark in the summer months as Germans go abroad for their holidays and so sell DM for foreign currencies (there has for many years been a tendency for corresponding strength during the same period in such currencies as the Spanish peseta, for example). But even this effect is more anecdotal than statistical, and it is anyway much reduced in recent years.

Seasonality of the Liability side of the Exchange Fund balance sheet

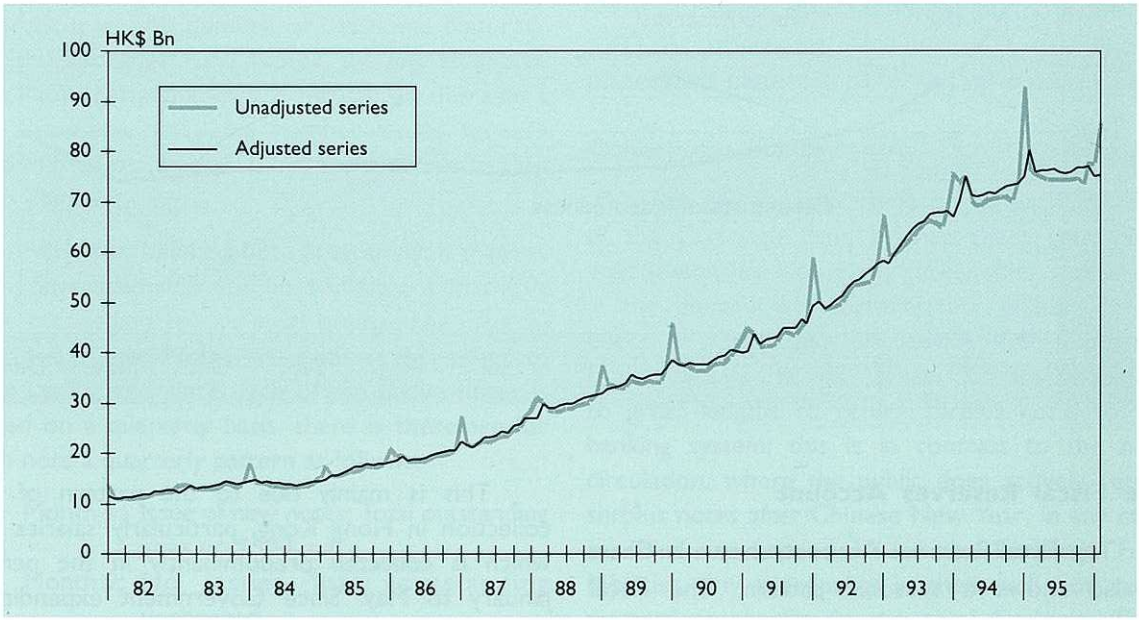
This suggests that the search for seasonality needs to concentrate on the Liabilities side of the balance sheet. Here, there are good grounds for expecting some seasonality to be observed, as there are three main factors which lend a seasonal element to the Exchange Fund's figures. These are the Certificates of Indebtedness (CIs) backing the note issue, the Fiscal Reserves Account, and the total outstanding issues of Exchange Fund Bills and Notes. For the first two of these, the data are driven by external factors in the real economy, and any seasonality in these would be expected to be reflected in the data for the Exchange Fund. For the third series, that of outstanding Bills and Notes, any seasonality would be driven by internal factors, as it arises not from the real economy but from decisions taken by the HKMA itself, namely the issuing pattern for the Bills and Notes respectively.

Certificates of Indebtedness

The series for total CIs is shown in Chart 1. As can be seen, there is a pronounced pattern to the figures, with a peak every year in January or February, then a tendency for the circulation to fall away in the middle of the year, then an increase again as the year moves towards a close.

The series was run through the X-11 seasonal adjustment package assuming multiplicative seasonality. Since the seasonality of the series is affected by Chinese New Year which, like Easter in the western calendar, can occur in different months, a holiday effect adjustment was applied as a prior adjustment for seasonal adjustment (see appendix). The results (F-statistic = 132.4) suggested that an identifiable and significant stable seasonality was found in the series. In particular, as shown in Chart 3, the seasonal peak of the series (i.e. those months with seasonal factors greater than 100) occurred in January to March and December. These corresponded to the periods of Chinese New Year and Christmas in which people tend to keep a large amount of currency (thus requiring the note-issuing banks to hold a correspondingly large amount of Certificates of Indebtedness issued by the HKMA) for shopping and 'lai see' or 'red packets'[4]. The seasonal pattern for the CI series was clear and strong over the period 1982-96.

Chart 1
Certificates of Indebtedness (Adjusted for Chinese New Year Effect)



4 These refer to "lucky money" sealed in red packets, usually given to children as gifts.

Chart 2
Fiscal Reserves

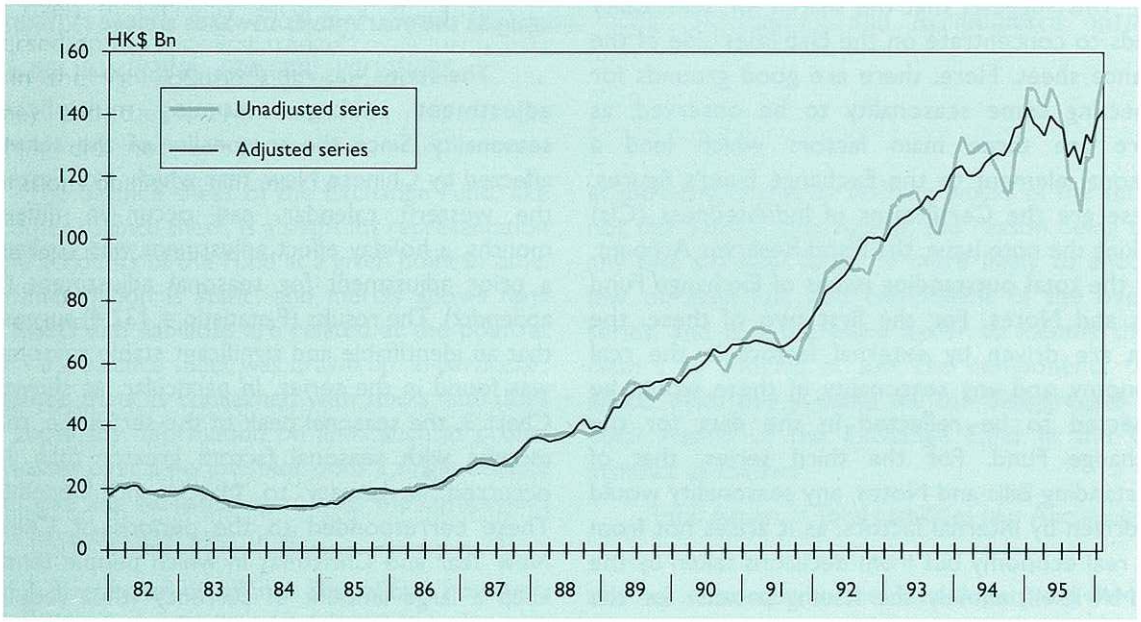
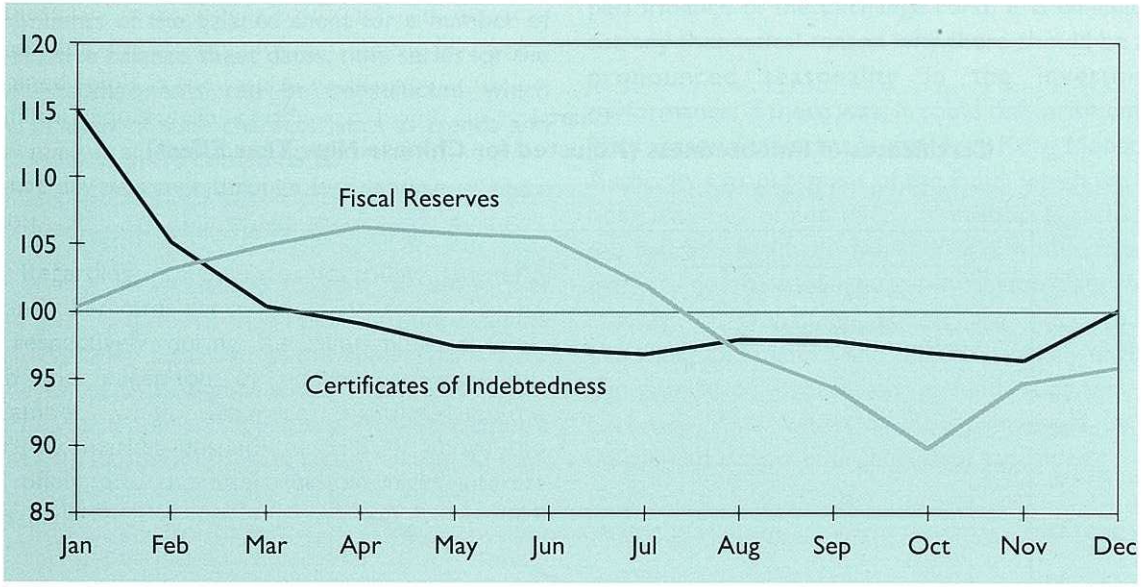


Chart 3
Seasonal Factors of Certificates of Indebtedness and Fiscal Reserves



The Fiscal Reserves Account

The Fiscal Reserves Account, shown in Chart 2, also shows a seasonal pattern. The Fiscal Reserves Account tends to rise in the first half of the year, then decline until about October, when it begins to pick up again.

This is mainly due to the pattern of tax collection in Hong Kong, particularly salaries tax which is collected predominantly in the period January to May. Since Government expenditure tends to have a much more constant pattern, with salary expenditure in particular showing little variation from month to month, the seasonality in

the tax collection translates into periods where government receipts exceed expenditure (the so-called "wet" or surplus months at the start of the year) and periods where receipts are less than expenditure (the "dry" months in the latter part of the year).

The series was also run through the X-11 seasonal adjustment package assuming multipicative seasonality. The F-statistic (53.7) indicates that the fiscal reserves series also displays a statistically significant and stable seasonality. The seasonal pattern (chart 3) reflected the changing nature of the tax base and the timing of the collection of tax revenue over time.

Exchange Fund Bills and Notes

The series for Exchange Fund Bills and Notes outstanding shows a different type of seasonality. As Chart 4 shows, there is a pattern, but it is repeated on a quarterly basis rather than an annual one and on Exchange Fund Notes more than on Bills. This reflects the origin of the seasonal variations, which arise because of the issuing pattern of Exchange Fund paper, especially Exchange Fund Notes. In the steady state, when a note programme is mature, the amount outstanding for that programme will usually be relatively constant, as newly issued notes largely replace maturing ones. The only way a change in the total outstanding can arise is if the number of new notes issued is different from the number of old notes maturing. For the Exchange Fund Notes, the 2-year and 3-year Note programmes are mature, in this sense, and therefore, since the number issued at each auction is constant at $500 mn, the total outstanding stays constant.

However, before a note programme is mature, each new issue will not be replacing a maturing note but adding to the total outstanding. The 5-year and 7-year Notes are both at this phase of their cycles, and since each of the above notes is issued on a quarterly basis, there is therefore for each note a quarterly pattern as follows:

Month 1: Issue of new notes; Total outstanding goes up $500 mn

Month 2: No issue; Total outstanding unchanged

Month 3: No issue; Total outstanding unchanged

The pattern is complicated by the interweaving of the note programmes (2-year, 3-year, 5-year, 7-year and the new 10-year issue) and by the fact that they all started at different times and become mature at different times. Table 1 below summarises the programmes[5].

Table 1:
Exchange Fund Bills and Notes Issue Schedule

Notes	First issued	Programme mature from
2-year	May 1993	May 1995
3-year	October 1993	October 1996
5-year	September 1994	September 1999
7-year	November 1995	November 2002
10-year	October 1996	October 2006

Each series was also run through the X-11 seasonal adjustment package assuming multipicative seasonality. The results, summarised in Table 2, show that, as expected, the amounts of Exchange Fund Bills and Notes outstanding do not exhibit any permanent seasonality. Even though a regular pattern was clear for the number of 2-year notes outstanding[6] during 1993 and 1994, the test marginally rejected the hypothesis of a stable seasonal pattern over the longer period from May 1993 to the present. As expected, tests indicated no seasonal pattern at all for the various bill issues.

Other seasonality

The other components of the Liabilities side of the Exchange Fund balance sheet show very little seasonality. Coins may reflect some seasonality in the demand for currency, but unlike CIs the effect is not readily discernible. Coins are not usually included in red packets and few people go to great lengths to return surplus coins to the banking system; this is in contrast to the note circulation, where the public does actively return surplus notes after Chinese New Year. In any case, as coins are around 1% of the Exchange Fund liabilities, any seasonality in them will not cause material seasonality in the total Exchange Fund

5 See Table 4 on page 15 of February 1996 *Quarterly Bulletin* for further information.

6 There are too few observations to apply statistical tests on stability and significance of the regular pattern for other maturities of notes.

Chart 4
Exchange Fund Bills and Notes Outstanding Issues

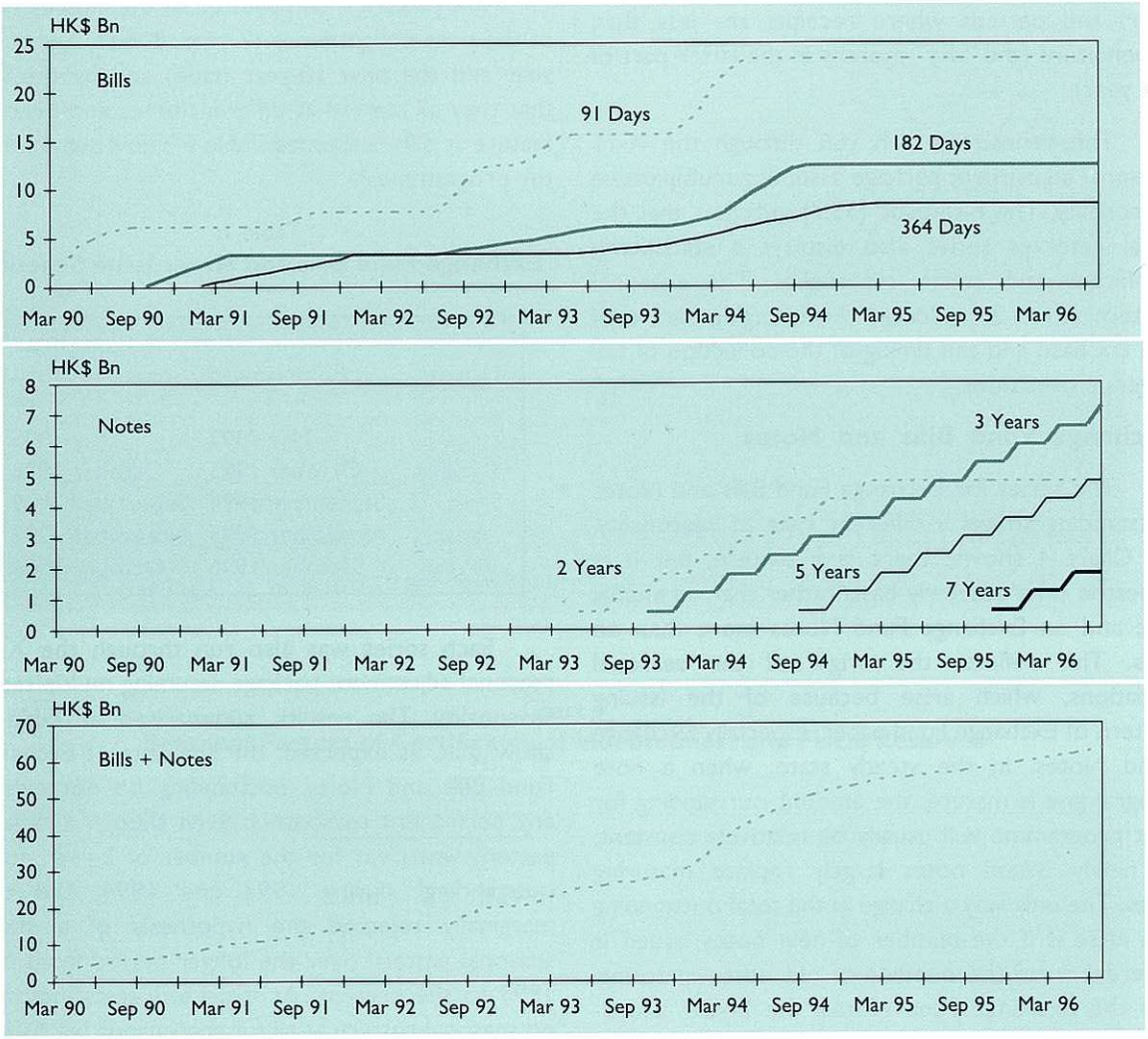


Table 2:
Tests on Stable Seasonality in Exchange Fund Bills and Notes Outstanding

Variables	F-statistics	Stable Seasonality
Bills	0.86	Absence
91 Days	0.96	Absence
182 Days	1.40	Absence
364 Days	1.57	Absence
Notes	1.13	Absence
2 Years	1.92	Absence (Marginally)
3 Years	–	–
5 Years	–	–
7 Years	–	–
Bills + Notes	0.87	Absence

balance sheet. The other factors, such as the Balance of the Banking System and the Other Liabilities, display no noticeable seasonality.

Market operations and the use of the forward market

There is one other seasonal element in the Exchange Fund that warrants our study, and that is the make-up of the total foreign currency assets of the Exchange Fund. The HKMA has since last year released quarterly data for the headline total foreign currency assets of the Exchange Fund, with a further division between settled assets and forward transactions still to be settled (Table 3).

The run of available data is as yet too short for statistically based conclusions to be drawn, but based on observation of the figures available, the data appeared initially to show a very pronounced seasonal pattern, with the forward transactions being small and negative at the end of the March and June quarters, large and positive (i.e. net forward purchases of foreign currencies) at the end of the September quarter, and reduced but still large and positive at the end of the December quarter. However the latest data, for 1996, suggest that this pattern may not be permanent – a good example of the danger of drawing conclusions on seasonality from too few data points.

Conclusion

Overall, the Exchange Fund can be disaggregated into components with and without seasonality. The seasonal component comprises Fiscal Reserves and Certificates of Indebtedness. Each sub-component shows a different regular pattern; the latter attains its peak in January while the former peaks in April to June. Exchange Fund Bills and Notes outstanding and the Accumulated Surplus do not show any seasonal variations. The amount of Exchange Fund Notes outstanding do exhibit an evident and observable pattern as new maturities are introduced. However, this effect disappears once the programme reaches a steady state. As the components with seasonal patterns account for around half of the total, the total liabilities of the Exchange Fund will display a degree of seasonality.

Table 3:
Exchange Fund Foreign Currency Assets

(US$ million)

As at end of	Settled foreign currency assets	Net forward transactions	Foreign currency assets including net forward transactions
1994 Mar	46,405	–257	46,148
Jun	47,121	–265	46,856
Sep	47,274	2,092	49,366
Dec	49,277	1,793	51,070
1995 Mar	52,418	–201	52,217
Jun	53,633	–50	53,583
Sep	51,762	2,862	54,624
Dec	55,424	1,747	57,171
1996 Mar	58,062	1,773	59,835
Jun	57,308	2,658	59,966

Appendix: Chinese New Year Holiday Adjustment[7]

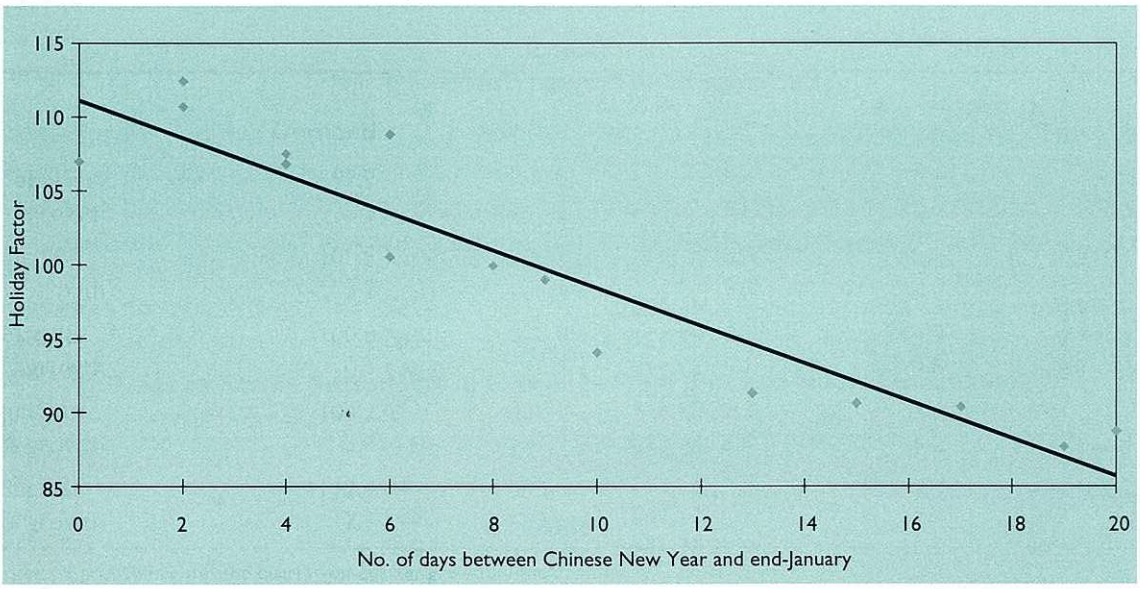
Chinese New Year (CNY) is associated with the strongest currency demand for the year. Therefore the amount of Certificates of Indebtedness (CI) issued reaches its peak at that time. If the CNY effect is not isolated from the data series of the CI, the irregular component (I_t) of the series will capture the CNY variations. Since CI statistics are collected at month-end, the closer is the Chinese New Year falling towards month-end, the greater would be its effect on the CI statistics.

As Chinese New Year moves between late January and mid-February, depending on the lunar calendar, Chart 5 plotted the irregular component for January with the number of days from the end of January to Chinese New Year. A pronounced, and statistically significant, pattern in the plot suggests a significant CNY holiday effect. The holiday adjusted series of January and February were derived from $\hat{I}_t$, the fitted values obtaining from regression in Chart 5. By forcing the holiday factors of both months to 200, the holiday adjusted January and February data were estimated as below:–

holiday adjusted Jan = 100 * holiday unadjusted Jan / $\hat{I}_t$
holiday adjusted Feb = 100 * holiday unadjusted Feb / (200 – $\hat{I}_t$)

Although a stable seasonality was identified in the series without prior holiday adjustment, the stability was further improved with prior holiday effect adjustment to the seasonal adjustment as reflected by a rise in the large F-statistic from 35.3 to 132.4.

Chart 5
Certificates of Indebtedness: Irregular Component



7 This is a modified version of a holiday adjustment method employed by the Research Branch of Census and Statistics Department.