HONG KONG MONETARY AUTHORITY

# IS THE HONG KONG DOLLAR REAL EXCHANGE RATE MISALIGNED?

Prepared by Frank Leung and Philip Ng[*]

Research Department

## Abstract

This paper estimates the equilibrium path of the Hong Kong dollar real effective exchange rate (REER) and compares it with the actual path of the Hong Kong dollar REER to assess the extent of real exchange rate misalignment. Empirical results from various approaches of exchange rate assessment adopted in this study generally suggest that there was no obvious evidence of exchange rate misalignment for the Hong Kong dollar in 2006. This is consistent with the observation that there were no obvious signs of macroeconomic imbalances in the Hong Kong economy.

*Executive Summary:*

- *In its recent surveillance decision on exchange rate policies, the IMF requires an assessment on whether the level of exchange rate of a member economy is misaligned as compared to its equilibrium. To facilitate our discussion with the IMF, we adopt the IMF methodologies to estimate the equilibrium path of the Hong Kong dollar real effective exchange rate (REER) and compare the actual path of the Hong Kong dollar REER with this estimated equilibrium path.*

- *Our estimates show that the equilibrium Hong Kong dollar REER has been depreciating since the late 1990s, reflecting primarily a larger equilibrium current account balance of the Hong Kong economy. The increase in Hong Kong's equilibrium current account balance in the past decade reflects a persistent decline in construction investment as well as an increase in outward investments as the economy transformed itself from a manufacturing centre to a financial and services hub. At the same time, domestic saving has increased due to the perceived higher economic uncertainties in the aftermath of the Asian financial crisis and the strengthening of Hong Kong's status as an international financial centre.*

- *The actual Hong Kong dollar REER has also been depreciating since the late 1990s, first due to the prolonged deflation during 1998-2004 and subsequently attributable to a depreciation of the Hong Kong dollar nominal effective exchange rate alongside the US dollar since 2002. The Hong Kong dollar REER has been flexible even though its nominal exchange rate against the US dollar has been fixed.*

- *Comparing the actual Hong Kong dollar REER with its estimated equilibrium path, we find that the real value of the Hong Kong dollar was overvalued by 10-30% at its peak in 1998; but by 2006, the gap had been basically closed. Overall, the various approaches of exchange rate assessment adopted in the paper generally suggest that there was no obvious evidence of exchange rate misalignment for the Hong Kong dollar in 2006. This is consistent with the observation that there were no obvious signs of macroeconomic imbalances in the Hong Kong economy. This conclusion is also shared by the IMF Article IV consultation team.*

# I.    INTRODUCTION

The real value of the Hong Kong dollar, as measured by the CPI-based real effective exchange rate index (REER), has been depreciating considerably since late 1998, first as a result of domestic price deflation and then the depreciation of the US dollar since 2002.   Meanwhile, Hong Kong has continued to register current account surpluses, or equivalently positive saving-investment balances, averaging 9.8% of nominal GDP between 2002 Q1 and 2006 Q4.   Because of the sustained current account surpluses, Hong Kong has accumulated a sizeable net foreign asset position, equivalent to almost three times nominal GDP at the end of 2006.

The continued current account surpluses and large net foreign asset positions may give rise to the perception that the Hong Kong dollar is undervalued.   However, if the large current account surplus and net foreign asset position were indeed symptoms of currency misalignment, it would be inconsistent with the fact that there were no visible internal macroeconomic imbalances in recent years: the inflation rate has remained low, labour market conditions were normal, and there were few signs of overheating in the residential property market.   Moreover, cursory observations show that a number of other small-and-open economies that enjoy the status of an international financial centre also tend to have persistent and sizable current account surpluses.

As part of our ongoing dialogue with the IMF on policy issues relating to monetary and financial stability, we adopt in this paper the methodology developed by the Consultative Group on Exchange Rate Issues (CGER) of the IMF, described in IMF (2006), to provide a comprehensive assessment of the level of the Hong Kong dollar exchange rate. When applying the IMF methodology, we also take into account the special situation of Hong Kong as a city-based international trade and financial centre.   In addition to using time-series data to examine the evolution of the Hong Kong dollar equilibrium exchange rate over time, we also compare Hong Kong, through the use of a panel data set, with the economies of five other international financial centres.

The paper is organised as follows. Section II reviews recent developments in the real exchange rate and the current account balance in Hong Kong. Section III describes the three major approaches used by the IMF for assessing exchange rate misalignment. Section IV describes the implementation of the methodologies and presents econometric evidence on the Hong Kong dollar exchange rate, and analyses the underlying trends and causes. Section V draws conclusions.

## II. DEVELOPMENTS OF THE REAL EXCHANGE RATE AND CURRENT ACCOUNT BALANCE

The Hong Kong dollar REER was on an appreciating trend from the early 1980s to 1997, but thereafter the trend reversed and the REER has been depreciating since 1998 (Chart 1).[1] The appreciation phase reflected the strength of the US dollar nominal exchange rate during the period as well as the higher domestic inflation rate in Hong Kong relative to its trading partners. In the depreciation phase after 1998, the decline in the REER was first driven by prolonged domestic price deflation and subsequently by the depreciation of the US dollar nominal effective exchange rate since 2002. Separately, Hong Kong registered current-account surpluses in most of the years since the early 1970s (Chart 2). Because of the sustained current account surpluses, Hong Kong has accumulated a sizeable net foreign asset position, equivalent to almost three times nominal GDP at the end of 2006.

---

[1] The Hong Kong dollar REER used in this paper is compiled based on Hong Kong's direct trade and service trade. Since Hong Kong's re-exports are complementary to, rather than in competition with, Mainland China's external trade, an inclusion of re-exports in the determination of currency weights would overstate the importance of the renminbi in the Hong Kong dollar REER. The competitiveness of re-export trade is measured by the renminbi REER.

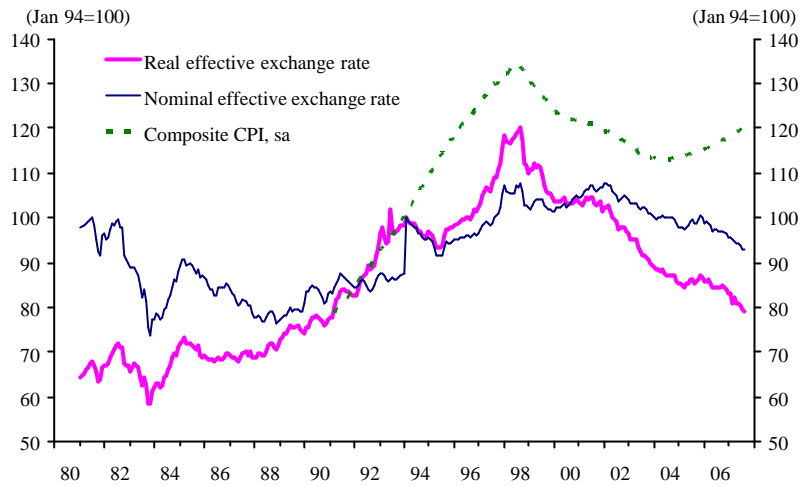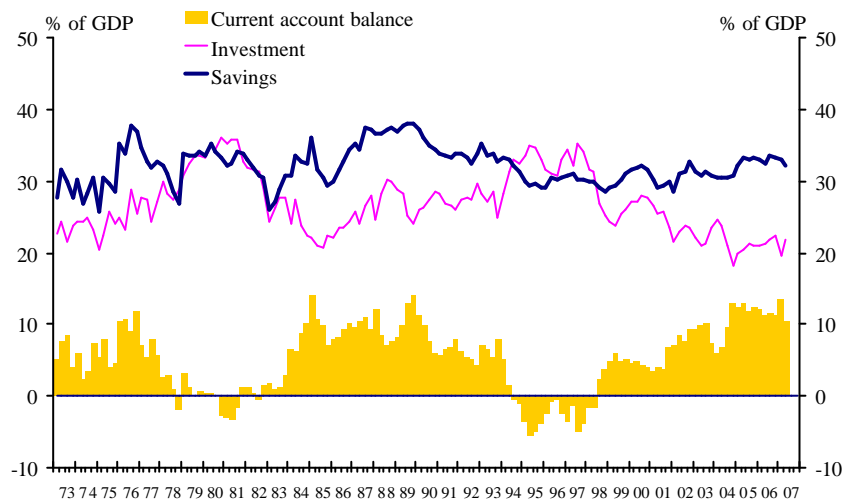**Chart 1:    Effective exchange rates and consumer price index**



Source: Census and Statistics Department (C&SD), HKMA.

**Chart 2:    Savings, investment and current account balance**



Note:    Current account balances are proxied by total trade balances
             due to limited data availability.
Source: C&SD.

A graphical comparison of other economies with characteristics similar to Hong Kong — a service-based economy and an international financial centre — shows that large current account balances and a large net foreign asset position are common features of these economies (Chart 3). In fact, empirical results in Leung (2006) show that an expansion of Hong Kong's role as an international financial centre, as proxied by a rising M2-to-GDP ratio in the empirical specification, is positively related to the current account balance.

**Chart 3: External position of economies with financial centre status**

| a. Current account | b. Net foreign asset position |
|---|---|
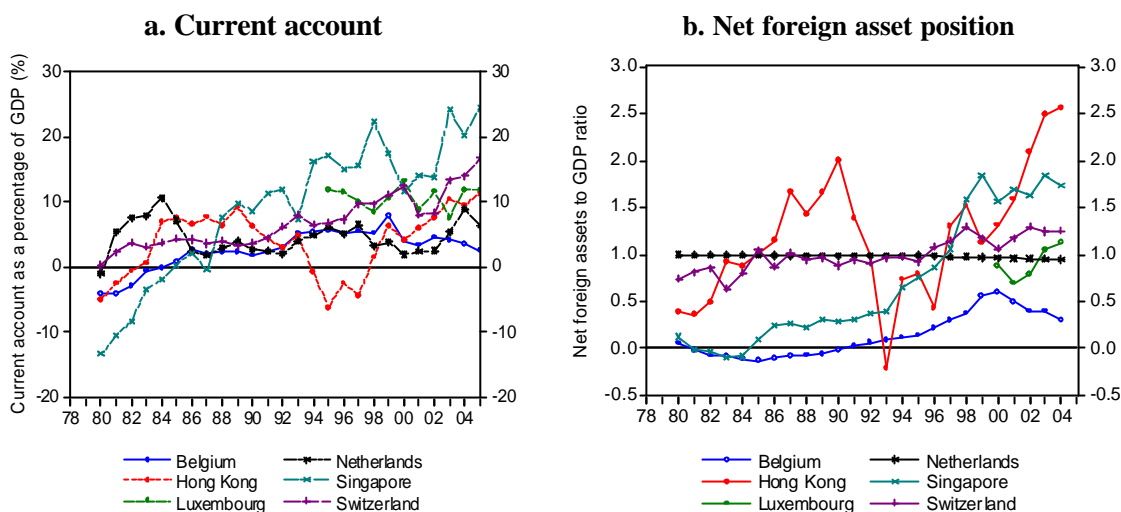


Source: IMF.

Source: Lane and Milesi-Ferretti (2006).

## III. ANALYTICAL APPROACHES OF EXCHANGE RATE ASSESSMENT

The IMF adopts three different approaches to assess the level of exchange rates. The first one is the equilibrium exchange rate approach. This approach attempts to estimate the long-run (equilibrium) relationship between the REER and its fundamental determinants such as the terms of trade, productivity growth differential between the tradable and non-tradable sectors, government spending and net foreign asset position (Edwards 1991 and IMF 2003).

The macroeconomic balance approach estimates a fundamental equilibrium exchange rate (FEER) based on the notion of internal and external macroeconomic balances (Isard and Faruqee 1998). Internal balance is achieved at a level of output consistent with full employment and a low rate of inflation, while external balance is characterised as an equilibrium position in the current account that reflects sustainable net flow of resources between economies. In terms of empirical implementation, this approach involves estimation of a current account equation that relates the current account (as a ratio of GDP) to REER, domestic demand and foreign demand. The estimated coefficients (elasticities) can then be used to calculate the FEER, which is the level of the REER required to attain the equilibrium current account positions, assuming domestic and foreign outputs are at potential.

The third approach of exchange rate assessment is called the "external sustainability approach" (IMF 2006). Based on the relationship between a country's stock net-foreign-assets position and its flow current account position, this approach first determines the current account or trade balance (as a ratio of GDP) that would stabilise the net foreign asset position at a benchmark level considered sustainable over the medium term. It then calculates the real exchange rate adjustment needed to close the gap between the prevailing full-employment current account balance and the net-foreign-asset-stabilising current account balance. This approach is still relatively new and is only recently endorsed by the IMF in the exchange rate assessment of the Consultative Group on Exchange Rate Issues.

## IV. ESTIMATES OF HONG KONG DOLLAR EQUILIBRIUM REAL EXCHANGE RATES

### *Equilibrium exchange rate approach*

Empirical implementation of the equilibrium real exchange rate approach involves three steps. First, the Hong Kong dollar REER is estimated as a function of its main determinants. Second, the trend values of the determinants are plugged into the estimated equation to calculate the trend (equilibrium) REER. Third, the exchange rate adjustment needed to restore equilibrium over the medium term is calculated as the difference between the estimated equilibrium and its current value. The equilibrium REER model is estimated using both time-series data for Hong Kong and panel data for six economies, including Hong Kong, Singapore, Switzerland, The Netherlands, Luxembourg, and Belgium. Table 1 summarises the theoretical rationales for the variables commonly used in the literature as determinants of the equilibrium real exchange rate.

Following the general-to-specific approach, the long-run relationship between the Hong Kong dollar REER and its determinants is estimated using a vector error correction model. The estimated long-run (co-integrating) relationship between the real exchange rate and its determinants using time-series data is as follows (Annex A presents more detailed estimation result).

$$REER^{HKD} = 7.28 - 0.33mf + 3.13gdppc + 2.56tot - 1.61trade \qquad (1)$$

where $REER^{HKD}$ is the logarithm of Hong Kong dollar REER, $mf$ is the logarithm of the manufacturing-to-GDP ratio, $gdppc$ is the logarithm of domestic per capita GDP relative to those of trading partners, $tot$ is the logarithm of terms of trade, and $trade$ is the logarithm of total trade-to-GDP ratio.

The estimated relationship shows that, as expected, movements in the Hong Kong dollar REER are inversely related to the manufacturing-to-GDP ratio, positively associated with the ratio of domestic per capita GDP to those of trading partners and the terms of trade, and negatively correlated with trade openness. Based on the estimated relationship, the equilibrium REER is derived by applying the trend (Hodrick-Prescott filtered) values of the explanatory variables to equation (1). The Hong Kong dollar REER is estimated to be close to its equilibrium value in 2006 (0.1% over-valued), slightly undervalued in 2005 and over-valued by around 10% in 1998 (Chart 4).

**Table 1: Fundamental determinants of equilibrium REER**

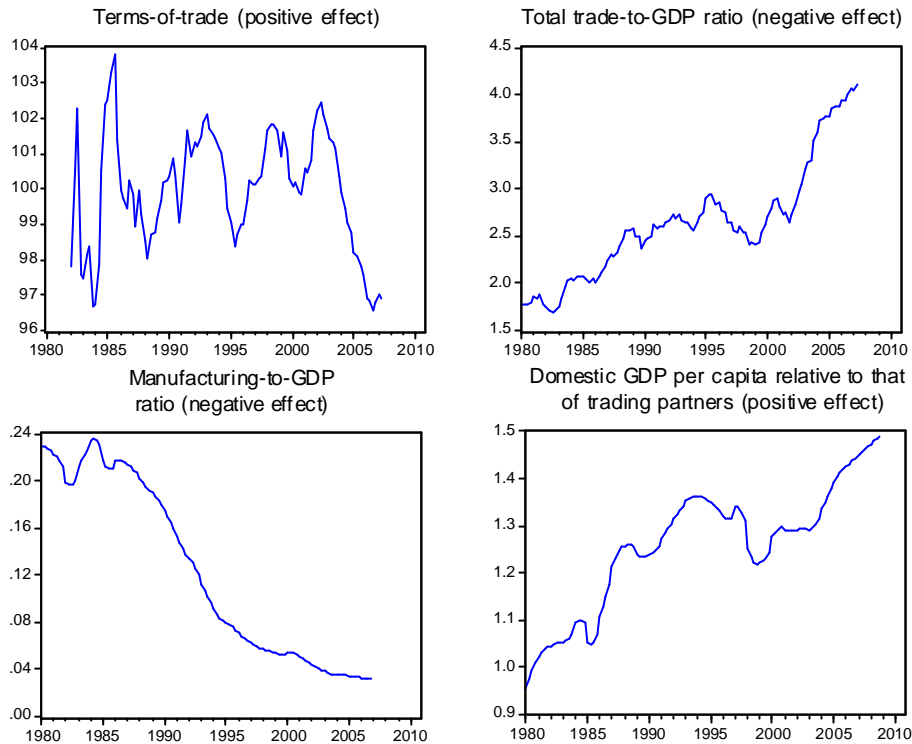| Fundamental determinants | Rationale |
|---|---|
| Manufacturing-to-GDP ratio | Empirically this is the key variable in IMF (1998). It is argued that a structural shift from manufacturing towards a high value-added, service-based economy reflects faster productivity growth in an economy than its trading partners, which supports real exchange rate appreciation. |
| Terms of trade | A rise in the terms of trade shifts production towards tradable goods, increasing wages in the tradable sector first and then inducing an increase in overall price levels and therefore the real exchange rate. |
| Total trade-to-GDP ratio | This is a measure of trade openness. Countries with higher trade openness face more competition in international markets and hence lower prices of tradable goods relative to those of non-traded goods. |
| Domestic per capita real GDP relative to that of trading partners | This is used as a proxy for productivity growth relative to that of trading partners. The variable is intended to capture the Balassa-Samuelson effect. |
| Net foreign assets | Higher net foreign assets induce higher expenditure on domestic goods, thus raising the price of non-tradable goods and the real exchange rate. Also, net foreign assets generate investment income, which supports a smaller trade account surplus or higher deficit, thus allowing a greater appreciation in the exchange rate. |
| Government expenditure to GDP ratio | Direction of effect depends on changes in the composition of government spending between traded and non-traded goods. |

**Chart 4:    Evolution of the equilibrium REER over time
(based on Hong Kong time-series data)**
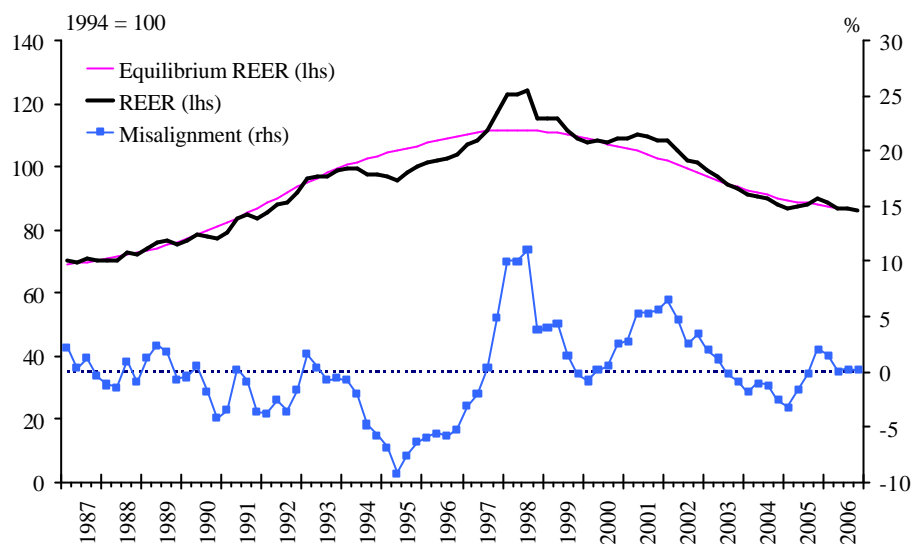


Source: HKMA staff estimates.

Why has the Hong Kong dollar equilibrium REER been depreciating since the late 1990s? A review of the movements of the major determinants of the equilibrium REER shows that this has been mainly attributable to two factors.   First, Hong Kong's terms of trade have been deteriorating sharply in recent years.   The deterioration shifts production away from tradable goods, lowering wages in the tradable sector and eventually inducing a decrease in the overall price level and hence the real exchange rate.   Second, the Hong Kong economy has become increasingly open in recent years (as indicated by the increase in the total trade-to-GDP ratio).   It faces more and more competition in the international market, lowering prices of tradable goods relative to those of non-traded goods, thereby reducing the equilibrium exchange rate (Chart 5).

**Chart 5:  Major determinants of the equilibrium REER**

Terms-of-trade (positive effect)

Total trade-to-GDP ratio (negative effect)

Manufacturing-to-GDP
ratio (negative effect)

Domestic GDP per capita relative to that
of trading partners (positive effect)

Note: Positive or negative effect refers to the impact on the equilibrium REER.
Sources: C&SD, HKMA, IMF.

We also estimated the long-run relationship between the REER and the explanatory variables listed in Table 1 for a panel data set of six economies including Hong Kong, Singapore, Switzerland, The Netherlands, Luxembourg, and Belgium. The estimated long-run (co-integrating) relationship between the real exchange rate and the explanatory variables for Hong Kong is as follows (Annex B presents more detailed estimation result).

$$REER^{HKD} = 5.16 - 0.27 + 0.41\,gdphktous + 0.80tot - 0.21gc \qquad (2)$$

where $REER^{HKD}$ is the logarithm of REER, $gdphktous$ is the logarithm of domestic per capita GDP relative to that of the US, $tot$ is the logarithm of terms of trade, and $gc$ is the logarithm of government share of real GDP. The common constant is estimated to be 5.16 and the fixed effect for Hong Kong is -0.27.

The estimated relationship shows that movements in the Hong Kong dollar REER are positively related to the domestic GDP relative to that

of the US and terms of trade, and negatively associated with government share of real GDP.   Again, the equilibrium REER is derived by applying the trend (Hodrick-Prescott filtered) values of the explanatory variables to equation (2).   As shown in Chart 6, the Hong Kong dollar was estimated to be 0.2% over-valued in 2006.

**Chart 6:   Evolution of equilibrium REER of the Hong Kong dollar
(based on panel data of six financial centre economies)**
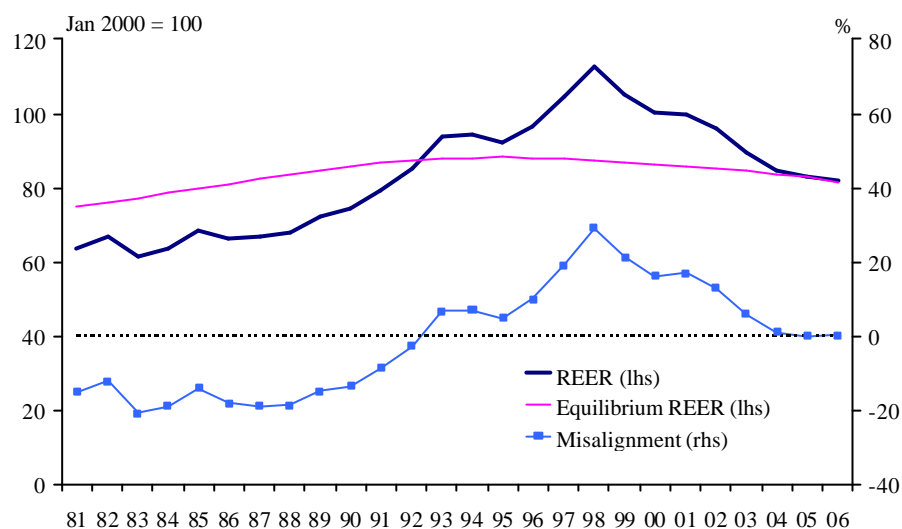


Source: HKMA staff estimates.

The time-series-data-based model and the panel-data-based model are in agreement to suggest that there was little real exchange rate misalignment for the Hong Kong dollar in 2006, but there are important differences between the two models.   First, the goodness of fit of the panel-data-based model is worse than the time-series-data-based model, resulting in more substantial and persistent undervaluation during the 1980s and overvaluation between 1995 and 2003.   In particular, the panel-data-based model suggests that the Hong Kong dollar REER was overvalued by almost 30% at its peak in 1998, while the time-series-data-based model only suggests 10-15% peak overvaluation. Second, apart from the difference in the set of explanatory variables, the estimated terms of trade elasticity of the real exchange rate in the panel-data-based equation is markedly smaller than that estimated in the time-series-data-based equation.   As a result, the-panel-data-based model shows less significant depreciation of the equilibrium real exchange rate since the late 1990s than the time-series-data-based model.

*Macroeconomic balance approach*

Implementation of the macroeconomic balance approach involves three steps.  First, the structural determinants of the current account balance are estimated to obtain an equilibrium current account balance or a current account balance norm.   Second, the full-employment or underlying current account balance that would emerge at prevailing market exchange rates if the home country and its foreign trading partners were producing at their potential output levels is calculated.   Third, the amount of exchange rate adjustment needed (the extent of misalignment) to close the gap between the underlying current account and the current account norm is computed by using the real exchange rate elasticity of the current account balance.

<u>*Step 1: Estimating the equilibrium current account balance*</u>

Based on the specification in Leung (2006) and updated with more recent data, the relationship between Hong Kong's current account balance and its structural determinants is estimated as follows (<u>Annex C</u> provides more estimation details).[2,3]

$$cab = -4.15 + 0.09trade(-2) + 0.15m2(-4) - 2.77depend(-1)$$
$$+ 0.91tot(-1) + 0.88nservice(-1) + 1.32sdygap(-3) \qquad (3)$$

where *cab* is the current account-to-GDP ratio, *trade* is the total trade-to-GDP ratio, *m2* is the total M2-to-GDP ratio, *depend* is the old-age dependency ratio, *tot* is the logarithm of terms of trade, *nservice* is the non-service sector-to-GDP ratio, and *sdygap* is the volatility of output gap proxied by its six-quarter rolling standard deviation.

---

[2]  Instead of using a time-series based model for each member economy, the Research Department of the IMF, in its CGER exercises, uses a common panel-data set that includes a large number of member economies in order to calculate the equilibrium current account for each member economy.
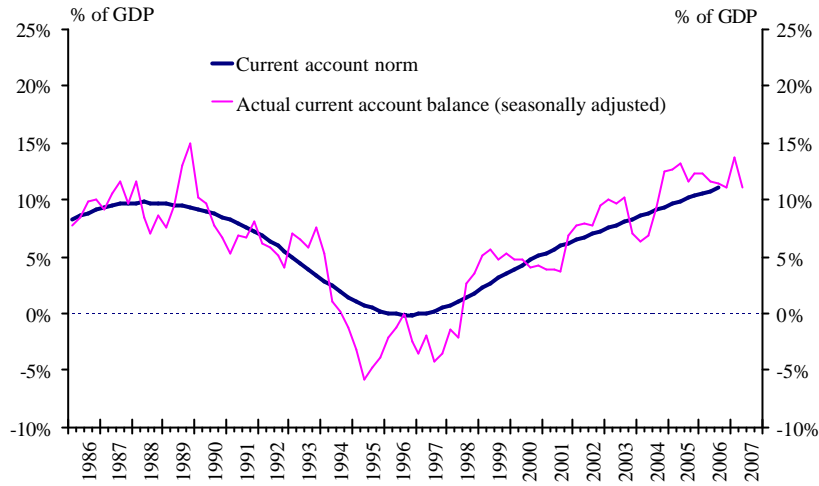
[3]  The current account-to-GDP ratio is proxied by total trade balance-to-GDP ratio as data on the current account balance are available only from late-1990s onwards.  In any case, changes in the balance of trade in goods and services accounted for most of the variations in the current account position in recent years.

Estimation results show that the current account (as a percentage of GDP) is positively associated with trade openness, M2-to-GDP ratio, terms of trade, volatility of output gap and the non-service sector-to-GDP ratio, and is negatively related to the old-age dependency ratio. The economic rationale for the relevance of these fundamental variables for current account determination in Hong Kong is explained in Table 2. With the estimated equation, the equilibrium current account balance is derived using the trend (Hodrick-Prescott filter smoothed) values of the structural determinants. Chart 7 shows that the computed equilibrium current account balance as a percentage of nominal GDP has been rising since 1997, at about 11% in the third quarter of 2006.

**Table 2: Structural determinants of current account**

| Variable | Economic Rationale |
|---|---|
| Trade openness (total trade-to-GDP ratio) | Trade openness as proxied by the total-trade to GDP ratio has been increasing in Hong Kong since the inception of the Linked Exchange Rate system in 1983, mainly reflecting higher merchandise re-exports and expansion in service trade, as Hong Kong has been expanding its role as an intermediary of China trade. Trade intermediation generates external income from service exports to contribute to the current account surplus, suggesting a positive relationship between trade openness and current account balance. Alternatively, a higher degree of trade openness is often associated with greater output volatility, which calls for the need to accumulate substantial net foreign assets for the purpose of income smoothing and risk diversification. This is done by running a current account surplus. Both interpretations suggest a positive relationship between trade openness and the current account position in Hong Kong. |
| M2-to-GDP ratio | This is a measure of financial deepening. Chinn and Prasad (2000) and Chang (2004) report a positive relationship between this variable and the current account balance. The total M2-to-GDP ratio has been rising in Hong Kong over the past two decades, reflecting deepening of Hong Kong's banking and financial system and expansion of its role as an international financial centre. International financial centres tend to have higher private saving ratios. |
| Age composition of population (as captured by the dependency ratio) | According to the life-cycle model, consumption and saving behaviour are tied to the stage in the life cycle. A higher ratio of elderly dependent population relative to working population would reduce the current account, as people start to dissave after they retire. |
| Terms of trade | Terms of trade deterioration decreases current income relative to permanent income, decreasing domestic savings and thus the current account balance. |
| Non-service sector to GDP ratio | Hong Kong has gone through a structural shift from manufacturing to services, following relocation of manufacturing facilitates to Mainland China (as indicated by a decrease in the non-service sector to GDP ratio). This "hollowing-out" of manufacturing facilities deprived Hong Kong of a manufacturing base for exports, reducing the current account balance. |
| Output or inflation volatility | This is a measure of uncertainty in the domestic economic environment. Economic uncertainty decreases investment and increases precautionary savings, leading to a higher current account position. |

**Chart 7:    Evolution of the equilibrium current account balance**



Source: C&SD, HKMA staff estimates.

What have been the underlying forces that explain the upward trend of the equilibrium current account balance?    From a saving-investment perspective, the increase in Hong Kong's equilibrium current account balance in the past decade reflects a persistent decline in construction investment and an increase in outward investments as the economy transformed itself from a manufacturing centre to a financial and services hub.    At the same time, domestic saving has increased due to the perceived higher economic uncertainties in the aftermath of the Asian financial crisis and the strengthening of Hong Kong's status as an international financial centre.    From a trade-flow perspective, a higher total trade-to-GDP ratio indicates the expansion of Hong Kong's role as a service centre for trade intermediation, generating external income and increasing the equilibrium current account balance.

_Step 2. Estimating the underlying current account balance_

A reduced-form equation that relates the current account balance (through the underlying trade flows) to movements in domestic and foreign economic activities and changes in real effective exchange rates is estimated as follows (<u>Annex D</u> provides more details on estimation).

$$CA \, / \, Y = 1.95 - 0.34 REER^{HKD} - 0.69 y^d + 0.77 y^f - 0.13 REER^{RMB} \tag{4}$$

where _CA/Y_ is the ratio of current account balance to GDP, $REER^{HKD}$ is the logarithm of Hong Kong dollar REER, $y^d$ is the logarithm of domestic output, $y^f$ is the logarithm of a trade-weighted average of foreign output and $REER^{RMB}$ is the logarithm of renminbi REER. The renminbi REER is included because trade flows relating to re-export activities depend primarily on demand conditions on the Mainland and of its trading partners, and the real exchange rates of the renminbi against currencies of these trading partners. An appreciating renminbi REER could reduce export competitiveness of the Mainland and hurt Hong Kong's re-exports from the Mainland. The inclusion of renminbi REER as an additional variable to account for Hong Kong's complex trade structure should provide a more appropriate estimate of the response of the current account balance to Hong Kong's REER.

With this reduced-form trade equation, the underlying current account position is obtained from equation (4) by assuming both domestic and foreign economies operate at their potential and the renminbi stays at its trend level. The potential levels of domestic and foreign potential outputs are obtained by applying the Hodrick-Prescott filter to the series and the trend renminbi REER is assumed to be the four-quarter moving average. The estimated underlying current account balance is shown in Chart 8.

**Chart 8:    Evolution of the underlying current account balance**
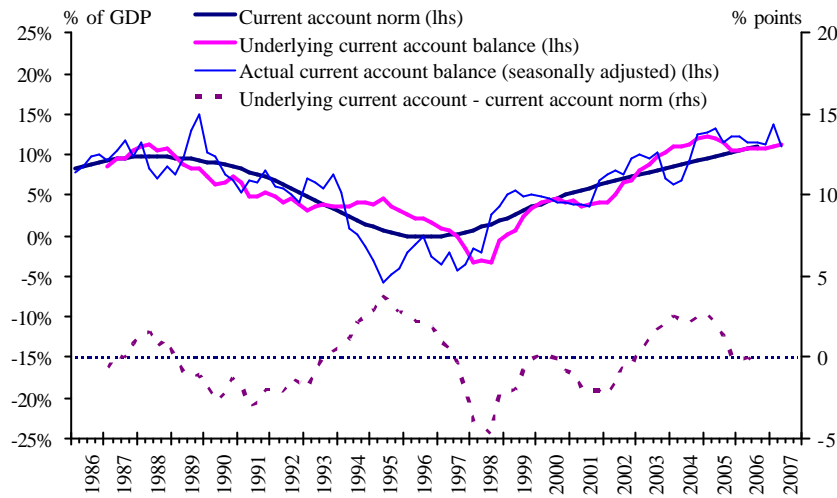


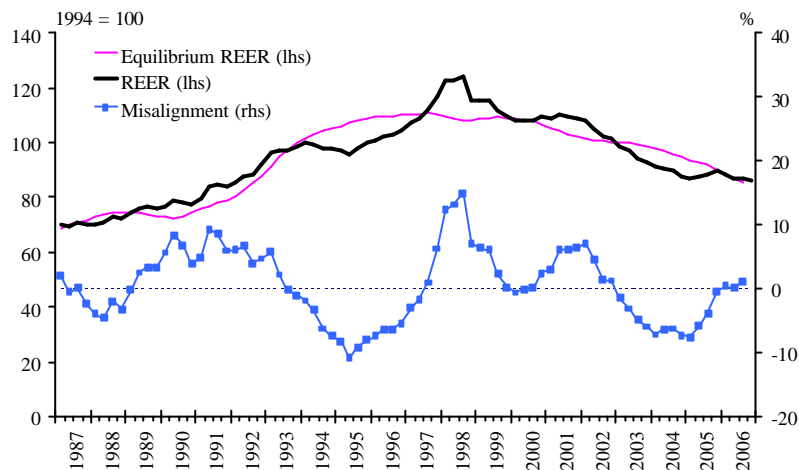Source: C&SD, HKMA staff estimates.

## *Step 3. Computing the extent of real exchange rate misalignment*

Based on the estimated trade equation, the equilibrium REER is defined as the level of the Hong Kong dollar REER required to achieve the equilibrium current account balance or the current account norm, assuming both domestic and foreign economies operate at their potential and the renminbi REER stays at its recent trend level.   The extent of misalignment represents the extent by which the exchange rates would have to change, other things being equal, to equilibrate the underlying current account position with the current account norm.   It is calculated by applying the inverse of the REER elasticity of the current account balance to the gap between the underlying current account and the current account norm.

In general, given a negative current account response to the REER, a larger current account norm implies a lower equilibrium REER. Moreover, given a particular level of current account norm, if the elasticity is higher or the current account balance is more responsive to the REER, the exchange rate adjustment needed to restore the equilibrium would be smaller. The elasticity of the current account-to-GDP ratio with respect to the Hong Kong dollar REER is assumed to be -0.34, which is drawn from equation (4). The elasticity implies that, after controlling for the effect of renminbi REER, a 1% decrease in Hong Kong dollar REER would increase the current

account-to-GDP ratio by 0.34 percentage points on average.   Applying this elasticity to the gap between the current account norm and the underlying current account, the Hong Kong dollar is estimated to be about 1% over-valued in 2006 (Chart 9).   The estimation result shows over-valuation of the Hong Kong dollar in the late 1990s, at a peak of about 15% in 1998.

**Chart 9:    Evolution of equilibrium exchange rate (based on the macroeconomic balance approach)**



Source: HKMA staff estimates.

Alternatively, estimation can also be done based on disaggregated trade elasticities obtained from various sources instead of using the elasticity obtained from the reduced-form current account equation (4).   This is done using the following formula in IMF (2006): current account elasticity = export elasticity * export-to-GDP ratio – (import elasticity-1) * import-to-GDP ratio.   According to this method, the Hong Kong dollar REER is estimated to be 3%-4.7% overvalued in 2006 (Annex E shows the details of the estimation based on disaggregated trade elasticities).

*External sustainability approach*

The external sustainability approach follows a procedure similar to macroeconomic balance approach except that it estimates the current account (trade balance) norm differently. The approach first specifies a benchmark value for the net foreign asset position and uses a sustainability criterion to derive an implied norm for the current account that would stabilise the net foreign assets position at the benchmark level based on the following formula:

$$ca^s = -\frac{r_a - g}{1+g}GFA^s + \frac{r_l - g}{1+g}GFL^s \tag{5}$$

where $ca^s$ is the norm for the current account-to-GDP ratio, $r_a$ is the rate of return on gross foreign assets ($GFA^s$), $r_l$ is the rate of return on gross foreign liabilities ($GFL^s$) and $g$ is the nominal GDP growth.[4] Intuitively, equation (5) shows that as long as the rate of return on foreign assets is higher than nominal GDP growth, an economy can afford to run a trade deficit. If the rate of return on foreign liabilities is higher than the nominal GDP growth, an economy has to run trade surplus to cover the difference. Given the current account norm estimated from equation (5), exchange rate misalignment can be calculated by following a procedure similar to the macroeconomic balance approach.

Table 3 shows the estimation results obtained from the external sustainability approach, assuming that the net foreign asset position stays at its 2000-2006 average level and returns on gross foreign assets and liabilities are equal to those calculated solely from interest and dividend income, ignoring capital gains or losses. The estimated over-valuation is 13.6%.

---

[4] For details regarding how this formula is derived, see IMF (2006).

**Table 3:  Calculations of the external sustainability approach**

|  |  | Estimate | Comment |
|---|---|---|---|
| Return on gross external assets | $r_a$ | 4.18% | 2000-2006 average |
| Return on gross external liabilities | $r_l$ | 5.61% | 2000-2006 average |
| Medium-term nominal GDP growth | $g$ | 8.67% | Assume real GDP growth = 5%, inflation rate = 3.5% (government medium-term projection) |
| Equilibrium gross external assets (% of GDP) | $GFA^s$ | 772.15% | 2000-2006 average |
| Equilibrium gross external liabilities (% of GDP) | $GFL^s$ | 552.81% | 2000-2006 average |
| Benchmark value of net foreign assets (% of GDP) |  | 219.34% | 2000-2006 average |
| Implied equilibrium trade balance (% of GDP) | $ca^s$ | 16.34% |  |
| Overvaluation (%) |  | 13.62% |  |

Source: HKMA staff estimates.

The estimated degree of exchange rate misalignment is sensitive to the underlying assumptions of returns on gross foreign assets and liabilities.  If only interest and dividend incomes are used to calculate return, the estimated over-valuation would be about 13% (Table 4, highlighted in green).  However, if the return on gross foreign assets is adjusted by valuation gains from investments in H-shares (which are regarded as foreign equities under the Balance of Payments accounting standard because H-share companies are incorporated on the Mainland), the estimated return on gross foreign assets would increase by 0.4-0.6 percentage points, reducing the extent of overvaluation to 0.3%-4.5% (Table 4, highlighted in yellow).  Moreover, IMF researchers use a different set of assumptions and come up with an over-valuation of less than 1%.

**Table 4:   Sensitivity analysis under different rate of return assumptions**

**Estimated over- or under-valuation**

| | | Return on gross foreign assets (%) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 3.6 | 3.8 | 4.0 | 4.2 | 4.4 | 4.6 | 4.8 | 5.0 | 5.2 |
| | 4.6 | 10.5 | 6.3 | 2.1 | -2.1 | -6.4 | -10.6 | -14.8 | -19.0 | -23.3 |
| | 4.8 | 13.6 | 9.3 | 5.1 | 0.9 | -3.3 | -7.6 | -11.8 | -16.0 | -20.2 |
| | 5.0 | 16.6 | 12.4 | 8.1 | 3.9 | -0.3 | -4.5 | -8.8 | -13.0 | -17.2 |
| | 5.2 | 19.6 | 15.4 | 11.2 | 6.9 | 2.7 | -1.5 | -5.7 | -10.0 | -14.2 |
| Return on gross foreign liabilities (%) | 5.4 | 22.6 | 18.4 | 14.2 | 10.0 | 5.7 | 1.5 | -2.7 | -6.9 | -11.2 |
| | 5.6 | 25.7 | 21.4 | 17.2 | 13.0 | 8.8 | 4.5 | 0.3 | -3.9 | -8.1 |
| | 5.8 | 28.7 | 24.5 | 20.2 | 16.0 | 11.8 | 7.6 | 3.3 | -0.9 | -5.1 |
| | 6.0 | 31.7 | 27.5 | 23.3 | 19.0 | 14.8 | 10.6 | 6.4 | 2.1 | -2.1 |
| | 6.2 | 34.7 | 30.5 | 26.3 | 22.1 | 17.8 | 13.6 | 9.4 | 5.2 | 0.9 |
| | 6.4 | 37.8 | 33.5 | 29.3 | 25.1 | 20.9 | 16.6 | 12.4 | 8.2 | 4.0 |
| | 6.6 | 40.8 | 36.6 | 32.3 | 28.1 | 23.9 | 19.7 | 15.4 | 11.2 | 7.0 |

Source: HKMA staff estimates.

## V.   CONCLUSIONS

Table 5 summarises the estimation results of Hong Kong's real exchange rate misalignment in 2006 using the three approaches.   Overall, except for the external sustainability approach under which the estimation results are not quite robust, the other two approaches suggest that the degree of deviation of the Hong Kong dollar REER from its equilibrium was very small in 2006.   This indicates that Hong Kong's external price competitiveness had been restored.   Given the Linked Exchange Rate system, adjustment to macroeconomic imbalances and external shocks took place through changes in the real exchange rate driven by the price flexibility of domestic markets.   Following prolonged deflation, these prices had all turned around, indicating that adjustment to negative shocks had been over.   In 2006, goods and wage inflation was low, equity prices rose in line with earnings, and property prices stabilised.   Stable price increases across goods, labour, and asset markets suggest that price competitiveness was broadly in line with the fundamentals.

It should be noted that the IMF team agreed with the above conclusion during the Article IV consultation that took place in Hong Kong during 29 October-6 November 2007.

**Table 5:    Exchange rate misalignment in 2006**

| Methodology | Estimated real exchange rate misalignment in 2006 | Specification |
|---|---|---|
| Equilibrium exchange rate approach | 0.1% over-valued | The equilibrium real exchange rate model is based on Hong Kong time-series data only. |
| | 0.2% over-valued | The equilibrium real exchange rate model is based on panel data consisting of six international financial centres: Belgium, Hong Kong, Luxembourg, Singapore, Netherlands, and Switzerland. |
| Macroeconomic balance approach | 1% over-valued | The model of equilibrium current account balance is based on Hong Kong time-series data only. The underlying current account position and the REER elasticity of current account are calculated from a reduced-form trade equation, which considers the negative effect of renminbi REER on Hong Kong's re-exports. |
| | 3% or 4.7% over-valued | While the source of the equilibrium current account balance is the same as above, the underlying current account position is drawn from an IMF estimate. The REER elasticity of current account is computed from the REER elasticities of different trade components. The 3% estimate takes into account the negative effect of renminbi REER on Hong Kong's re-export earnings. |
| External sustainability approach | A fairly wide range (3%, 4.7%, or 13.6% over-valued) | The equilibrium current account balance is derived from a benchmark value of net foreign asset position, which is assumed to be the 2000-2006 average. Otherwise, the specification is similar to the macroeconomic balance approach. |

## REFERENCES

Bayoumi, Tamim, Jaewoo Lee, and Sarma Jayanthi (2006) "New Rates from New Weights." *IMF Staff Papers*, Vol. 53, No. 2.

Cashin P., Cespedes, L., and Sahay, R., (2004), "Commodity Currencies and the Real Exchange Rate", Journal of Development Economies, Vol. 75, pp. 239-268.

Chang, Dongkoo (2004), "An Analysis of Long-term Determinants of the Current Account and the Evaluation of its Sustainability in Korea", Bank of Korea Economic Papers Vol. 6 No. 2, January 2004.

Chinn, Menzie and Eswar S. Prasad (2000), "Medium-term Determinants of Current Accounts in Industrial and Developing Countries: An Empirical Exploration", NBER Working Paper 7581, March 2000.

Debelle, G. and H. Faruqee (1996), "What Determines the Current Account? A Cross-Sectional and Panel Approach", IMF Working Paper 96/58, 1996.

Edwards, Sebastian (1991), Real Exchange Rates, Devaluation, and Adjustment–Exchange Rate Policy in Developing countries, MIT Press.

Edwards, Sebastian (1995), "Why are Savings Rates so Different across Countries? An International Comparative Analysis", NBER Working Paper 5097, April 1995.

Ghosh, Atish R. and Jonathan D. Ostry (1997), "Macroeconomic Uncertainty, Precautionary Saving and the Current Account", Journal of Monetary Economics, Volume 40, No.1, page 121-139.

International Monetary Fund (1998), Article IV Consultation on the Hong Kong SAR, June 1998.

International Monetary Fund (2003), "Estimation of the Equilibrium Real Exchange Rate for South Africa", IMF Working Paper 03/44, March 2003.

International Monetary Fund (2005), Surveillance Guidance Note, May 2005.

International Monetary Fund (2006) "Methodology for CGER Exchange Rate Assessments." Available via the internet:
http://www.imf.org/external/pp/longres.aspx?id=3957

Isard, Peter, and Hamid Faruqee (1998) "Exchange Rate Assessment: Extensions of the Macroeconomic Balance Approach." *IMF Occasional Paper No. 167*. International Monetary Fund.

Isard, Peter, Hamid Faruqee, G. Russell Kincaid, and Martin Fetherston (2001) "Methodology for Current Account and Exchange Rate Assessments." *IMF Occasional Paper No. 209*, International Monetary Fund.

Ito, Takatoshi, Peter Isard, Steven Symansky, and Tamin Bayoumi (1996) "Exchange Rate Movements and Their Impact on Trade and Investment in the APEC Region." *IMF Occasional Paper No. 145*, International Monetary Fund.

Lane, Philip R. (2000), "International Investment Positions: A Cross-Sectional Analysis", Journal of International Money and Finance, Volume 19 No.4, page 513-534.

Lane, Philip R., and Gian Maria Milesi-Ferretti (2006) "The External Wealth of Nations Mark II: Revised and Extended Estimates of Foreign Assets and Liabilities,
1970-2004." *IMF Working Paper 06/69*, International Monetary Fund.

Leigh, Lamin (2006), "Hong Kong Special Administrative Region: Macroeconomic Impact of an Ageing Population in a Highly Open Economy", IMF Working Paper 06/87, March 2006.

Leung, Frank (2006), "Structural Determinants of Hong Kong's Current Account Surplus", *HKMA Research Memorandum, No. 14/2006*.

Liu, Li-gang, Kelvin Fan, and Jimmy Shek (2006), "Hong Kong's Trade Patterns and Trade Elasticities", *HKMA Research Memorandum, No. 18/2006*.

MacDonald, Ronald and Ricci, Luca (2003), "Estimation of the Equilibrium Real Exchange Rate for South Africa", International Monetary Fund Working Paper WP/03/44, March 2003.

Marsh, Ian and Stephen Tokarick (1994), "Competitiveness Indicators: A Theoretical and Empirical Assessment", International Monetary Fund Working Paper WP/94/29, March 1994.

Montiel Peter J. (1997), "Exchange Rate Policy and Macroeconomic Management in ASEAN Countries", in Macroeconomic Issues Facing ASEAN Countries, IMF, 1997.

**Equilibrium exchange rate approach based on Hong Kong time-series data**

The following table reports the estimated long-run (co-integrating) relationship between the real exchange rate and a set of explanatory variables employing a vector error correction model. Following the general-to-specific approach, some variables are eliminated in the estimation process if their coefficients are insignificant or of the wrong signs. A lag length of two is chosen for estimation.

**Table A1: Long-run relationship of real exchange rate**

|  | Coefficient | Standard error | t-statistics |
|---|---|---|---|
| **Cointegrating vector** | | | |
| **Hong Kong real effective exchange rate** | 1 | | |
| **Manufacturing-to-GDP ratio** | 0.33 | 0.03 | 9.73 |
| **Domestic GDP relative to those of trading partners** | -3.13 | 0.43 | -7.34 |
| **Terms of trade** | -2.56 | 1.26 | -2.03 |
| **Total trade-to-GDP ratio** | 1.61 | 0.15 | 10.54 |
| **Constant** | 7.28 | | |
| **Adjustment coefficient** | | | |
| **Equation on Hong Kong real effective exchange rate** | -0.03 | -0.04 | -0.75 |

Note: All variables used in the vector error correction model are in logarithm and the total trade-to-GDP ratio is seasonally adjusted. The sample period is 1985 Q4-2006 Q4.
Data source: C&SD, HKMA.

**Equilibrium exchange rate approach based on panel data**

        The following table shows the estimated equilibrium (long-run) relationship between the real exchange rate and a set of explanatory variables using a panel dataset consisting of six economies with financial centre status including Hong Kong, Singapore, Switzerland, Belgium, Luxembourg and Netherlands. The choice of explanatory variables draws from the IMF (2006) specification (the CGER methodologies) but the definition of the variables differs slightly from that of the IMF due to data availability. Following the general-to-specific approach, some variables are eliminated in the estimation process if their coefficients are insignificant or of the wrong signs.

**Table B1: Equilibrium real exchange rate relationship**

Dependent variable: Real effective exchange rate
Countries included: Belgium, Hong Kong, Luxembourg,
                       Netherlands, Singapore, Switzerland
Estimation method: Dynamic OLS, 1 lead and 1 lag

| Independent variable | Coefficient | t-ratio | p-value |
|---|---|---|---|
| Constant | 5.16 | | |
| Domestic GDP relative to that of US | 0.41 | 2.06 | 0.02 |
| Terms of trade | 0.80 | 2.42 | 0 |
| Government consumption-to-GDP ratio | -0.21 | 1.03 | 0.15 |
| Fixed effect (Hong Kong) | -0.27 | | |
| R-squared | 0.73 | | |
| Adjusted R-squared | 0.69 | | |

    Note: Yearly data. All variables are in logarithm. The sample period is between 1982 and 2003.
    Data source: IMF, HKMA.

**Macroeconomic balance approach:
Structural determinants of current account balance
based on Hong Kong time-series data**

The following table shows the estimated equilibrium relationship between Hong Kong's current account balance and its structural determinants. Following the general-to-specific approach, some variables are eliminated in the estimation process if their coefficients are insignificant or of the wrong signs. It should be noted that the total trade balance is used as a proxy for the current account balance because data on the current account balance are available only from late-1990s onwards. This is not a serious limitation as changes in the balance of trade in goods and services accounted for most of the variations of the current account balance in recent years.

**Table C1:   Equilibrium current account balance relationship**

| | Dependent variable: Current account-to-GDP ratio | | | |
|---|---|---|---|---|
| **Independent variable** | **Coefficient** | **Standard error** | **t-statistic** | **p-value** |
| Constant | -4.51 | 1.03 | -4.37 | 0.00 |
| Openness, total trade-to-GDP ratio (lag 2) | 0.09 | 0.01 | 6.04 | 0.00 |
| M2-to-GDP ratio (lag 4) | 0.15 | 0.02 | 6.90 | 0.00 |
| Old-age dependency ratio (lag 1) | -2.77 | 1.16 | -2.40 | 0.02 |
| Logarithm of terms of trade (lag 1) | 0.91 | 0.22 | 4.09 | 0.00 |
| Standard deviation of output gap (lag 3) | 1.32 | 0.27 | 4.92 | 0.00 |
| One minus service sector-to-GDP ratio (lag 1) | 0.88 | 0.22 | 3.96 | 0.00 |

Note:  The sample period is between 1983 Q4 and 2006 Q3.  Current account balance
is proxied by trade balance due to data availability.
Data source: C&SD, HKMA.

## Macroeconomic balance approach: current account regression

The following table shows the estimation result of a reduced-form equation that relates the current account balance (through the underlying trade flows) to movements in domestic and foreign economic activities and changes in real effective exchange rates.

### Table D1:   Current account regression

| Independent variable | Coefficient | Heteroskedasticity and autocorrelation consistent standard error | Asymptotic p-value |
|---|---|---|---|
| | **Dependent variable: Current account-to-GDP ratio** | | |
| Constant | 1.95 | 0.32 | 0.00 |
| Hong Kong real effective exchange rate | -0.34 | 0.04 | 0.00 |
| Domestic output | -0.69 | 0.19 | 0.00 |
| Trade-weighted average of foreign output | 0.77 | 0.18 | 0.00 |
| Renminbi real effective exchange rate | -0.13 | 0.05 | 0.01 |

Note:  All variables are in logarithm except the current account-to-GDP ratio.  All variables are seasonally adjusted apart from the real effective exchange rates. The sample period is 1985 Q3:2006 Q4.   Current account balance is proxied by trade balance due to data availability.

Data source: C&SD, HKMA, IMF.

The renminbi REER is included because trade flows related to re-export activities depend primarily on demand conditions on the Mainland and of its trading partners, and the real exchange rates of the renminbi against currencies of these trading partners.  An appreciating renminbi REER could reduce export competitiveness of the Mainland and hurt Hong Kong's re-exports from the Mainland.   The inclusion of renminbi REER as an additional variable to account for Hong Kong's complex trade structure should provide a more appropriate estimate of the response of the current account (as a percentage of GDP) to Hong Kong's REER.

**Macroeconomic balance approach: disaggregating the trade elasticities**

In the macroeconomic balance approach used by the IMF, the magnitude of the exchange rate adjustment is derived by applying the inverse of the REER elasticity of the current account balance to the gap between the underlying current account and the current account norm.   In order to come up with an appropriate response of the current account to the real exchange rate, it is important to consider Hong Kong's complex trade structure.   Table E1 reports the disaggregated long-term trade elasticities.   Elasticities of domestic exports and service exports are drawn from the HKMA's small forecasting model, while the elasticity of retained imports and service imports combined is taken from Liu et al (2006).    The rest is newly estimated.

**Table E1:   Hong Kong's trade elasticities**

|  |  | Long run elasticity of trade components with repect to Hong Kong real effective exchange rate | Ratio to GDP ( in 2006 ) |
|---|---|---|---|
|  |  | **Exports** | |
| **Domestic exports** |  | 0.33 | 0.09 |
| **Exports of services** |  | 0.81 | 0.38 |
| **Re-exports** |  | 0.23 | 1.58 |
|  | **Re-exports earning** | 0.73<br>1.4 * | 0.27 |
|  |  | **Imports** | |
| **Imports of Goods** |  | 0.16 | 1.75 |
| **Retained imports and imports of services** |  | 0.65 | 0.63 |

* Renminbi REER is included in estimating the long run relationship.
Note: Quarterly data
Data source: C&SD

Taking into account complications arising from Hong Kong's re-exports activities, the estimated REER elasticity of current account balance is -0.32 or -0.5, as shown in column (c) on the second and third rows of Table E2. The results point to slight over-valuations, in line with the result based on the current account regression.

**Table E2:   Exchange rate misalignment calculated based on disaggregated trade elasticities**

| Trade components considered: | Negative volume effect | Positive price effect | Reponse of current account balance to REER | Implied real effective exchange rate misalignment in 2006 (%) |
|---|---|---|---|---|
| | (a) | (b) | (c)=(a)+(b) | (d) = CAGAP*100/(c) |
| Domestic exports + service exports + re-exports earnings - retained imports and service imports | -0.95 | 0.63 | -0.32 | 4.70% |
| Domestic exports + service exports + re-exports earnings - retained imports and service imports (where re-export earnings elasticity is controlled for the renminbi REER effect) | -1.13 | 0.63 | -0.5 | 3.00% |

Note:   The equilibrium current account (as a percentage of GDP) is estimated to be 0.108 in 2006. The underlying current account is assumed to be 0.093, which is the projected 2008 figure in the IMF WEO database.   The CAGAP represents the difference between the underlying and equilibrium current accounts and is equal to (0.093-0.108=) -0.015 in this case.

Source: HKMA staff estimates.