THE DEMAND FOR HONG KONG DOLLAR *

Our econometric tests show that the demand for HK dollar appears to be sensitive to income, interest rates, inflation, business activity and sentiment in Hong Kong. Like other economies, currency holdings declined relative to GDP for many years, but in Hong Kong the ratio turned upward since 1984. We attribute this to currency circulating outside Hong Kong, mainly in China, perhaps amounting to around HK$19 billion or a quarter of total currency issued. Unlike currency, demand for HK dollar deposits tends to be positively associated with stock market activity. HK dollar time deposits, and so HK dollar M3, rise more than proportionately with income. Under current economic conditions, the velocity of broad money is expected to fall by around 2% a year.

Introduction

Analysing the behavior of monetary aggregates is of interest to policymakers and forecasters for understanding how monetary variables are related to the real economy and inflation. The case of Hong Kong may also be of more general interest for what it says is about the behavior of monetary aggregates in an economy where the interest rate is clearly exogenous (i.e. determined outside Hong Kong's financial system).

This paper is mainly concerned with the HK dollar money supply and the main component of that can be seen to be time deposits. Trends in various components of the money supply in Hong Kong are shown in Chart 1. In the medium term the HK$M3 measure of the money supply has been growing faster than nominal GDP by an average of 2.2 percentage points a year (Chart 2). This differential in growth rates represent a trend decline in 'velocity', similar to that in most other high income economies.

Other than for currency, the econometric estimates in this paper all start from 1984 so that the whole sample period has the same exchange rate regime (the link to the US dollar at the unchanged rate of 7.8 HK dollars per US dollar). Estimates spanning different exchange rate regimes are likely to be unstable. An earlier study by Kwong & Ho (1983) covered the floating exchange rate regime as it used data from 1974 to 1980.

Demand for Currency

Currency is generally used for transactions rather than as a store of value. As it pays no interest, the amount of currency held by an individual is determined by the 'opportunity cost' in terms of interest foregone by holding it and the 'inconvenience cost' of not having enough on hand to make transactions. Baumol (1952) developed a model, drawing on studies of the demand for inventories. Baumol's model implies that the demand for currency has an income elasticity of +0.5 and an interest rate elasticity of -0.5. However, most empirical studies find that income elasticities are closer to one while interest rate elasticities vary considerably.

In a currency board system, theoretically the supply of currency is determined by the balance of trade/payments. In practice, however, it is not fully exogenous. Banks will always accept currency deposits from customers so there can be no excess supply. Deposits are also readily convertible into currency. In practice then it is correct to regard currency as demand-determined.

Technological change has affected the demand for currency. The ready availability of automatic teller machines is likely to have reduced the amount of currency people carry with them while electronic payments systems have reduced the number of transactions which involve cash payments. Along with financial innovations and deregulation, technology

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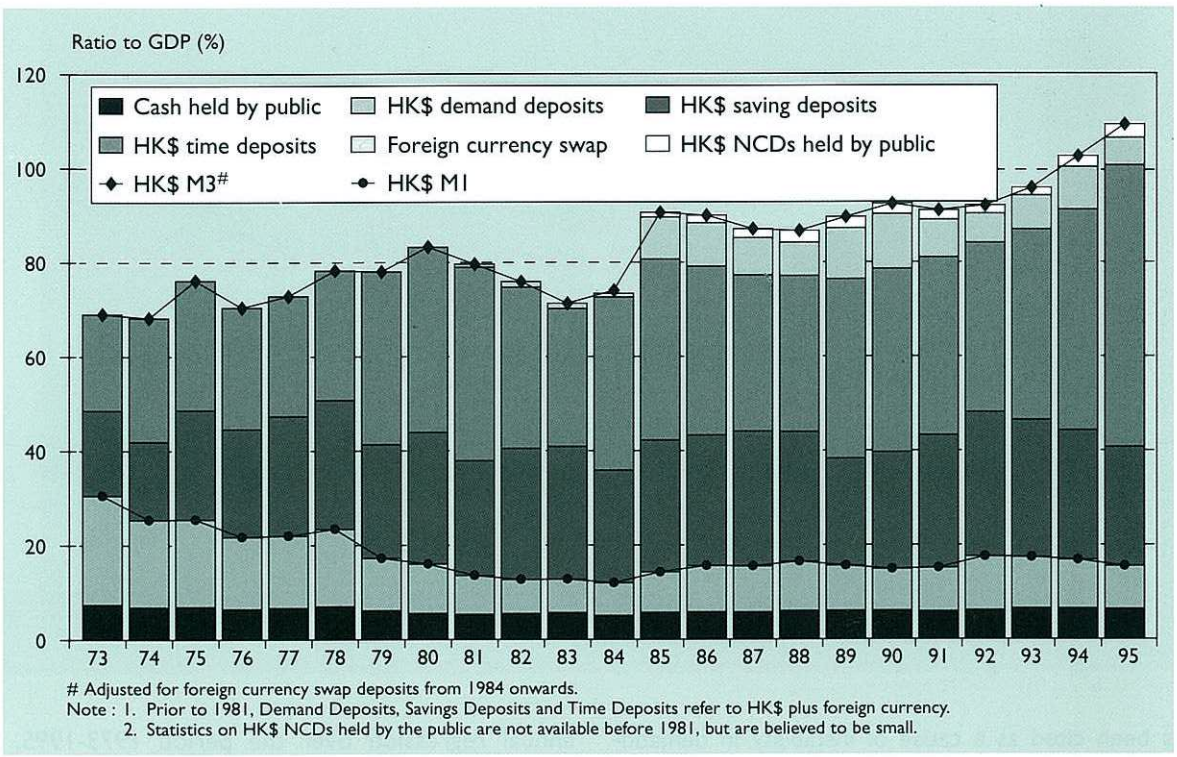
* This article is primarily the work of John Hawkins and Cynthia Leung. Mr Hawkins was formerly Head of Economic Division and Miss Leung is Manager. Helpful comments and encouragement were provided by Professor Charles Goodhart.

Chart 1a

Components of HK$ Money Supply to GDP Ratio



Adjusted for foreign currency swap deposits from 1984 onwards.

Note : 1. Prior to 1981, Demand Deposits, Savings Deposits and Time Deposits refer to HK$ plus foreign currency.

2. Statistics on HK$ NCDs held by the public are not available before 1981, but are believed to be small.

Chart 1b

HK Dollar to Foreign Currency Deposits Ratio

(adjusted for foreign currency swap deposits)

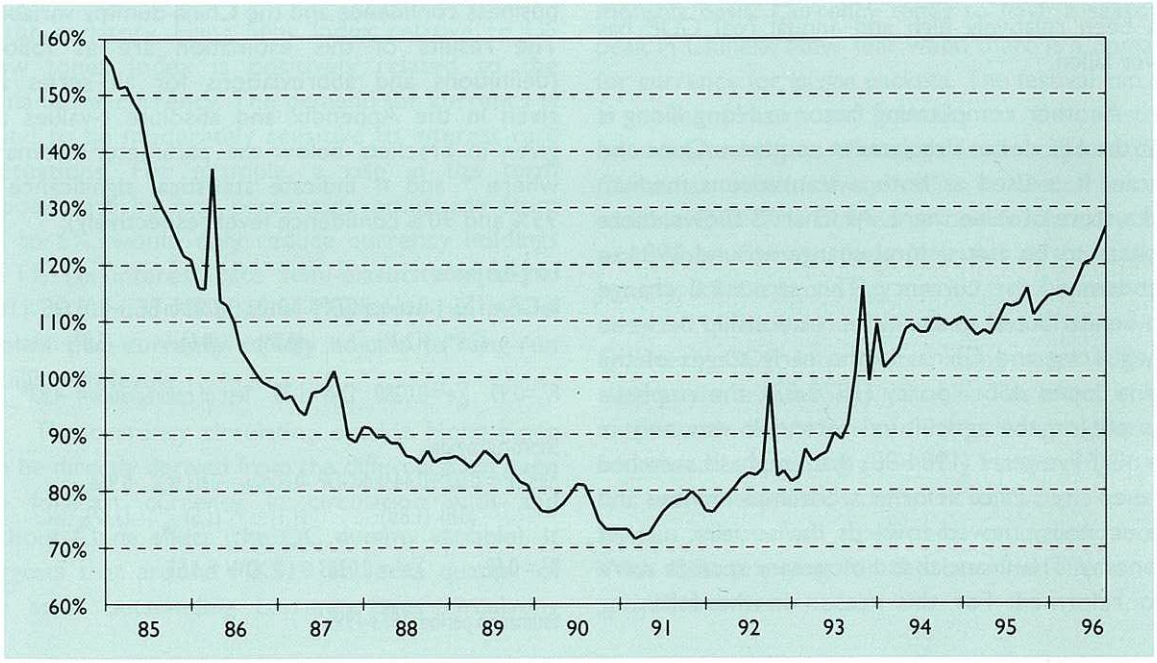
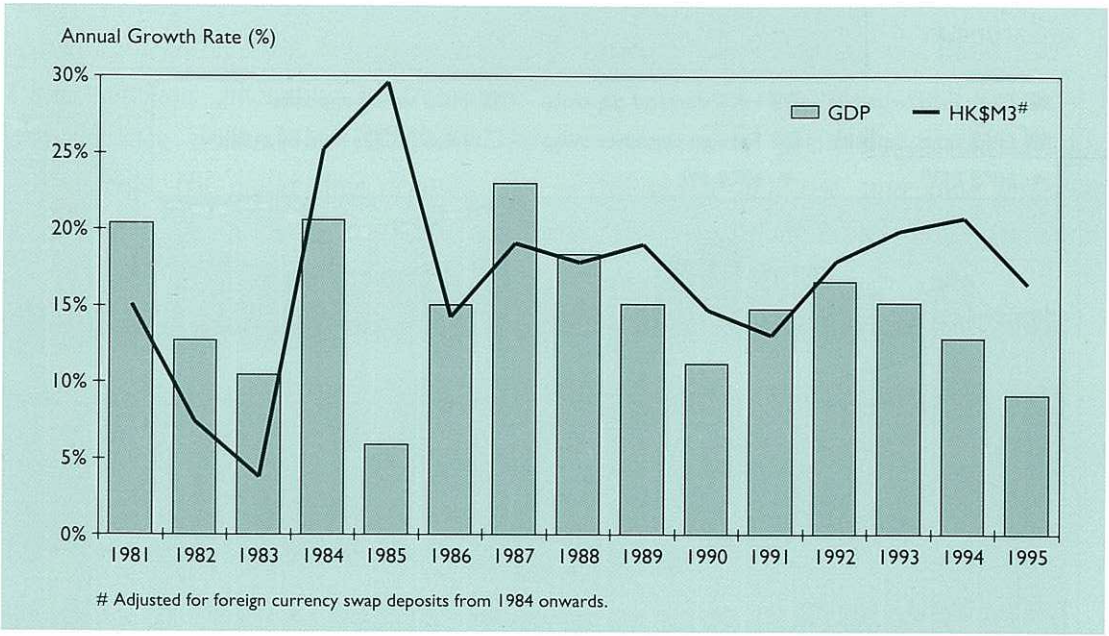


Chart 2
Nominal GDP and HK$M3# Growth Rate



Adjusted for foreign currency swap deposits from 1984 onwards.

has been cited as a cause of instability in demand-for-money functions in a number of countries.[1] It is hard to quantify this effect; a common response is to include a time trend in regressions but this introduces severe multicollinearity as the time trend and the income term are closely correlated. This is especially a problem in Hong Kong where inflation has been relatively high and annual real GDP has never fallen.

Another complicating factor in Hong Kong is that the HK dollar circulates in southern China and Macau. It is used as both a transactions medium and a store of value there. As Chart 3 shows, there appears to be a structural change around 1984 in the demand for currency. This structural change can be attributed to the close relationship between Hong Kong and China. In the early stages of the China "open door" policy (1979-83), the emphasis was put on the agricultural sector. It was only in the next five years (1984-88) that emphasis switched to the "city". Price reforms were implemented and the economy moved towards the socialist market economy. The financial and monetary sectors were also reformed. For this reason in the following annual regression over the period 1973-1995, a dummy variable QC is added taking the value zero until 1983, one in 1984, two in 1985 and so forth. The equations are presented in the Appendix.

The demand for real currency is therefore modelled as a function of income, interest rate, business confidence and the China dummy variables. The results of this estimation are as follows (definitions and abbreviations for all series are given in the Appendix and absolute t-values are given in brackets below the parameter estimates where * and # indicate statistical significance at 95% and 90% confidence level respectively):

Long-run model :

$$\ln C/P = 1.53 + 0.66 \ln RGDP - 0.010\, i_T + 0.02 \ln BC + 0.03\, QC$$
$$(2.3^*)\quad (12.7^*)\quad (2.7^*)\quad (0.6)\quad (5.8^*)$$

$R^2 = 0.99$ $\sum e^2 = 0.0280$ DW=1.79 Test of cointegration= -4.83*

Short-run model :

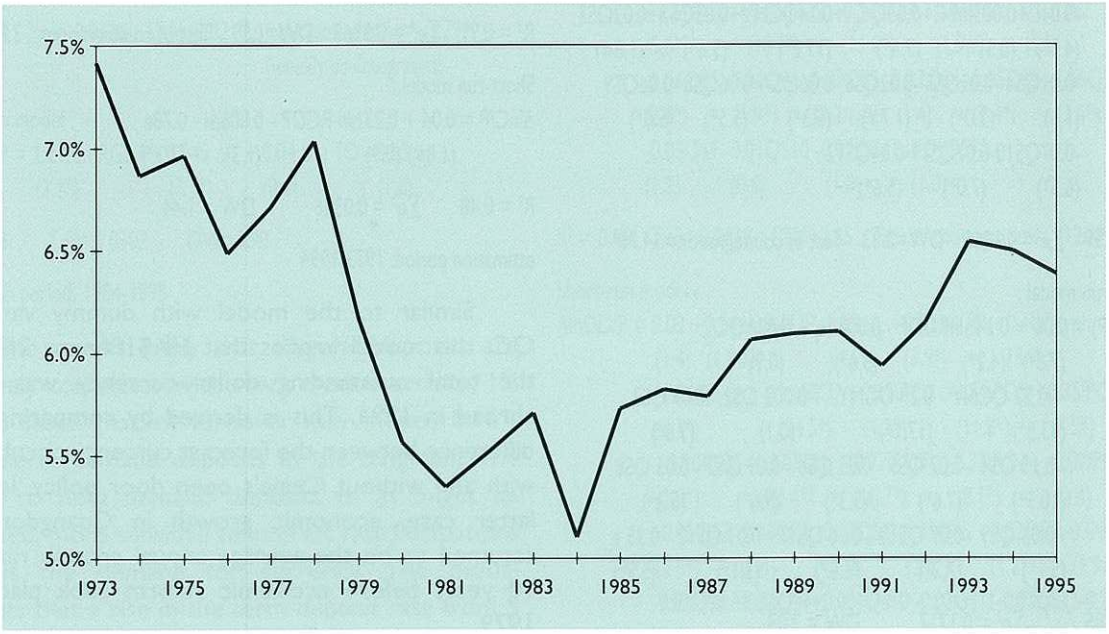
$$\Delta \ln C/P = 0.02 + 0.44 \Delta \ln RGDP - 0.004 \Delta i_T + 0.03 \Delta QC - 0.96 e_{t-1}$$
$$(0.8)\quad (1.8\#)\quad (1.1)\quad (1.5)\quad (3.6^*)$$

$R^2 = 0.62$ $\sum e^2 = 0.0263$ DW = 1.53

estimation period: 1973-1995

1 For example, the survey by Siklos (1995) leads him to conclude "conventional demand for money functions tend not to be stable due in large measure to financial innovation".

Chart 3
Ratio of Currency to GDP



The results suggest that currency is an inferior good as the demand for it grows less than proportionately with income. This will partly reflect the impact of technology, which may become more accelerated if smart cards[2] become popular. Reflecting business/consumer confidence in the territory, Hang Seng Index relative to US Dow Jones Index is positively related to the demand for currency. The demand for currency is found to be moderately sensitive to interest rate fluctuations. For example, a rise in the term deposit rate by one percentage point, say from 5% to 6%, would only reduce currency holdings by 1% (as interest rate semi-elasticity equal to 0.01) or around HK$0.7bn. The short-run model implies that currency rapidly adjusts to long-run equilibrium levels.

The currency circulating outside Hong Kong can be directly derived from the difference between the forecast currency in circulation with and without China effect (the QC dummy variable). It suggests that around HK$19 bn, or a quarter of the total outstanding currency, was circulating outside Hong Kong in 1994. Most of this is believed to be in southern China although some will be in Macau and possibly some in neighbouring countries.

The relationship was also estimated on a monthly basis. Currency tends to have a seasonal peak in Chinese New Year when there is a demand for currency for *lai see* packets. The festival can fall in either January or February in the western calendar, making its effect trickier to capture than Christmas which always falls in December. A variable QCNY is defined as one for January in a year when Chinese New Year fall at the end of January, 0.9 if it is one day away, 0.8 if it is two days away... 0.1 if it is nine days away and 0 otherwise. Quarterly GDP, interpolated using retail sales, is used as the transactions variable. The effect of the extramural circulation of Hong Kong dollars is addressed by entering a monthly version (QC_{12}) of QC with an imposed coefficient equivalent to one-twelfth the annual coefficient estimated above. With QSs proxying for the seasonal effects, the specification is:

2 See Yam (1995) in the August 1995 issue of the Quarterly Bulletin for a discussion.

Long-run model :

$$\ln(C/P) = 3.39 + 0.26\ln RGDP + 0.13\ln RGDP_{-1} + 0.13\ln RGDP_{-2} + 0.12\ln RGDP_{-3} - 0.01 i_T + 0.005\ln BC + 0.03 QC_{12} + 0.24 QCNY + 0.05 QS2 + 0.02 QS3 - 0.01 QS4 - 0.02 QS5 - 0.02 QS6 - 0.06 QS7 - 0.06 QS8 - 0.06 QS9 - 0.07 QS10 - 0.07 QS11 - 0.04 QS12$$

(8.0*)(8.2*) (4.6*) (4.5*) (4.0*) (4.5*) (0.3) (7.4*) (17.2*) (5.6*) (1.8#) (1.3) (2.0*) (1.7#) (5.3*) (5.5*) (5.0*) (6.5*) (7.0*) (5.6*)

$R^2 = 0.99$ $\sum e^2 = 0.1966$ DW=2.33 Test of cointegration= -4.76*

Short-run model :

$$\Delta\ln(C/P) = 0.06 + 0.14\Delta\ln RGDP - 0.008\Delta i_T + 0.03\Delta QC_{12} + 0.22 QCNY - 0.29 QCNY_{+1} - 0.002 QS2 - 0.09 QS3 - 0.10 QS4 - 0.07 QS5 - 0.05 QS6 - 0.09 QS7 - 0.05 QS8 - 0.05 QS9 - 0.07 QS10 - 0.06 QS11 - 0.03 QS12 - 0.35 e_{-1}$$

(7.8*) (4.2*) (3.6*) (0.9) (13.5*) (17.1*) (0.1) (9.6*) (10.9*) (7.6*) (5.3*) (9.6*) (5.2*) (5.1*) (7.2*) (6.6*) (3.1*) (5.9*)

$R^2 = 0.85$ $\sum e^2 = 0.1717$ DW = 2.03

estimation period: 1973-1995

Currency has a pronounced seasonality. As expected, Chinese New Year increases demand for currency; if it falls at the end of January, currency may rise by 24% or HK$15bn. The rise will be reversed in the next month as reflected by the negative and similar valued coefficient of $QCNY_{+1}$. Moreover, the specification suggests that the long-run current currency demand depends not only on the current transaction volume, but also the previous three months. With this specification, a somewhat higher currency demand, HK$20bn, outside Hong Kong is estimated.

With China's "open-door" policy, Hong Kong has extensive trade links with China, which became Hong Kong's second largest domestic export market in 1984. This mainly relates to the processing arrangements (especially in the manufacturing sector) between Hong Kong and China, particularly in the Special Economic Zones. The southern province of Guangdong, which borders on Hong Kong and in which Hong Kong people invest heavily has developed very rapidly. Given the growing interdependence of the Hong Kong and Guangdong economies, the following specification replaces the previous dummy variable QC with Gross Domestic Product of Guangdong province (GD) yielding the following results:

Long-run model :

$$\ln C/P = 2.06 + 0.49 \ln RGDP - 0.011 i_T + 0.02 \ln BC + 0.26 \ln RGD$$

(1.8#) (3.7*) (2.2*) (0.4) (3.0*)

$R^2 = 0.99$ $\sum e^2 = 0.0368$ DW=1.59 Test of cointegration= -3.86*

Short-run model :

$$\Delta\ln C/P = 0.04 + 0.23\Delta\ln RGDP - 0.006\Delta i - 0.78 e_{-1}$$

(1.8#) (0.9) (1.3) (3.3*)

$R^2 = 0.48$ $\sum e^2 = 0.0326$ DW = 1.44

estimation period: 1973-1994

Similar to the model with dummy variable QC, this model implies that HK$18bn or 24% of the total outstanding dollar currency was held abroad in 1994. This is derived by comparing the difference between the forecast currency circulation with and without China's open door policy. In the latter case, economic growth in Guangdong is assumed to be the average annual growth rate of 10 years before economic reform took place in 1979.

Demand Deposits

Demand deposits are close substitutes for currency so many of the comments made above also apply to them. In addition, however, they may be used for settling transactions such as in the stock market. So, stock market turnover, TO, is expected to be positively associated with the balance of demand deposits. The effect of technological change is ambiguous for demand deposits as some innovations have made them more useful while some have made them less needed.

In Hong Kong no interest rate is paid on demand deposits. For that reason the term deposit rate is used to measure the opportunity cost of holding them. Demand deposits may also be held for what is termed the "speculative motive". If interest rates on term deposits and bonds are currently low, this may lead investors to expect them to rise and so bond prices to fall. They would therefore want to keep their funds in demand deposits until rates move back up. This provides a further reason to expect the interest rate on term deposits to enter with a negative sign.

Since no interest is paid on demand deposits, such deposits are demand-determined. The equation was first estimated using annual data:

Long-run model :

$$\ln DD/P = 0.75 \ln RGDP - 0.029\, i_T + 0.16 \ln TO$$
$$(30.0^*) \qquad (1.9^*) \qquad (3.7^*)$$

$R^2 = 0.95$ $\sum e^2 = 0.0536$ DW=2.02 Test of cointegration= -3.29 (weakly co-integrated)

Short-run model :

$$\Delta \ln DD/P = 1.21 \Delta \ln RGDP - 0.045\, \Delta i_T + 0.04\, \Delta \ln TO - 0.55\, e_{-1}$$
$$(3.7^*) \qquad (3.1^*) \qquad (0.6) \qquad (1.6)$$

$R^2 = 0.78$ $\sum e^2 = 0.0302$ DW=1.90

estimation period: 1984-1995

The results imply that demand deposits are positively correlated with stock market activity; 1% rise in stock market turnover may induce 0.16% increase in demand deposits in the long-run. The desire to hold demand deposits is, as might be expected, more sensitive to interest rate fluctuations than is the demand for currency. The model suggests that a rise in the term deposit rate from 5 to 6% would reduce demand deposits by 2.9% or around HK$3.2bn.

Similar estimation is also applied on a monthly basis. Additional dummy variables are added to allow for the impact of share flotations (initial public offerings). These have often been greatly oversubscribed, giving rise to large amounts of funds sitting in demand deposits temporarily. They had particularly large impacts in the months of April 1986 (IPO1), September 1992 (IPO2), October 1992 (IPO3), October 1993 (IPO4) and January 1994 (IPO5). The typhoon signal hoisted at the end of August 1995 also locked up a large amount of funds in demand deposits. This effect is captured by adding a dummy variable, taking value one in that month and zero otherwise.

The results imply that current real demand deposits balances are sensitive to the current real GDP, interest rate and stock market turnover. As expected, seasonal fluctuations were not as clear as that of currency since most of the seasonal dummies are insignificant.

Long-run model :

$$\ln DD/P = 4.89 + 0.11 \ln RGDP - 0.034 i_T + 0.04 \ln TO + 0.21 Qtyph + 1.11 IPO1$$
$$(5.5^*)\ (1.4) \qquad (5.1^*)\ (3.8^*) \qquad (6.3^*) \qquad (32.9^*)$$
$$+0.21 IPO2 + 0.76 IPO3 + 0.37 IPO4 + 0.06 IPO5 - 0.03 QS2$$
$$(5.6^*) \qquad (19.7^*) \qquad (11.0^*) \qquad (1.9\#) \qquad (1.5)$$
$$-0.04 QS3 - 0.04 QS4 - 0.07 QS5 - 0.03 QS6 - 0.05 QS7 - 0.06 QS8$$
$$(2.0^*) \qquad (1.9^*) \qquad (3.2\#) \qquad (1.4) \qquad (2.4^*) \qquad (2.4^*)$$
$$-0.03 QS9 - 0.01 QS10 - 0.02 QS11 - 0.01 QS12$$
$$(1.2) \qquad (0.6) \qquad (1.0) \qquad (1.0)$$

$R^2 = 0.95$ $\sum e^2 = 0.2449$ DW=2.55 Test of cointegration= -12.0*

Short-run model :

$$\Delta \ln DD/P = 0.02 + 0.14 \Delta \ln RGDP - 0.03 \Delta i_T + 0.05 \Delta \ln TO + 0.18 Qtyph$$
$$(1.4)\ (1.8\#) \qquad (4.6^*)\ (3.9^*) \qquad (3.9^*)$$
$$-0.26 Qtyph_{+1} + 1.11 IPO1 + 0.19 IPO2 + 0.54 IPO3 + 0.35 IPO4$$
$$(5.7^*) \qquad (24.5^*) \qquad (4.2^*) \qquad (11.8^*) \qquad (7.5^*)$$
$$+0.10 IPO5 - 1.07 IPO1_{+1} - 0.77 IPO3_{+1} - 0.37 IPO4_{+1} - 0.02 IPO5_{+1}$$
$$(2.2^*) \qquad (23.4^*) \qquad (16.7^*) \qquad (8.1^*) \qquad (0.4)$$
$$-0.05 QS2 - 0.03 QS3 - 0.02 QS4 - 0.05 QS5 + 0.02 QS6 - 0.04 QS7$$
$$(2.3^*) \qquad (1.4) \qquad (1.0) \qquad (2.3^*) \qquad (1.2) \qquad (1.9\#)$$
$$-0.01 QS8 + 0.02 QS9 + 0.001 QS10 - 0.02 QS11 - 0.02 QS12 - 0.23 e_{-1}$$
$$(0.6) \qquad (1.1) \qquad (0.1) \qquad (0.8) \qquad (0.7) \qquad (3.0^*)$$

$R^2 = 0.95$ $\sum e^2 = 0.2175$ DW = 2.24

estimation period: 1984-1995

Narrow Money Supply

The narrow measure of the money supply, HK$M1, comprises currency and demand deposits. It could be modelled as the sum of these components. Alternatively, if it was thought that the main variations were substitution between the two components and this was not well captured by the specification, HK$M1 could be directly modelled. Given the sample period, the China variable was highly correlated with transaction variable, so it was excluded from the specification. The decrease in elasticity of stock market turnover suggests that the inclusion of currency dilutes the association.

Long-run model :

$$\ln HK\$M1/P = 0.79 \ln RGDP - 0.017\, i_T + 0.14 \ln TO$$
$$(38.9^*) \qquad (1.4) \qquad (4.4^*)$$

$R^2 = 0.96$ $\sum e^2 = 0.0308$ DW=2.24 Test of cointegration= -4.26*

Short-run model :

$$\Delta \ln HK\$M1/P = 0.02 + 0.83\, \Delta \ln RGDP - 0.026 \Delta i_T + 0.05 \Delta \ln TO - 0.69 e_{-1}$$
$$(0.6) \quad (1.3) \qquad (2.0^*) \qquad (0.8) \qquad (1.6\#)$$

$R^2 = 0.87$ $\sum e^2 = 0.0135$ DW = 2.01

estimation period: 1984-1995

Savings Deposits

Savings deposit accounts are the ordinary type of deposits which allow account holders to earn interest on their deposits and withdraw money flexibly and at call. The depositors cannot write cheques on savings accounts. Since it enables the depositors to change the use of deposits from a store of value to a means of transactions and vice versa at any time, savings deposit rates are always lower than time deposit rates. The interest rate paid on them is determined by the Hong Kong Association of Banks (HKAB). As individual banks do not have the discretion to adjust savings deposit rates to attract additional deposits and the HKAB savings deposit rates tend to move with time deposit rates (Chart 4), savings deposits are also likely to be demand-determined.

The relevant opportunity cost is therefore the difference between the savings deposit rate and that on term deposits, which is shown to have a significant effect. The model suggests that an increase in term deposit rates relative to those on savings deposits of one percentage point will greatly reduce the demand for savings deposits by 28% or about HK$79 bn. The income elasticity is a little less than one.

Long-run model :

$$\ln DS/P = 0.92 \ln RGDP - 0.28 (i_T - i_S) + 0.29 \ln BC$$
$$(88.5^*) \qquad (2.5^*) \qquad (4.2^*)$$

$R^2 = 0.94$ $\sum e^2 = 0.0335$ DW=1.77 Test of cointegration = -2.9 (weakly co-integrated)

Short-run model :

$$\Delta \ln DS/P = -0.08 + 2.08 \Delta \ln RGDP - 0.32 \Delta(i_T - i_S) + 0.41 \Delta \ln BC - 1.16 e_{-1}$$
$$(2.1\#) \quad (3.7^*) \qquad (3.6^*) \qquad (4.9^*) \qquad (3.3^*)$$

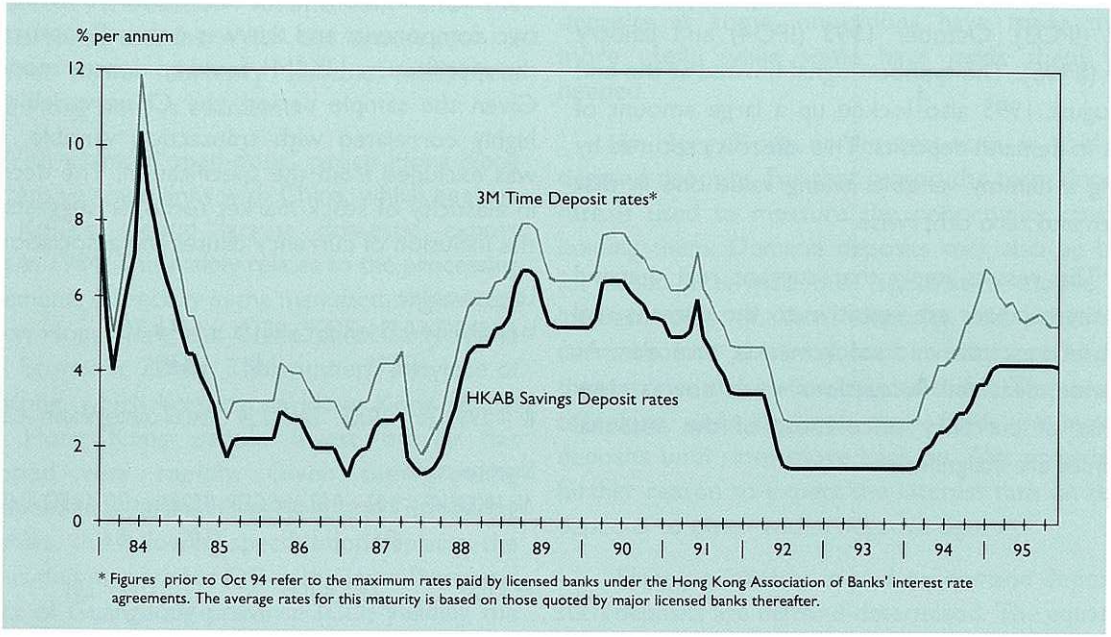
$R^2 = 0.85$ $\sum e^2 = 0.0169$ DW=1.77

estimation period: 1984-1995

Time Deposits

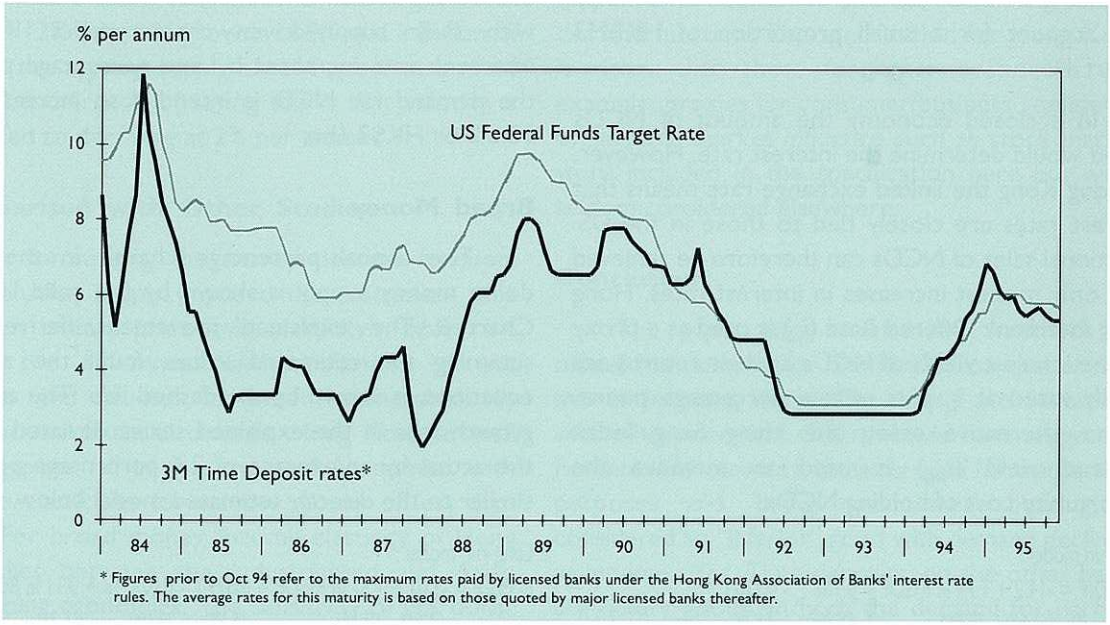
Until recently interest rates paid on time deposits of under HK$500,000 were all set by the HKAB, but have been deregulated in phases since 1 October 1994. The first two phases were carried out on 1 Oct 1994 and 3 January 1995 for deposits fixed for more than one month and more than seven days respectively. Afterwards, the HKMA conducted an assessment of the impact and it was determined that the last phase of the process would be for seven-day time deposits to be implemented on 1 Nov 1995. The share of HK

Chart 4
Deposit Rates: Savings and Time



* Figures prior to Oct 94 refer to the maximum rates paid by licensed banks under the Hong Kong Association of Banks' interest rate agreements. The average rates for this maturity is based on those quoted by major licensed banks thereafter.

Chart 5
Comparison on US and HK interest rates



* Figures prior to Oct 94 refer to the maximum rates paid by licensed banks under the Hong Kong Association of Banks' interest rate rules. The average rates for this maturity is based on those quoted by major licensed banks thereafter.

dollar deposits governed by HKAB has dropped to 35% from an average of 56% before deregulation. In general, since 1992 time deposit rates have moved broadly in line with US Federal Funds Target Rate (Chart 5). For any individual bank, major time deposit rates are exogenous and deposits are demand-determined.

Foreign currency swap deposits are deposits involving customers buying foreign currencies in the spot market and placing them as deposits, while at the same time entering into a contract to sell such foreign currencies (principal plus interest) forward in line with the maturity of such deposits. For most analytical purposes, including this study, they are treated as HK$ time deposits. Swap deposits have been declining in importance with the partial deregulation of term deposit interest rates. From a peak of HK$104 bn in November 1994, they have since dropped by two-thirds.

Time deposits act as a store of value rather than as a means of transactions so there are different considerations in modelling them. GDP is now representing wealth rather than income. The interest rate is included as a measure of the incentive to save. The estimated equation for time deposits (including foreign currency swap deposits) is given below. Time deposits are luxury goods; the demand for them rises more than proportionately with income. They are responsive to interest rates; a rise of one percentage point is estimated to increase deposits by 11% or HK$ 66bn.

Long-run model :

$$\ln DT/P = -7.52 + 1.49 \ln RGDP + 0.11\, i_T - 0.05\, \Delta p + 0.33 \ln BC$$
$$(2.3^*)\quad (5.8^*)\qquad (8.0^*)\quad (4.0^*)\quad (2.2\#)$$

$R^2 = 0.99$ $\sum e^2 = 0.0144$ DW=1.88 Test of cointegration=-3.14 (weakly co-integrated)

Short-run model :

$$\Delta \ln DT/P = 0.06 + 0.64 \Delta \ln RGDP + 0.10 \Delta i_T - 0.06 \Delta \Delta p + 0.23 \Delta \ln BC - 0.57 e_{-1}$$
$$(7.1^*)\quad (5.2^*)\qquad (30.1^*)\quad (17.3^*)\quad (4.5^*)\qquad (3.2^*)$$

$R^2 = 0.99$ $\sum e^2 = 0.0007$ DW=2.82

estimation period: 1984-1995

Negotiable Certificates of Deposit

Negotiable certificates of deposit, NCDs, are bank deposits that are transferable (negotiable) in the market. A depositor can get higher interest yields by investing in a long-term bank deposit, but forfeit liquidity unless he "breaks" the time deposit before maturity. He can sell an NCD to obtain liquidity but the paper would be discounted at the prevailing interest rate. In a sense NCD is a type of transferable time deposit but is marketed more to the wholesale rather than retail market and is not subject to interest rate ceilings. More than any

other components of the money supply, NCDs are likely to be supply-driven. Banks will issue NCDs depending on their funding needs. However, they only account for a small proportion of HK$M3 (Chart 1).

In a closed economy the amount of NCDs issued would determine the interest rate. However, in Hong Kong the linked exchange rate means that interest rates are closely tied to those in the US. Additional sales of NCDs can therefore be achieved with only modest increases in interest rates. Hong Kong Interbank Offered Rate (i_H) is used as a proxy for the interest yields of NCDs as their returns are usually rated at i_H plus certain percentage points. As an alternative asset, the Hang Seng Index dividend yield (i_{HSI}) is used to measure the opportunity cost of holding NCDs.

Long-run model :

$$\ln NCD/P = -14.2 + 1.76 \ln RGDP + 0.106\, i_H - 0.115\, i_{HSI}$$
$$(3.5^*)\quad (5.8^*)\qquad (2.7^*)\quad (1.1)$$

$R^2 = 0.86$ $\sum e^2 = 0.0996$ DW=2.19 Test of cointegration= -3.18 (weakly co-integrated)

Short-run model :

$$\Delta \ln NCD/P = -0.2 + 5.5\, \Delta \ln RGDP + 0.098\, \Delta i_H - 1.09 e_{-1}$$
$$(2.4^*)\quad (3.6^*)\qquad (6.0^*)\quad (3.4^*)$$

$R^2 = 0.92$ $\sum e^2 = 0.0266$ DW=2.16

estimation period: 1986-1995

The results indicate that NCDs are also luxury goods. The amount on issue is independent of business/consumer confidence which is consistent with their supply-driven characteristics. If the interbank rate increases by one percentage point, the demand for NCD is intended to increase by 10.6% or HK$2.6bn.

Broad Money

The annual percentage change in the HK dollar money supply is shown by the solid line in Chart 6. The 'explained' movement, derived by summing the estimated values from the above equations, is shown by the dashed line. The annual growth rate in the explained series deviated from the actual by an average of 2.6 percentage points, similar to the directly estimated model below.

Long-run model :

$$\ln M3/P = -5.03 + 1.37 \ln RGDP + 0.029\, i_T - 0.024\, \Delta p + 0.11 \ln BC$$
$$(2.6^*)\quad (9.1^*)\qquad (3.5^*)\quad (3.0^*)\qquad (1.3)$$

$R^2 = 0.99$ $\sum e^2 = 0.0050$ DW=1.74 Test of cointegration=-3.59*

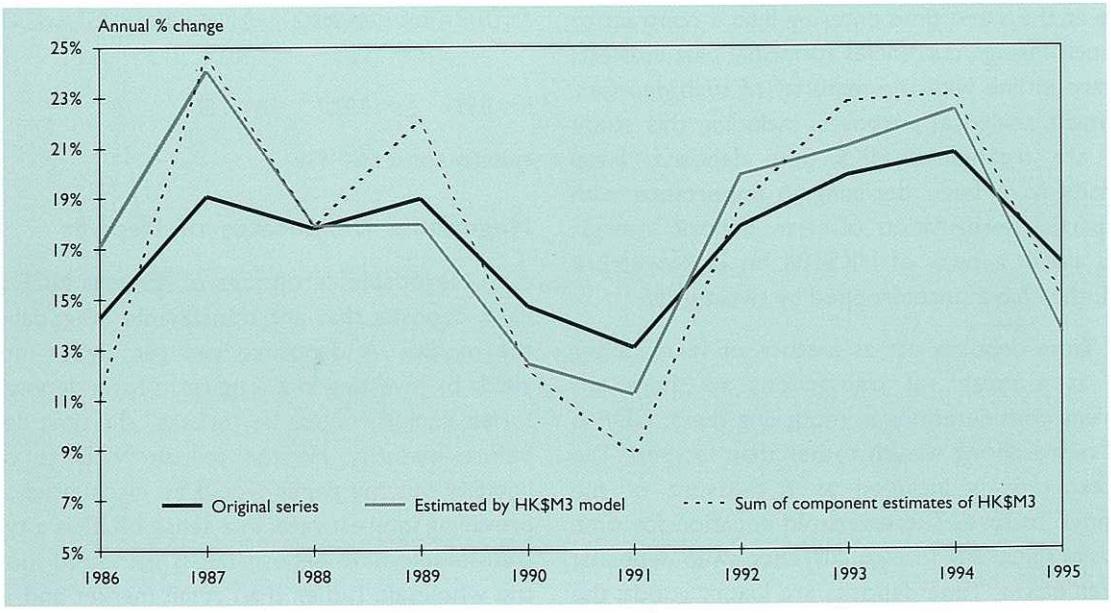
Short-run model :

$$\Delta \ln M3/P = 0.04 + 0.82 \Delta \ln RGDP + 0.018 \Delta i_T - 0.023 \Delta \Delta p + 0.05 \Delta \ln BC - 0.60 e_{-1}$$
$$(4.9^*)\quad (6.9^*)\qquad (6.7^*)\quad (9.2^*)\qquad (2.5^*)\quad (3.9^*)$$

$R^2 = 0.95$ $\sum e^2 = 0.0033$ DW=2.18

estimation period: 1984-1995

Chart 6
Broad Money Supply



Based on this approach, if interest rates stay at around their present levels, technology proceeds at the same pace and nominal GDP grows at around 12% (say real growth of 5% and inflation of 6-7%), the money supply should grow at around 14%. Another way of saying this is that velocity is expected to decrease at 2% per annum.

Comparison with Other Studies

In formulating the money demand function, most studies simply imposed the restriction of a long-run unitary price level elasticity[3]. Tables 1-4 reveal the differences and similarities of our findings and studies in other economies. As international financial centres, Hong Kong as well as Singapore fall in the group of economies with income elasticities for narrow money of less than unity. For broad money, income elasticity of Hong Kong lies between the industrialised and Asian developing economies. The sensitivity of HK dollar demand to interest rate fluctuation is similar to those of industrialised and financially developed economies. On an annual basis, the speeds of adjustment (i.e. the coefficients of error correction term) of broad and narrow money are 0.6 and 0.7. For other economies as shown in Table 4, the speeds are somewhat slower. Most studies include only income/wealth and interest rate in the money demand function. The specification for Hong Kong is richer than those for other economies. For example, proxies for consumer/business confidence or financial market influence such as stock market were included in the specification here but were seldom considered elsewhere.

Conclusion

The paper uses econometric methods to model the demand for the various components of money in Hong Kong. The results are consistent with what economic theory would have suggested. For example, currency is mainly used for transaction purposes and, being non-interest bearing, is considered an "inferior" good with demand declining as income rises. Time deposits, on the other hand, are luxury goods. In both the demand for narrow money and broad money, real sector activities, as measured by real GDP, are found to be the most influential explanatory variable. The study also provides an estimate of the amount of currency circulating outside the territory.

3 Although in some cases, the restriction is not supported by the data empirically, price homogeneity is still imposed when estimating the long-run money demand functions.

Table 1:
Elasticity Comparison for Currency

Economy	Source	Real Income Elasticity	Interest Rate Elasticity	Remarks
Australia	(2)	1.10	-0.010	1971-91
Germany	(3)	0.74	-0.010	no foreign demand, 1960-69
China	(4)	0.83	NA	1989-93
Hong Kong		0.66	-0.010	1973-95

NA - not available

Table 2:
Elasticity Comparison for Narrow Money

Economy	Source	Real Income Elasticity	Interest Rate Elasticity	Remarks
China	(4)	1.48	-0.030	1989-93
Indonesia	(1)	1.16	-0.007	1974-89
Korea	(1)	0.79	-0.008	not co-integrated, 1970-89
Malaysia	(1)	1.11	NA	1970-89
Myanmar	(1)	1.27	NA	1970-89
Nepal	(1)	1.75	NA	weakly co-integrated, 1970-89
Philippines	(1)	0.67	-0.012	weakly co-integrated, 1973-89
Singapore	(1)	0.86	-0.012	1975-89
Sri Lanka	(1)	0.92	-0.016	not co-integrated, 1978-89
Thailand	(1)	0.85	-0.015	not co-integrated, 1977-89
Hong Kong		0.79	-0.017	

NA - not available

Table 3:
Elasticity Comparison for Broad Money

Economy	Source	Real Income Elasticity	Interest Rate Elasticity	Remarks
Part 1: Own interest rate as the return on broad money				
Italy	(5)	0.46	0.009	1980-91
Belgium	(5)	1.00	0.020	1980-91
Sri Lanka	(1)	1.22	0.005	weakly co-integrated, 1978-89
Netherlands	(5)	1.26	0.044	1980-91
France	(5)	1.32	0.024	1980-91
China	(4)	1.58	-0.050	1989-93
UK	(5)	1.61	0.012	1980-91
Germany	(5)	1.72	0.031	1980-91
Hong Kong		1.37	0.029	
Part 2: Opportunity cost of alternative assets				
Korea	(1)	1.00	-0.008	weakly co-integrated, 1970-89
Australia	(2)	1.35	-0.004	weakly co-integrated, 1971-91
Singapore	(1)	1.37	-0.021	not co-integrated, 1975-89
Myanmar	(1)	1.43	NA	not co-integrated, 1970-89
Philippines	(1)	1.47	NA	1973-89
Indonesia	(1)	1.58	-0.021	1974-89
Malaysia	(1)	1.63	-0.017	weakly co-integrated, 1970-89
Thailand	(1)	1.72	-0.025	not co-integrated, 1977-89
Nepal	(1)	2.60	NA	not co-integrated, 1970-89

NA - not available

Sources:
(1) Tseng and Corker, July 1991
(2) Reserve Bank of Australia, December 1993
(3) Seitz, January 1995
(4) IMF, November 1994
(5) Filosa, November 1995

Table 4:
Coefficient of error-correction term (on quarterly basis)

Economy	Narrow Money	Broad Money
Malaysia	0.20	0.12
Philippines	0.13	0.11 [4]
Korea	NA	0.10
Indonesia	NA	0.21
China	0.44	0.22

NA - not available

4 Equal to 0.46 from 1984 onward.

Appendix

Econometric estimation

The money demand function is estimated using ordinary least squares (OLS). However, most of the macroeconomic time series are nonstationary and OLS estimators are not consistent in the presence of nonstationary time series. Thus, although OLS estimation results may have high values for R^2 and significant t-statistics, inferences based on these spurious test statistics may not be correct. The cointegration technique was developed by Engle and Granger in 1987 to deal with this problem. The idea behind the concept of cointegration is that even though level variables are individually I(1), their linear combinations will be I(0).

Thus, before testing for cointegration, the order of integration of the individual time series must be determined. Tests for unit roots are performed on all of the data using the augmented Dickey-Fuller test. The null hypothesis is that the variable under investigation is nonstationary (or has a unit root).

Demand functions are estimated here for the HK dollar components of currency (C), demand deposits (DD), saving deposits (DS), time deposits (DT), negotiable certificate of deposits (NCD), narrow money supply (M1) and broad money supply (M3). Gross domestic product (GDP) represents the transactions/wealth/income variable.[5] The three-month time deposit rate (i_T) is used as a measure of opportunity costs for holding currency and demand deposits or interest yields from holding time deposits or broad money. The expected inflation rate (Δp), proxied by a 13-month centered moving average of actual inflation from t-6 to t+6, is entered as a measure of opportunity cost of holding money instead of goods. In particular, returns and opportunity costs of holding NCDs are measured by Hong Kong Interbank Offered Rate (i_H) and Hang Seng Index dividend yields (i_{HSI}) respectively. GDP deflator is used as the price series. Hang Seng Index relative to US Dow Jones Index is used as a measure of consumer/business confidence (BC). TO denotes stock market turnover and QS denotes seasonal effects. Variables are in nominal terms except those with prefix "R" which are in real terms. All the variables, except interest rate and inflation, are in natural logarithms (ln). The changes (Δ) relate to one period before, i.e. they are first differences. The subscripts -1,-2,... represent one, two, ... period lags. The stationarity tests are performed sequentially on these time series and the results are given in Table A1.

As indicated by test results listed in the table, the Augmented Dickey-Fuller statistic indicates, at least at a significance level of 5%, that the variables used are I(1). This means that simple differencing ensures the stationarity of the time series.

Estimation procedure

Conventional money demand functions are specified in a general framework, in which current real money balances are regressed on real income, real opportunity cost, real rate of return, measures of activity and business confidence, seasonal dummies and some other dummy variables to account for special events such as Chinese New Year or typhoon.

$$\ln(M/P) = \alpha_0 + \alpha_1 \ln RGDP + \alpha_2 (i_T - \Delta p) + \beta (QC, QS, QIPO, Qtyph, QCNY, lnBC, lnTO)$$

Long-run elasticity of real money balance with respect to real income and the real opportunity cost/rate of return variables are given by α_1 and α_2 respectively while β is a vector representing the long-run elasticity or semielasticity of selected variables with respect to the real money balance.

Note that this formulation imposes the restriction that money balances are homogenous of degree 1 with respect to prices. Tests to assess this restriction are reported in the following section. The restriction will be rejected if the F-test statistic, derived from the sum of square of residuals of the

5 As an alternative, private consumption was also tried but the results were generally inferior.

Table A1
Stationarity Tests

Variables	t-value (absolute)		Variables	t-value (absolute)	
	Annual	Monthly		Annual	Monthly
Ln C/P	0.11	0.23	ΔLn C/P	4.14*	4.48*
Ln DD/P	2.08	0.46	ΔLn DD/P	3.76*	9.70*
Ln M1/P	2.28	–	ΔLn M1/P	3.76*	–
Ln DS/P	1.92	–	ΔLn DS/P	5.19*	–
Ln DT/P	1.18	–	ΔLn DT/P	4.03*	–
Ln NCD/P	1.42	–	ΔLn NCD/P	8.81*	–
Ln GDP/P	1.12	1.08	ΔLn GDP/P	4.33*	3.63*
Ln TO	0.09	–	ΔLn TO	5.85*	–
Ln BC	2.25	1.78	ΔLn BC	4.04*	4.32*
i_{HSI}	3.39*	–	–	–	–
i_T-p	4.06*	3.50*	–	–	–
i_T-i_S	3.91*	–	–	–	–
i_H	1.62#	–	–	–	–
i_T	2.77#	2.24[6]	Δi_T	–	5.34*

* and # indicate significantly different from zero at the 5% and 10% level respectively.

restricted and unrestricted equations, exceeds the critical value. In this case, the nominal balances should be modeled as a function of prices, real income, and opportunity cost/rate of return variables.

The Engle-Granger two-step error-correction model approach is applied which provides a way to separate the long-run and short-run properties of the data. In the first step, as suggested by theory, the relationship between the time series is estimated by using level variables and OLS. If the estimation yields a stationary residual series, a cointegration relationship exists between these variables, and the regression yields an estimate of the cointegrating vector. The reformulation of the model in first differences produces a term representing the extent of the error in each time period in achieving the long-run equilibrium. Thus, in the second step, the short run adjustment or error correction mechanism can be estimated as follows:

$$\Delta\ln(M/P) = \alpha_0 + \alpha_1 \Delta\ln RGDP + \alpha_2 \Delta(i_T - \Delta p) + \beta\,(QC, QS, QIPO, QIPO_{+1}, Qtyph, Qtyph_{+1}, QCNY, QCNY_{+1}, \Delta\ln BC, \Delta\ln TO) + \alpha_3 e_{-1}$$

where e = residuals from the long-run regression
α_3 = coefficient of adjustment.

The dummy pair is used to measure the impact and recovery of special events. Taking the August 1995 typhoon as an example, Qtyph is 1 in August 95 while $Qtyph_{+1}$ is 1 in September 95. The first variable measures how typhoon boosted up demand deposits while the latter reflects how demand deposits recovered. It is expected that the sum of coefficients of dummy pair should equal zero.

Price homogeneity test

As previously mentioned, tests should be done before imposing the restriction that money balances are homogenous of degree 1 with respect to prices. In such a case, we estimate

$$\ln(M/P) = \alpha_0 + \alpha_1 \ln RGDP + \alpha_2 (i_T - \Delta p) + \beta\,(QC, QS, QIPO, Qtyph, QCNY, \ln BC, \ln TO) \quad \text{Restricted equation}$$

6 This series is weakly I(1). It may be due to the fact that with the linked exchange rate system, changes in HK dollar interest rates usually follows the change in US policy rate which is not varied frequently. Therefore, the monthly series shows nonstationary to some extent.

$$\ln(M) = \alpha_0 + \alpha_1 \ln RGDP + \alpha_2 (i_T - \Delta p) + \beta (QC, QS, QIPO, Qtyph, QCNY, lnBC, lnTO) + \alpha_3 \ln P \quad \text{.....Unrestricted equation}$$

If the restriction is not valid, we can expect a difference between the restricted residual sum of squares SSR_R and its unrestricted equivalent SSR_U. Therefore, we reject the restriction if the proportionate increase in the sum of squared residuals resulting from their imposition (i.e. $(SSR_R - SSR_U)*(n-k)/SSR_U$) is sufficiently large. The results below indicate restrictions on all money demand functions are valid, suggesting price homogeneity holds for all cases.

Money	Test Statistics	Remarks
C	4.0	with QC proxy for China effect
DD	2.6	
M1	0.2	
DS	0.8	
DT	0.5	
M3	1.5	

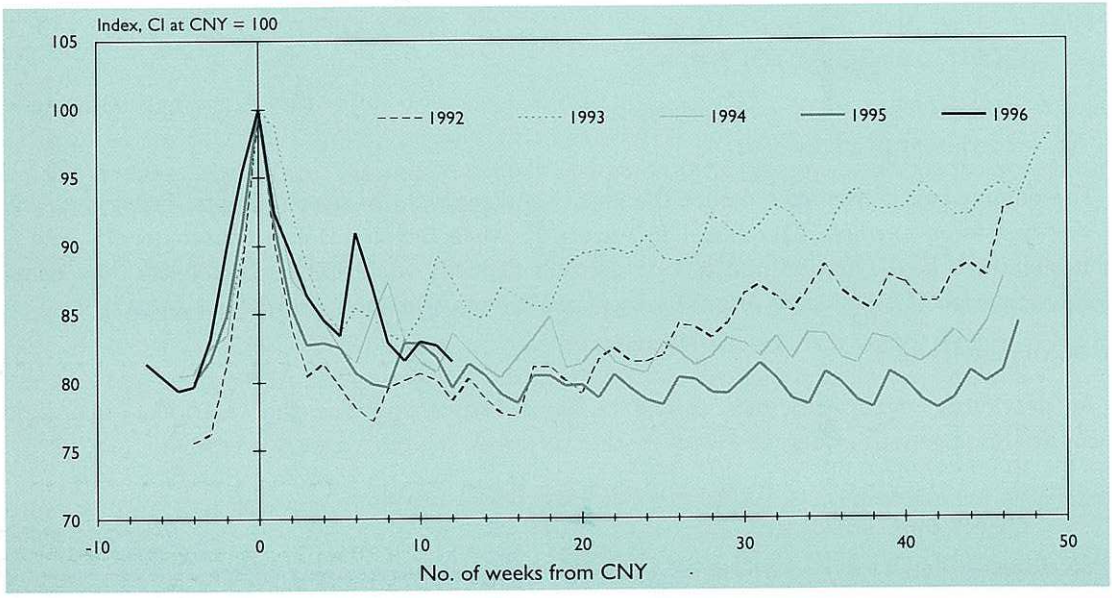
Note : Critical values for C and the rest are 5.98 and 7.57 respectively.

Demand for currency

During Chinese New Year (CNY), strong demand for currency is created for red packets (or lai see) or shopping. Since any HK dollar currency issued require the note-issuing banks to hold a corresponding amount of Certificates of Indebtedness (CI) issued by the Exchange Fund, such strong demand will also boost holding of CI of note-issuing banks. From the following chart (Chart A1a), it is observed that demand for CI builds up and decays gradually during 10 days before and after CNY respectively. So a dummy QCNY, defined as 1 if any of the CNY falls at the end of the month, 0.9 if it is one day *away*, 0.8 if it is two days *away* .... 0.1 if it is nine days away and 0 otherwise, is added. In the short-run estimation, the disequilibrium of currency increase and reversal are captured by QCNY and $QCNY_{+1}$ respectively. However, as $QNCY_{+1}$ is positively associated with the seasonal dummy for February (QS2), coefficient sum of QCNY and $QCNY_{+1}$ does not equal zero (F-statistic=11.7*) and QS2 become insignificant.

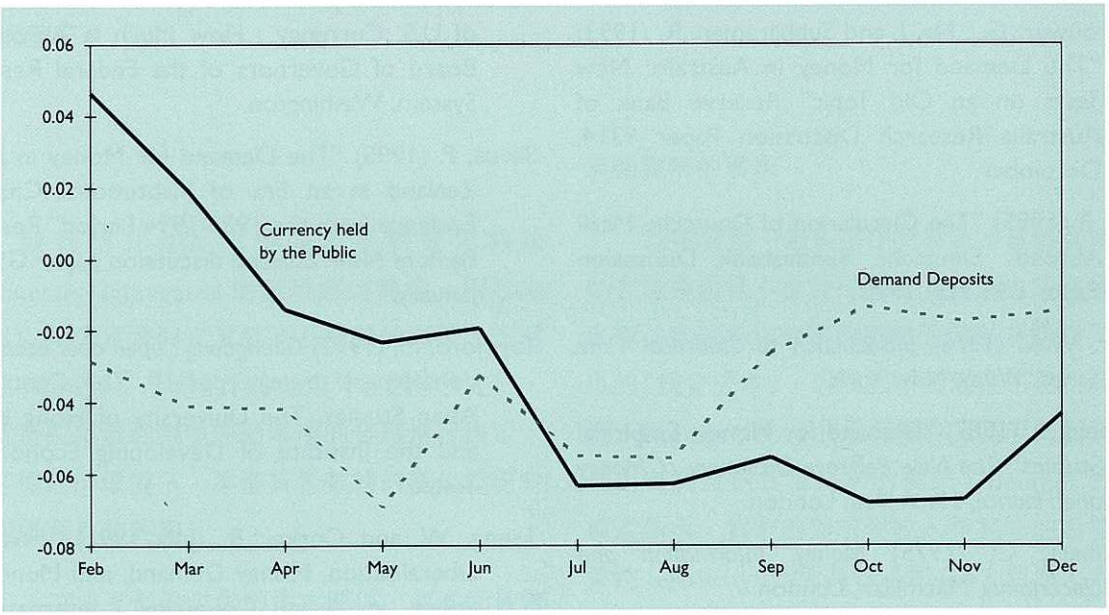
Chart A1a

Outstanding issue of Certificate of Indebtedness



In the monthly estimation, the currency series is seasonally unadjusted and seasonal dummies on the right-hand side are used to capture its seasonal effect. So, their semi-elasticity (or coefficients) reflect the seasonal pattern of currency series (Chart A1b).

Chart A1b
Seasonal pattern comparison:
Currency held by the Public and Demand Deposits



Demand deposits

In the monthly short-run estimation, restriction tests on sum of coefficients of dummy pairs of Qtyph and IPOs are shown in the following table. The insignificant F-statistics indicates that the coefficient pairs sum to zero, reflecting any boost up in demand deposits by typhoon or IPOs will be completely reversed in the next month.

Dummy pairs	F-statistics
Qtyph	1.72
IPO2, IPO3, IPO4, IPO5	0.62

In the final monthly short-run specification, IPO2 is not paired. Its reverse effect, captured by $IPO2_{+1}$, in October 92 is completely dominated by the boost up effect of IPO3, which has five times of IPO2's excess subscriptions, in the same month. So it is highly insignificant and dropped.

Compared with currency, chart A1b also reveals that the seasonal pattern of demand deposits is less pronounced.

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