

# External Demand for Hong Kong Dollar Currency

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This article examines the circulation of the Hong Kong dollar outside of Hong Kong. It is estimated that some 15-25% of the total outstanding Hong Kong dollar stock (around HK\$15-25 billion) is held outside of Hong Kong. Most of it is held in the southern parts of Mainland China, where the demand for Hong Kong dollars has grown in recent years, despite a stable renminbi. The demand is attributable to the increased economic integration of Hong Kong and the southern China region, the non-convertibility of the renminbi, and the relatively larger denominations of Hong Kong dollar banknotes.

## I. INTRODUCTION

This article discusses issues related to the circulation of Hong Kong dollar currency outside Hong Kong, and provides estimates of its likely magnitude. The external holdings of Hong Kong dollars bring benefits as well as concerns to Hong Kong. In particular, it may affect the measurement of monetary aggregates, which can be useful as an economic indicator, while not playing a role in guiding policy under the Linked Exchange Rate system. Furthermore, given increasing socio-economic integration between Hong Kong and the Mainland, co-circulation of currencies may have implications for the future developments of monetary systems in Hong Kong. The rest of the article is organised as follows. The next section outlines the implications of Hong Kong dollar circulation outside Hong Kong, including the potential benefits and concerns for Hong Kong. Section III examines the factors that have contributed to the external demand. Section IV provides some estimates of the likely size of the external holdings of Hong Kong dollars, including a review of other studies in this area. The final section concludes.

## II. POTENTIAL BENEFITS AND CONCERNS

There are a number of reasons why it is of interest to study the size of the external holdings of Hong Kong dollar currency.<sup>1</sup> First, it brings benefits to Hong Kong in the form of seigniorage. In its purest form seigniorage is simply the profit which accrues to the issuer from the physical currency issue, because the holders of currency are in effect holding obligations of the central bank or government on which no interest is paid. In Hong Kong, when the three note-issuing banks (NIBs) issue banknotes, they are required by law to submit US dollars (at HK\$7.80=US\$1) to the Hong Kong Monetary Authority (HKMA) for the account of the Exchange Fund in return for Certificates of Indebtedness.<sup>2</sup> The US dollar funds are then invested by the Exchange Fund in liquid US dollar assets. At the end of 2002, the total amount of outstanding Certificates of Indebtedness was equivalent to about US\$15 billion. Assuming a rate of return of 1.6% p.a., the seigniorage is estimated to be US\$0.25 billion

<sup>1</sup> Latter (2000) provides a discussion of the benefits and disadvantages of the internationalisation of currencies, which is related to the general use of a currency for international trade and financial transactions.

<sup>2</sup> In the case of coins, which are issued by the HKMA, transactions between the HKMA and the agent bank responsible for storing and distributing the coins to the public are settled against US dollars at the rate of HK\$7.80 to one US dollar. A new \$10 note, issued by the SAR Government, has gone into circulation in mid-September 2002, and its backing arrangement is the same as for coins.

per year.<sup>3</sup> If 20% of the Hong Kong dollar currency notes is held outside Hong Kong, this means that the SAR Government earns US\$0.05 billion per year from non-residents.<sup>4</sup> As will be discussed later, most of the Hong Kong dollar currency outside Hong Kong are held in the southern parts of the Mainland, particularly in Guangdong province.

One could also count as seigniorage, in a broader sense, any gains to the Hong Kong banking system that arises from the use of Hong Kong dollars in the Mainland, associated with additional demand for bank balances in the currency. Specifically, part of the Hong Kong dollar banknotes brought to the Mainland, for instance by visitors from Hong Kong, are deposited with Mainland banks, and are re-deposited with banks in Hong Kong. The banks in Hong Kong earn a profit margin on this intermediation. Hong Kong residents also benefit from savings on foreign exchange transactions when they use Hong Kong dollar notes for transactions in the Mainland.

While the external demand for currency notes brings some benefits, it also has some potential disadvantages that warrant attention. One is concerns about counterfeiting. Opportunities to counterfeit are increased when a currency circulates outside the issuing jurisdiction because some users may be unfamiliar with the currency and counterfeiting control mechanisms may be absent. In recent years, there have been occasional reports of discoveries of fake Hong Kong dollar currency, but the total value has been minimal compared with the total notes outstanding.<sup>5</sup> Efforts have been made to combat counterfeiting and increase public awareness of forged notes, including the introduction of new

security features to \$1,000 banknotes issued since 2000.

Secondly, external holdings of Hong Kong dollars, if significant and unrelated to domestic spending, may complicate the interpretation of movements in the currency outstanding and other monetary aggregates. Thirdly, they can also create distortions to the balance of payments statistics. Specifically, circulation of the Hong Kong dollar in the Mainland increases Hong Kong's external liabilities, which is a capital inflow in the balance of payments. Conversely, the Mainland increases its external claims, which are capital outflows. However, these flows may not be captured by the balance of payments statistics, and estimates of such flows would help reduce the size of the error-and-omission category in the external transaction accounts.<sup>6</sup>

### III. THE EXTERNAL DEMAND FOR HONG KONG DOLLAR

With the opening of the Mainland economy since the late 1970s, there have been increasing flows of goods, capital and people across the boundary. In particular, the numbers of visitors from Hong Kong to the Mainland (mainly to the neighbouring Guangdong province) have risen strongly in the past two decades (Chart 1). The growth of trade, investment and personal contacts has implied that Hong Kong dollar currency is frequently transferred to the Mainland. Part of the currency flows back to Hong Kong through channels, including interbank placements and spending in Hong Kong by Mainland visitors. The remainder circulates in the Mainland as a medium of exchange as well as a store of value.<sup>7</sup>

<sup>3</sup> The assumption of a 1.6% rate of return was based on the average yields of 3-month US treasuries in 2002. The net return is reduced by the costs of producing the banknotes, but these are negligible relative to the earnings, particularly in the case of the higher denomination notes.

<sup>4</sup> As shown later, 20% is about the mid-point of the range of our estimates.

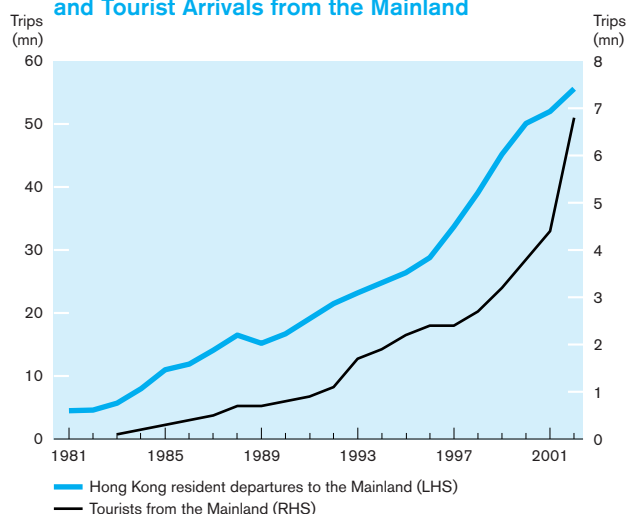
<sup>5</sup> The comparison was based on reports of discoveries of fake notes to the Commercial Crime Bureau, Hong Kong Police Force.

<sup>6</sup> If the funds flow back to Hong Kong through the interbank placements as noted above, they are still Hong Kong liabilities, but would be reflected in the balance of payments statistics.

<sup>7</sup> Hong Kong dollar banknotes have long been circulated in Macau in parallel to patacas. However, the magnitude of the holdings in Macau is estimated to be small because of the small size of its population (about 437,700) and economy. See Chan (2002).

CHART 1

### Hong Kong Resident Departures to the Mainland and Tourist Arrivals from the Mainland



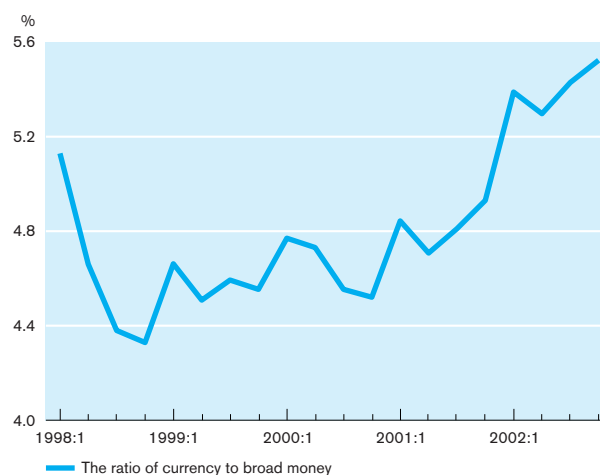
In earlier years, relatively high inflation in the Mainland, episodes of renminbi (RMB) devaluation before the unification of the dual exchange rate system in 1994, and the comparative lack of alternative financial assets were important factors underlying the demand for Hong Kong dollars.<sup>8</sup> Since the mid-1990s, RMB has been stable along with the strong performance of the Mainland economy. In fact, reflecting increased confidence in RMB and the rising importance of the Mainland as a trade and investment partner, there is an increasing use of RMB in the neighbouring economies including Hong Kong. Nevertheless, the Hong Kong dollar continues to be in demand in the Mainland. If anything, there are signs of an increase in the external holdings of Hong Kong dollar currency in recent years.

First, Hong Kong dollar banknote issuance increased considerably in recent years despite a generally weak level of economic activity in Hong Kong, and only a

moderate rise in broad money. As a result, the ratio of currency to broad money has increased (Chart 2). Of course, there are factors that suggest an increase in the domestic demand for cash. In particular, the decline in interest rates in 2001 has reduced the opportunity costs of holding cash.<sup>9</sup> In addition, the price deflation in the past few years has increased the amount of small value purchases, and thus the use of cash. The introduction of bank charges and fees for various types of services may have induced some customers to make larger and more frequent cash withdrawals, resulting in increased cash holdings.<sup>10</sup> It may also have discouraged the use of cheques or bank coupons for small-value transactions. On the other hand, there has been increasing use of non-cash payment means including credit cards. The number of credit card accounts nearly doubled in the past four years (to 9.5 million at the end of June 2002). The more popular use of Octopus cards in some retail chains since 2000 may also have substituted cash to some extent in the small-value transactions.

CHART 2

### The Ratio of Hong Kong dollar Currency to Broad Money (Quarterly Figures)



<sup>8</sup> During 1986-93, the Mainland maintained a dual exchange rate system, with an official rate that was adjusted periodically and a more depreciated market-determined rate prevailed in the Foreign Exchange Adjustment Centres (the swap centres).

<sup>9</sup> Furthermore, there is reportedly an increase in underground economic activity, such as rising numbers of hawkers. While it is difficult to gauge the size of this increase, the incentive structure suggests that it is unlikely to be large. The tax regime has been stable, and if anything, there have been tax concessions in the

past few years. Moreover, an increase in inbound tourists from the Mainland, who use cash as the primary means of transactions, may have also raised the use of Hong Kong dollar cash in Hong Kong. Nevertheless, part of the transactions by Mainland visitors are now conducted in RMB.

<sup>10</sup> A number of banks in Hong Kong have introduced a variety of fees and charges on account and banking services following the final phase of interest rate deregulation in July 2001.

Secondly, the rise in the stock of the Hong Kong dollar banknotes in recent years was due mainly to issuance of relatively large denomination notes (\$100s, \$500s and \$1000s) (Chart 3). Given the increasing use of non-cash payment means and the weak level of economic activity in Hong Kong, it is hard to imagine that the increased issuance of large banknotes was solely for domestic use. Thirdly, informal information from some major banks suggests that their transfer of Hong Kong dollar cash across the boundary changed from a net inflow to Hong Kong three to four years ago to a net outflow currently, indicating increased demand from the Mainland.

The unabated demand for Hong Kong dollar currency in the Mainland in the face of a stable RMB may reflect a combination of factors.<sup>11</sup> First, the RMB is still not freely convertible into other currencies, and there are controls on capital and financial account transactions by the Mainland authorities. Holding Hong Kong dollar banknotes — a convertible, stable currency — represents a means of accumulating foreign assets for some individuals and business firms on the Mainland.

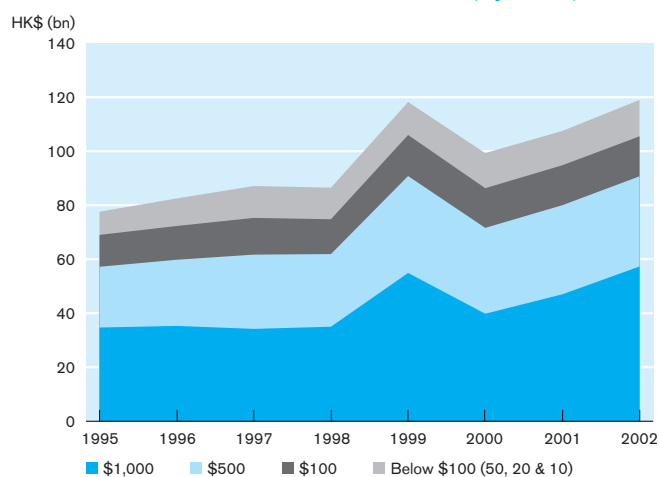
Secondly, an increasing number of Hong Kong enterprises operate on and a rising number of Hong Kong residents live on, or frequently travel to, the Mainland.<sup>12</sup> For these persons, the preferred means

of transaction remains the Hong Kong dollar, reflecting the exchange controls on the RMB.

Thirdly, the relatively large denominations of Hong Kong dollar banknotes render them more useful as a store of value as well as a means of payment, particularly since the Mainland is still largely a cash-based economy. While Hong Kong dollar banknotes are issued in large denominations including \$100, \$500, and \$1,000 notes, the denomination of the largest note of RMB is only RMB100 (about 95 Hong Kong dollars at an exchange rate of 1.05).<sup>13</sup>

CHART 3

## Distribution of Notes in Circulation (By Value)



<sup>11</sup> The stable RMB was attributable to strong economic growth with low inflation and a strong external position. The RMB/USD exchange rate has stayed within a range of 8.272-8.710 following the unification of the dual exchange rate system in 1994.

<sup>12</sup> According to a recent survey conducted by the Planning Department, some 41,300 Hong Kong residents are living in the Mainland. Of the total, around 95% of them were living in Guangdong province and 78% of them were "required by work". Another survey conducted in 2001 suggests that some 496,300 persons travelled frequently, at least once a week,

across the boundary for various purposes, including business, working, leisure and visiting family members. The numbers represented an increase of 35% over that of the 1999 survey, and most of them travelled to Guangdong areas (Shenzhen, Dongguan and Guangzhou).

<sup>13</sup> Experiences of the US indicate that the net new demand for US\$100 notes came primarily from abroad (Porter and Judson, 1996). Rogoff (1998) suggests that the issuance of large euro notes (including 100, 200 and 500) may enable the euro over time to challenge the dominance of the US dollar in the global market for a safe, reliable vehicle currency.

Finally, some regulatory changes in the Mainland in the past few years have possibly also facilitated the increased use of Hong Kong dollar banknotes. Foreign invested enterprises in the Mainland are now allowed to use their RMB earnings to buy Hong Kong dollars from banks to pay the salary and other living expenses for their foreign employees. In addition, more domestic banks in the Mainland are allowed to conduct foreign exchange transactions. Foreign banks are permitted to conduct such business not only with foreign-funded enterprises as in the past, but also with Mainland enterprises and residents. These imply that demand by banks for Hong Kong dollar vault cash has increased to meet daily transaction needs in the Mainland.<sup>14</sup>

#### IV. ESTIMATING EXTERNAL HOLDINGS OF HONG KONG DOLLAR CURRENCY

In general, there are two possible ways of estimating the portion of the currency stock that is held externally. Either we could find data that measure the size of external holdings directly or we can try to find characteristics that explain domestic holdings and then take foreign holdings as the residual. The first method cannot be applied to Hong Kong because of a lack of data.<sup>15</sup> There are some studies that rely on the indirect methods by examining the demand for the Hong Kong dollar currency. This section provides a brief review of the existing analyses, as well as our own estimates based on alternative approaches.

Hawkins and Leung (1997), and Chan (2002) estimated external holdings of Hong Kong dollar by explicitly taking into account the influence of the opening and reform of the Mainland, using a currency demand function for the Hong Kong dollar. The former added a “dummy” time trend in the currency demand equation to approximate the external influences. The latter explicitly included macro-economic variables in Guangdong in the model. Both studies assumed that “the Mainland impact” started from around the mid-1980s.<sup>16</sup> Hawkins and Leung estimated that around 25% of the total currency outstanding at end-1994 were held outside Hong Kong, while Chan’s estimates pointed to about 11% at end-1999.<sup>17</sup>

It should be noted that both methods have limitations. In Hawkins and Leung’s case, the linear time trend may not capture the dynamic impact on demand for Hong Kong dollars alongside the ongoing structural and financial reforms in the Mainland. There is no particular reason to assume an increasingly linear trend in the demand for Hong Kong dollar currency, for example. One drawback of Chan’s method is that the estimates rely heavily on the use of appropriate macro-economic variables of the Mainland, which may vary in line with the structural and regulatory changes in the period.

An earlier study by Greenwood (1990) employed a more straightforward method, based on the assumption that the currency-to-GDP ratio (CR) would decrease over time as a result of the

<sup>14</sup> This point was made by banks that have considerable foreign exchange transactions in the Mainland.

<sup>15</sup> Studies on the foreign holdings of US dollar currency have made use of some direct sources of information about currency flows abroad. These include the Currency and Monetary Instrument Reports required by the US Customs Services and information acquired by the Federal Reserve Bank of New York on incoming and outgoing currency shipments by banks. However, these studies do not provide a complete picture since they miss much of the cash that is hand-carried or remitted by guest workers and travellers. Sources of indirect information

about currency flows such as surveys have thus been employed. Porter and Judson (1996) provide a review of the different approaches to estimating the amount of US dollar holdings by foreigners.

<sup>16</sup> In the early stages of the Mainland’s economic reform (1979-83), the emphasis was put on the agricultural sector. It was only after 1984 that the emphasis shifted. Price reforms were implemented and the economy was moved towards the socialist market system. Reforms in the financial and monetary sectors have also been steadily introduced since the mid-1980s.

<sup>17</sup> Including an estimate of about 3% of holdings in Macau.

development of cashless payments and other financial innovations, which reduce the need to hold cash for transaction purposes. Specifically, a trend to the ratio was fitted for the period 1966-1984, which was extrapolated to predict the domestic demand for Hong Kong dollars in 1985-1989. His estimates suggest that about 18% of the total outstanding Hong Kong dollar currency was held outside Hong Kong at end-1989.

We update Greenwood's estimates by extending the sample period to 2001. Chart 4 exhibits the ratio of currency to nominal GDP from 1966 and 2001. The ratio recorded a pronounced downward trend during the period 1966-84, but reversed to an increasing trend in the subsequent period. This change in the trend is similar to the patterns observed for the US and Germany, both of which are known to have a significant amount of their currencies circulating offshore (Chart 5, Panel A). However, it is in contrast with the trend in the ratios for a group of Asian economies and some small OECD economies (Chart 5, Panels B and C).

CHART 4

The Ratio of Currency to Nominal GDP in Hong Kong

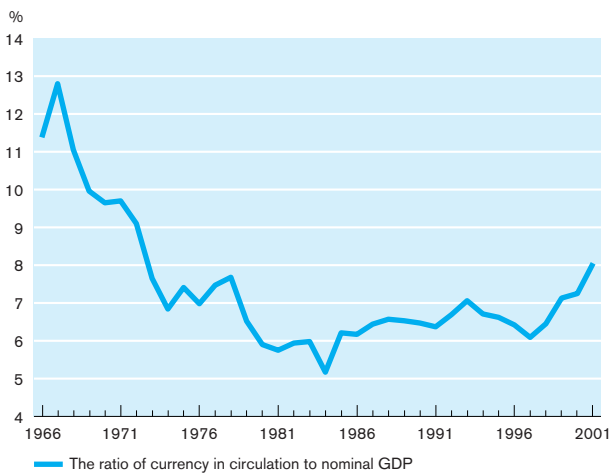
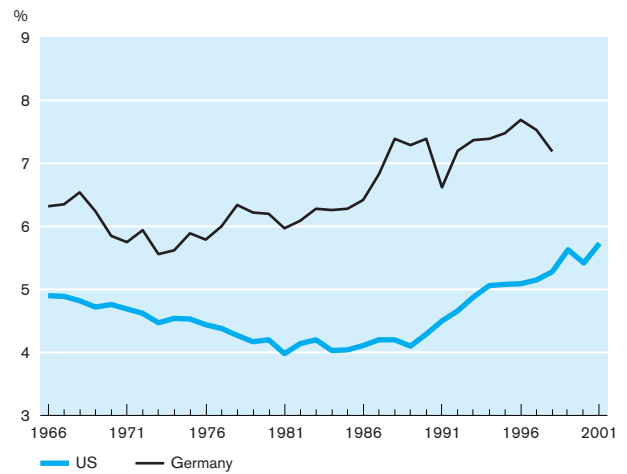


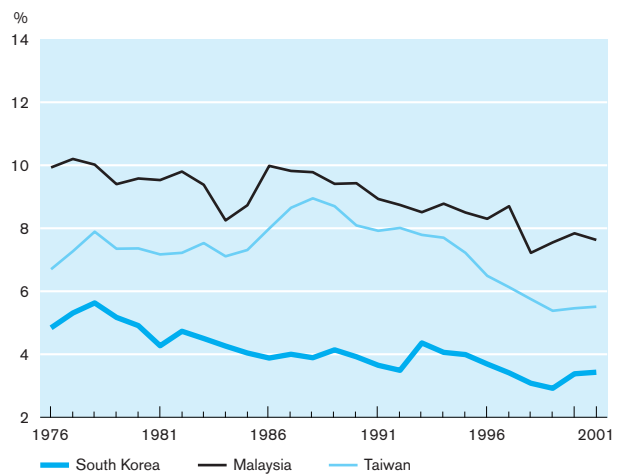
CHART 5

The Ratio of Currency to Nominal GDP

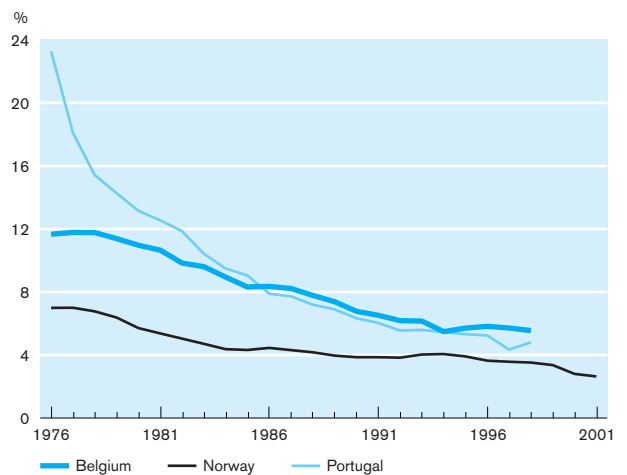
Panel A: US and Germany



Panel B: Asian Economies



Panel C: Small OECD Economies



A curve of the form of equation (1) was fitted for the period 1966-84, which was used to extrapolate the CR series for the period 1985-2001. Specifically,

$$CR = a + bx^{-n} \tag{1}$$

where  $x$  is the time trend 66,67 ...84, and  $n=12$ .<sup>18</sup>

The constant “ $a$ ” of equation (1) was determined with reference to the average ratio (of 0.06) in three Asian economies (Taiwan, South Korea, and Malaysia) during 1990-2001.<sup>19</sup> These economies are suitable benchmarks because they have similar sets of holidays, festivals and customs as Hong Kong, and there is no significant external demand for their currencies.

Chart 6 shows the actual and extrapolated CR for the period under study. It was found that the deviation of fitted CR from the actual CR was around 2% at end-2001, implying that about 25% (or HK\$25 billion) of the total outstanding Hong Kong dollar currency was held externally. It should be noted that the estimates are very sensitive to the

assumption of the underlying value of the ratio. For example, if the underlying ratio was assumed to be 4% or 5%, external holdings would be about 50% and 37% respectively of the total amount as of end-2001 (Chart 7). Furthermore, this method does not capture the effects of changes in interest rates on domestic demand for currency. In particular, the declines in interest rates in 2001, which have reduced the opportunity cost of holding currency, should have raised the demand for Hong Kong dollar currency.

To capture the interest rate effect, we estimate a demand function for Hong Kong dollar narrow money. However, rather than allowing explicitly for the influence of the Mainland factors, we let the data determine the best-fitting function of domestic demand by trying different proportions of external holdings of Hong Kong dollar. The ratio of external holdings is derived from the demand function that yields the maximum of the log likelihood. Specifically, the demand for narrow money balances in Hong Kong was specified as a function of real income and opportunity cost variables (including real interest rate and expected inflation rate) (Equation (2)).<sup>20</sup>

CHART 6

Actual and Fitted Currency-to-GDP Ratios

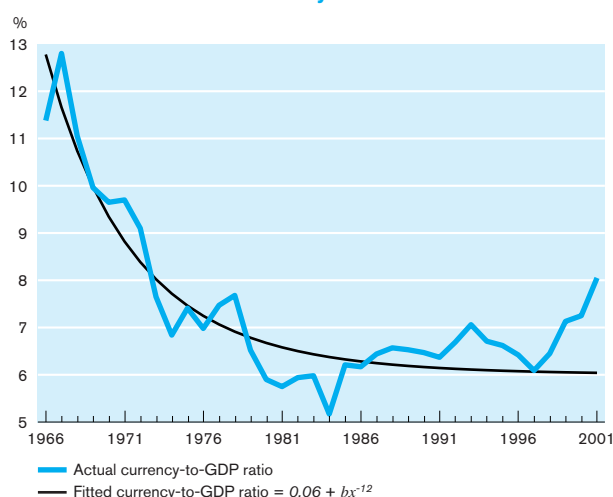
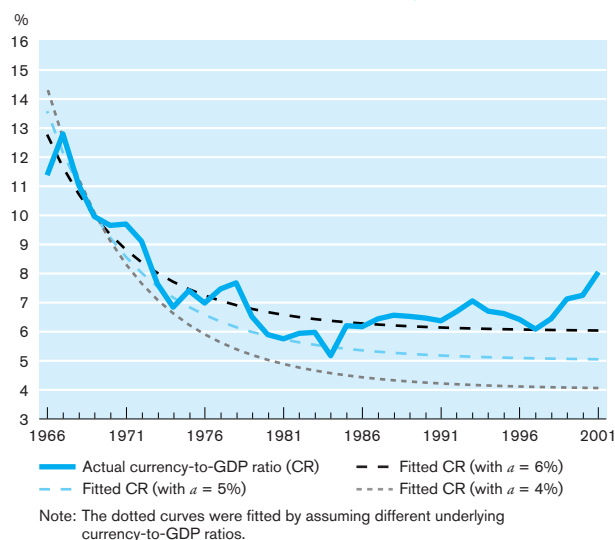


CHART 7

A Comparison on Various Currency-to-GDP Ratios



<sup>18</sup> The value of  $n$  was selected by try and error to make sure that CR converges asymptotically to  $a$ .

<sup>19</sup> It is assumed that should there be no offshore demand for Hong Kong dollar, the CR would converge gradually to the average ratio in these economies. Greenwood assumed a value of 4% for  $a$  with reference to the ratios in seven developed economies in the mid-1980s.

<sup>20</sup> A similar methodology was applied by Krueger and Ha (1995) to estimate the demand for the South African rand in Swaziland. See Krueger and Ha (1995). The real interest rate captures the real return on interest-bearing financial instruments, while expected inflation rate measures the opportunity cost of holding narrow money.

$$\log\left(\frac{M - \theta^* CU}{P}\right) = \alpha_0 + \alpha_1 \log\left(\frac{Y}{P}\right) + \alpha_2 \pi + \alpha_3 r + \varepsilon \quad (2)$$

where

$CU$  = Hong Kong dollar currency held by the public

$M$  = nominal narrow money, which includes the total outstanding stock of currency ( $CU$ ) and demand deposits with banks;

$\theta$  = the ratio of external holdings of Hong Kong dollar ( $0 \leq \theta \leq 1$ );

$P$  = price level;

$Y$  = nominal income;

$\pi$  = expected inflation rate; and

$r$  = real interest rate.

The left-hand side of the equation represents the real narrow money balances that is demanded domestically. For  $\theta = 0$ , all currency is held at home; for  $\theta = 1$ , all currency is held abroad. Equation (2) was estimated successively to find the value of  $\theta$  that yields the maximum of the log likelihood function (LLF). (See Appendix for the details on data and estimation.) The estimates suggest that the LLF reaches a maximum at  $\hat{\theta} = 0.16$  (Chart 8). This implies that some 16% (or 16 billion at end-2001) of Hong Kong dollar currency was held externally. A limitation of this method is that it assumes a constant proportion of external holdings, which may not be appropriate. As a result, it may over-estimate the ratio in the earlier years but under-estimate it in the more recent periods.

In view of the limitations and uncertainties about the different methods, all point estimates should be treated with caution. Nevertheless, they provide broad indication of the likely size of the external holdings of Hong Kong dollar currency. Specifically, our own estimates suggest that a range of 15-25% of the total amount of Hong Kong dollar currency are likely held outside Hong Kong (Table 1). These are broadly in line with the estimates of the other studies for the earlier periods. For a given ratio, the increased total amount of Hong Kong dollars in circulation implies a rise in the external holdings in recent years. For example, at a ratio of 20%, the amount of external circulation would be about HK\$21 billion in June 2002, compared with HK\$18 billion and HK\$20 billion at end-2000 and end-2001 respectively.

CHART 8

The Log Likelihood Functions (LLF) for Various Ratios of External Holdings of Hong Kong dollars ( $\theta$ )

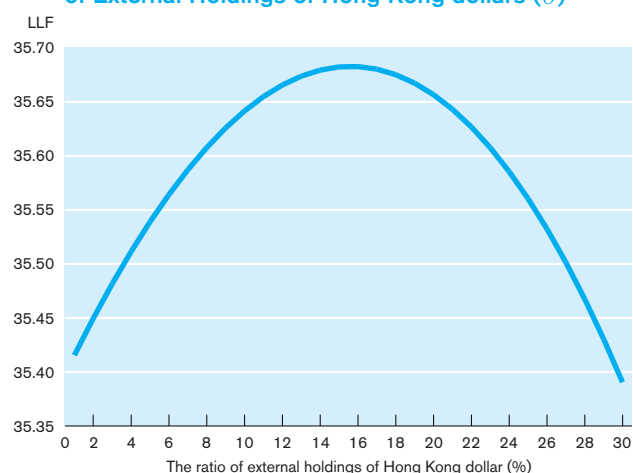


TABLE 1

A Summary of Estimates of External Holdings of Hong Kong dollars

Study	Estimates of External Holdings of Hong Kong dollar Currency		Period
	Value (HK\$ bn)	In % of Total Currency in Circulation	
Greenwood (1990)	6	18	end-1989
Hawkins and Leung (1997)	17	25	end-1994
Chan (2002)	9	11	end-1999
Peng and Shi (2002a) <sup>1</sup>	25	25	end-2001
Peng and Shi (2002b) <sup>2</sup>	16	16	end-2001

Notes:

<sup>1</sup> An updating of Greenwood estimates.

<sup>2</sup> Method based on searching for the best-fit of the domestic money demand function.



## V. CONCLUSION

This article examines a number of issues related to the circulation of Hong Kong dollar banknotes outside Hong Kong. These include potential benefits and concerns to Hong Kong, factors underlying the external demand for Hong Kong dollar currency, and empirical estimates of its likely size. Our estimates suggest that a significant amount of Hong Kong dollar currency — in a range of 15-25% of the total outstanding stock — is currently circulating outside Hong Kong.

It is interesting to note that Hong Kong dollar currency in the Mainland appears to have increased in recent years. This occurs in the face of a stable RMB, which itself has become a stronger currency that is increasingly used in the neighbouring economies, including Hong Kong. This development probably reflects a combination of factors, including the non-convertibility of the RMB, increasing socio-economic integration between Hong Kong and the Mainland, the relatively large denominations of the Hong Kong dollar, and some relaxation of foreign exchange transaction rules by the Mainland authorities.

Furthermore, it should be noted that the external demand for Hong Kong dollar currency largely depends upon conditions outside Hong Kong. In particular, the non-convertibility of RMB probably makes the acquisition of Hong Kong dollars — a convertible currency — particularly attractive.

Finally, the increasing use of the RMB in Hong Kong and the Hong Kong dollar in the Mainland suggests a co-circulation of the two currencies in Southern China. This raises the question of how the situation will evolve over time, as the process of socio-economic integration continues, financial and capital market reforms deepen in the Mainland, and full convertibility of RMB is eventually introduced. The concern is whether one currency will be favoured over the other, and if so, how it will affect the banking

and financial sector. These issues have been raised by a Viewpoint article by the Chief Executive of the Hong Kong Monetary Authority (Yam, 2002). They may have important implications for the development of the monetary and financial system in Hong Kong as well as on the Mainland. This article represents the first step in our research into issues relating to the co-circulation of currencies.

## APPENDIX

### THE DOMESTIC DEMAND FOR MONEY

Annual data from 1972 to 2001 were used in the estimation, and  $\theta$  was assumed to be zero before 1985. Real narrow money balances were obtained by deflating the nominal data by the price deflator for private consumption expenditures, and real income was measured by real GDP. The real interest rate was computed as the difference between the average three-month deposit rate and the inflation rate, which is measured by the year-on-year percentage change of the private consumption deflator. The expected inflation rate was proxied by the percentage change of the private consumption deflator over a year. All data except the interest rate and inflation rate were in logarithms.

An error-correction modelling approach was employed. This requires the variables to be stationary in first difference and co-integrated with a stationary linear relationship. These were confirmed by Augmented Dickey Fuller unit root tests and some preliminary results of Johansen co-integration tests. The money demand equation was then estimated successively to find the value of  $\theta$  that yields the maximum of the log likelihood function (LLF). The estimates suggest that the LLF reaches a maximum at  $\hat{\theta} = 0.16$ . The final estimation results are shown below. All coefficients are significant and have the expected signs. Diagnostic tests do not show evidence of instability in the residuals.

$$\Delta m_t = -1.807 + 1.196\Delta y_t - 1.962\Delta\pi_t - 0.432(m_{t-1} - 0.828y_{t-1} + 4.907r_{t-1} + 6.736\pi_{t-1})$$

(-1.88)    (2.51)    (-3.64)    (-2.38)    (-9.28)    (3.01)    (3.10)

$\bar{R}^2$	0.56	
Equation standard error	0.08	
LM test for serial correlation	0.95	[0.40]
Jarque-Bera test for normality	0.60	[0.74]
White test for heteroskedasticity	1.06	[0.45]

Note: Numbers in ( ) are t-ratios, and numbers in [ ] are p-values.

where  
 $m_t = \log\left(\frac{M - \theta^* CU}{P}\right)$ , and

$\Delta$  = the first difference operator.

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