# 5. Banking sector performance

*The Hong Kong banking sector continued to show healthy growth, characterised by sound asset quality, favourable liquidity conditions, and strong capital positions by international standards. Looking forward, as global monetary conditions normalise, the possible impacts on banks' balance sheets should be carefully monitored. In particular, in view of the recent rise in household indebtedness and corporate leverage, the debt servicing abilities of borrowers could be under test should interest rates increase markedly or a significant correction in the local property market take place. Banks should also continue to be vigilant about credit risks on their Mainland China-related exposure.*

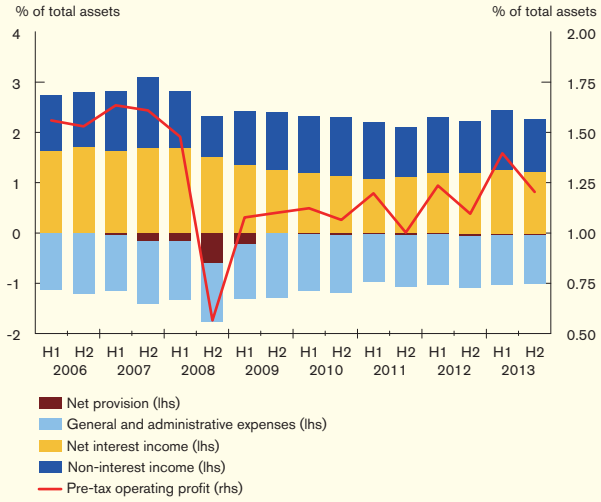
## 5.1 Profitability and capitalisation

### *Profitability*

The profitability of retail banks[38] moderated during the second half of 2013 from the very strong results of the first half, due to a mild decline in net interest income and non-interest income. Nevertheless, their performance remained more favourable than the same period of 2012, with a return on assets[39] of 1.2%, compared with 1.4% in the first half of the year and 1.1% in the second half of 2012 (Chart 5.1).

For 2013 as a whole, the aggregate pre-tax operating profits of retail banks recorded an increase of 22.1%, with the average return on assets rising to 1.3%, from 1.2% in 2012.

**Chart 5.1**
**Profitability of retail banks**



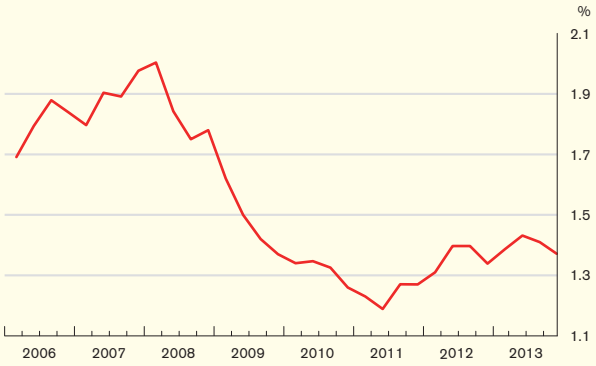

Note: Semi-annually annualised figures.
Source: HKMA.

[38] Throughout this chapter, figures for the banking sector relate to Hong Kong offices only, except where otherwise stated.

[39] Return on assets is calculated based on aggregate pre-tax operating profits.

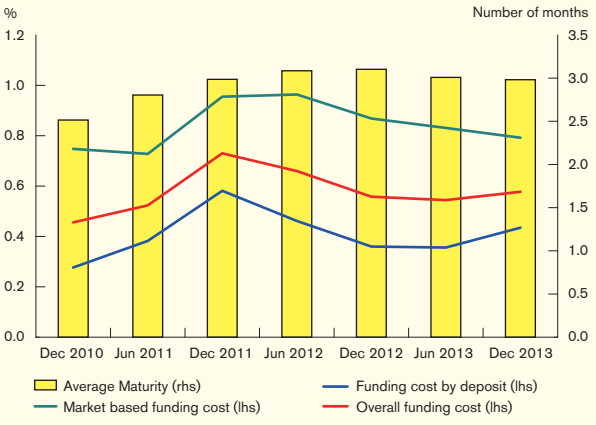
The net interest margin of retail banks held largely steady in 2013, averaging 1.39% in the second half, compared with 1.41% in the first half (Chart 5.2). For licensed banks as a whole, their overall interest costs registered an increase of 4 basis points in the second half, with the fall in market-based funding cost more than offset by the rise in deposit funding cost (Chart 5.3).[40] The composite interest rate, a measure of the average cost of Hong Kong dollar funds for retail banks, increased by 7 basis points during the second half to 0.39% at the end of December 2013 (Chart 5.4).

**Chart 5.2**
**Net interest margin of retail banks**



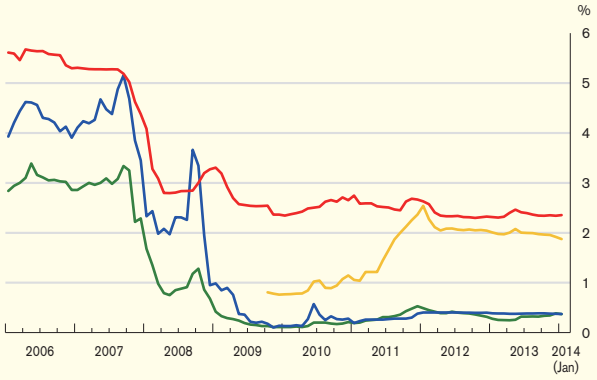

Note: Quarterly annualised figures.
Source: HKMA.

**Chart 5.3**
**Hong Kong and US dollar funding cost and maturity of licensed banks**




Source: HKMA.

**Chart 5.4**
**Interest rates**




Notes:
(a) End of period figures.
(b) Period-average figures for approved loans. All mortgage rates are estimates only.
Sources: HKMA and staff estimates.

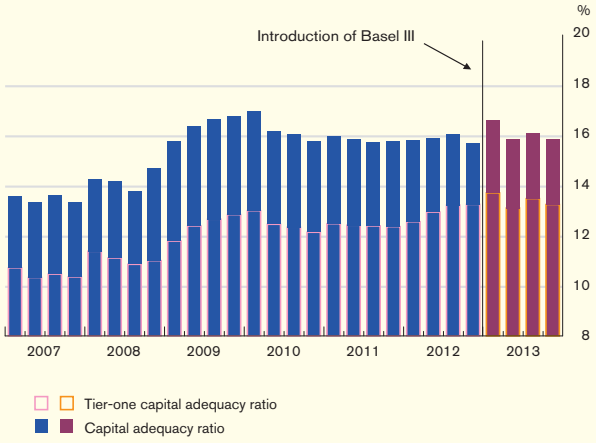
During the second half of 2013, both best lending rate-based (BLR-based) and HIBOR-based mortgage rates softened marginally. The share of HIBOR-based mortgages amongst newly approved mortgage loans increased to 30.1% in the second half, from 14.6% in the first half.

[40] Market-based funding cost is measured by the interest costs of banks' non-deposit interest bearing liabilities.

### *Capitalisation*

Capitalisation of the banking sector remained well above the minimum international standards. The consolidated capital adequacy ratio of locally incorporated AIs remained unchanged at 15.9% at the end of 2013 (Chart 5.5), with the tier-one capital adequacy ratio (the ratio of tier-one capital to total risk-weighted assets) edging up to 13.3%, from 13.1% six months earlier.

**Chart 5.5**
**Capitalisation of locally incorporated AIs**




Notes:
1. Consolidated positions.
2. With effect from 1 January 2013, a revised capital adequacy framework (Basel III) was introduced for locally incorporated AIs. The capital adequacy ratios from March 2013 onwards are therefore not directly comparable with those up to December 2012.

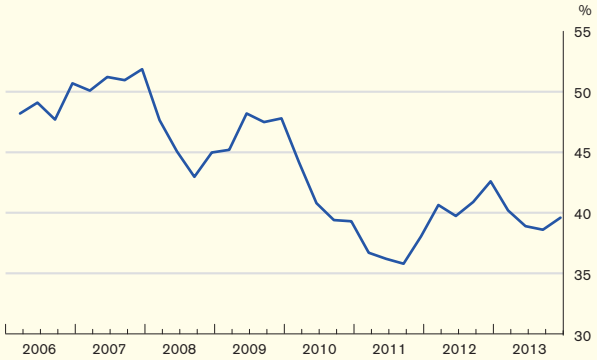
Source: HKMA.

## 5.2 *Liquidity, interest rate and credit risks*

### *Liquidity and funding*

Liquidity conditions of the banking sector continued to be favourable, with the average liquidity ratio of retail banks rising slightly to 39.6% at the end of December 2013, from 38.9% at the end of June (Chart 5.6), and remaining well above the regulatory minimum of 25%.

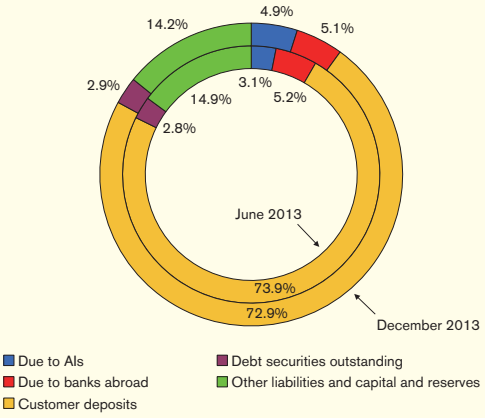
**Chart 5.6**
**Liquidity ratio of retail banks**




Note: Quarterly average figures.
Source: HKMA.

Customer deposits, which are typically less volatile than other funding sources, continued to be the primary funding source for retail banks. The share of customer deposits to banks' total liabilities was 72.9% at the end of 2013, marginally lower than the 73.9% at the end of June (Chart 5.7).

**Chart 5.7**
**Liabilities structure of retail banks**

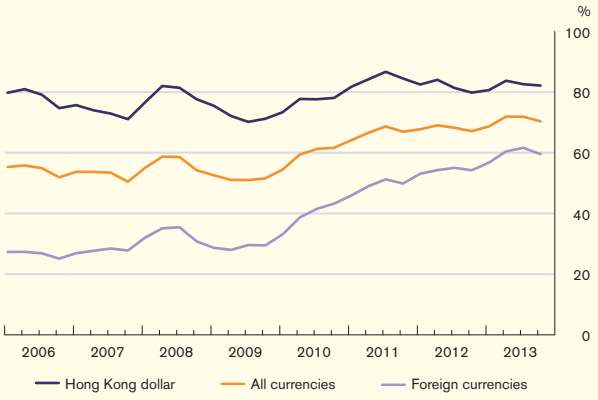



Notes:
1. Figures may not add up to total due to rounding.
2. Figures refer to the percentage of total liabilities (including capital and reserves).
3. Debt securities comprise negotiable certificates of deposit and all other negotiable debt instruments.

Source: HKMA.

The HKD loan-to-deposit (LTD) ratio of all AIs receded slightly to 82.1% at the end of December 2013, from 83.8% at the end of June (Chart 5.8), reflecting slower credit growth towards the end of the year. The foreign currency LTD ratio also edged down to 59.6% at the end of December, from 60.4% at the end of June. As a whole, the all currency LTD ratio fell to 70.4% at the end of December, from 71.9% at the end of June.

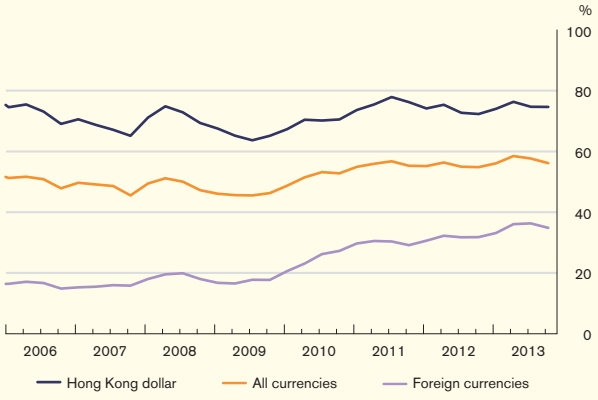
**Chart 5.8**
**Loan-to-deposit ratios of all AIs**




Source: HKMA.

For retail banks, the all currency LTD ratio fell from 58.5% to 56.2%, with both the Hong Kong dollar and foreign currency LTD ratios decreasing notably (Chart 5.9).

**Chart 5.9**
**Loan-to-deposit ratios of retail banks**




Source: HKMA.

Notwithstanding the favourable liquidity condition of banks, it is crucial to assess their ability to withstand stress. Box 5 assesses the liquidity risk of the Hong Kong banking sector. In short, the liquidity stress test shows that the systemic liquidity risk of Hong Kong banking sector would be contained in the face of severe economic and financial shocks. While the sensitivity test points to the same conclusion, it highlights that banks' liquidity risks are sensitive to interest rate movements. Banks should therefore be vigilant for the potential effect and pace of normalisation of interest rates. To prevent further build-up of funding vulnerability in banks' balance sheets, the HKMA introduced a Stable Funding Requirement with effect from January 2014.

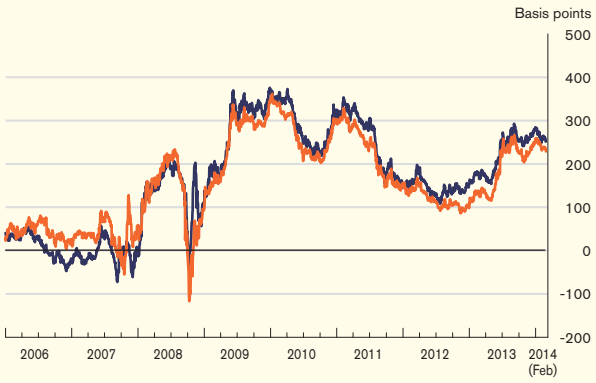
### *Foreign currency position*

The banking sector's capability to repay liabilities denominated in foreign currencies can be assessed by reference to the aggregate net open position of AIs for all foreign currencies. This position amounted to HK$73 billion at the end of 2013, which was equivalent to 0.4% of total assets of AIs, indicating that the overall exposure of AIs to foreign exchange risks may not be of significant concern.

### *Interest rate risk*

The spreads between the long- and short-term interest rates for the US dollar and Hong Kong dollar hovered more than 200 basis points during the second half of 2013 (Chart 5.10). This suggests that the incentive for banks to search for yield by borrowing short-term funds to purchase long-term interest-bearing assets has remained high. This could potentially lead to greater maturity mismatches and increased interest rate risk. Banks should prudently manage maturity mismatch between funding sources and loans.

**Chart 5.10**
**Term spreads of Hong Kong and US dollars**

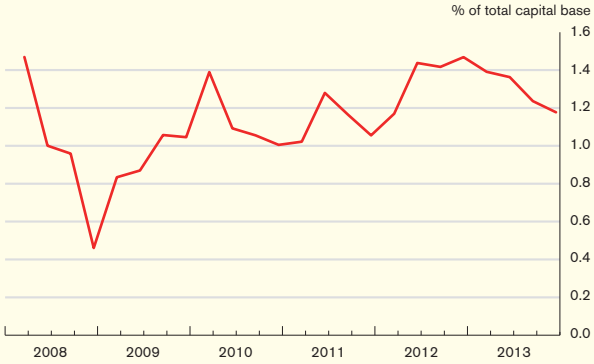



Note: Term spreads are defined as 10-year swap rates minus three-month money market rates of the respective currencies.

Source: HKMA staff estimates based on data from Bloomberg.

Such interest rate risk should not be underrated, as the possible impact of any significant shift in the yield curve or rise in interest rates on banks' balance sheets in the process of the normalisation of US monetary policy could be severe. It is estimated that under a hypothetical shock of an across-the-broad 200-basis-point increase in interest rates, the economic value of retail banks' interest rate positions could be subject to a decline equivalent to 1.2% of their total capital base as of December 2013 (Chart 5.11). While the impact appears to be manageable[41], a significantly larger interest rate hike or an unfavourable change in the shape of the yield curve could result in a much bigger impact.

**Chart 5.11**
**Impact of interest rate shock on retail banks**




Notes:
1. Interest rate shock refers to a standardised 200-basis-point parallel rate shock to institutions' interest rate risk exposures.
2. The impact of the interest rate shock refers to its impact on the economic value of banking and trading book[42], expressed as a percentage of the total capital base of banks.

Source: HKMA staff estimates.

### *Credit risk*

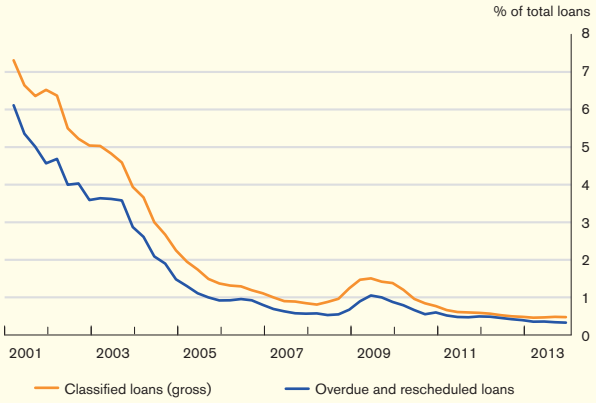
The asset quality of retail banks' loan portfolios remained healthy, with the classified loan ratio steady at a low level of 0.48% at the end of December, compared with 0.47% at the end of

41 The HKMA will be particularly attentive to the capital sufficiency of "outlier AIs" – those whose interest rate risk leads to an economic value decline of more than 20% of their capital base as a result of applying the standardised interest rate shock to the banking book. For details, see HKMA Supervisory Policy Manual's module "Interest Rate Risk Management" issued in December 2002.

42 Locally incorporated AIs subject to the market risk capital adequacy regime are required to report positions in the banking book only. Other locally incorporated AIs exempted from the market risk capital adequacy regime and overseas incorporated institutions are required to report aggregate positions in the banking book and trading book.

June, and the ratio of overdue and rescheduled loans falling from 0.36% to 0.33% during the period (Chart 5.12). Nevertheless, as global monetary conditions normalise, rising interest rates could test the debt-servicing ability of borrowers and may consequently affect the loan quality of AIs.

**Chart 5.12**
**Asset quality of retail banks**




Notes:
1. Classified loans are those loans graded as "sub-standard", "doubtful" or "loss".
2. Figures related to retail banks' Hong Kong office(s) and overseas branches.

Source: HKMA.

Credit growth moderated towards the end of the year, after its rapid expansion during the first three quarters. On a half-yearly basis, the growth of domestic lending[43] of AIs slowed from 10.2% in the first half to 3.3% in the second half.

According to results of the HKMA Opinion Survey on Credit Condition Outlook of December 2013, the share of surveyed AIs expecting higher loan demand in the next three months had increased from the previous survey, while the share of more than two-thirds of the respondents expecting loan demand to remain the same was unchanged (Table 5.A).

**Table 5.A**
**Expectation of loan demand in the next three months**

| As % of total respondents | Mar 2013 | Jun 2013 | Sep 2013 | Dec 2013 |
|---|---|---|---|---|
| Considerably higher | 0 | 0 | 0 | 0 |
| Somewhat higher | 10 | 10 | 19 | 24 |
| Same | 67 | 71 | 71 | 71 |
| Somewhat lower | 24 | 19 | 10 | 5 |
| Considerably lower | 0 | 0 | 0 | 0 |
| Total | 100 | 100 | 100 | 100 |

Note: Figures may not add up to 100% due to rounding.

Source: HKMA.

## *Household exposure*

The growth of household loans[44] slowed further to 3.3% in the second half of 2013 from 3.8% in the first half (Table 5.B). The moderation was mainly due to the slowdown in mortgage lending, in line with a decline in property transaction volumes. However, other loans for private purposes registered further fast growth of 10.1%, after rising by 10.9% in the first half.[45]

**Table 5.B**
**Half-yearly growth of loans to households of all AIs**

| | 2011 | | 2012 | | 2013 | |
|---|---|---|---|---|---|---|
| (%) | H1 | H2 | H1 | H2 | H1 | H2 |
| Mortgages | 5.5 | 1.2 | 2.5 | 5.0 | 3.1 | 0.8 |
| Credit cards | -1.4 | 15.9 | -1.6 | 15.3 | -4.0 | 10.3 |
| Other loans for private purposes | 9.4 | 3.8 | 5.0 | 9.3 | 10.9 | 10.1 |
| Total loans to households | 5.6 | 2.7 | 2.6 | 6.5 | 3.8 | 3.3 |

Source: HKMA.

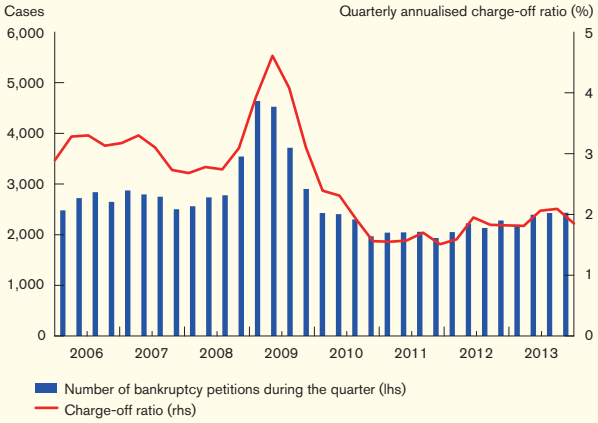
43 Defined as loans for use in Hong Kong plus trade-financing loans.

44 Loans to households constitute lending to professional and private individuals, excluding lending for other business purposes. Mortgage lending accounts for a major proportion of household loans while the remainder comprises mainly unsecured lending through credit card lending and other personal loans for private purposes. At the end of December 2013, the share of household lending in domestic lending was 29%.

45 Personal loans represent one of the key drivers behind the recent trend of rising household indebtedness. In view of this, the HKMA has issued circulars to banks about the prudential requirement on personal lending business to be adopted. For details, see circular "Risk Management of Personal Lending Business" issued on 14 January 2014.

The credit risk of unsecured household exposure remained contained, with the annualised credit card charge-off ratio and the number of bankruptcy petitions staying low (Chart 5.13).

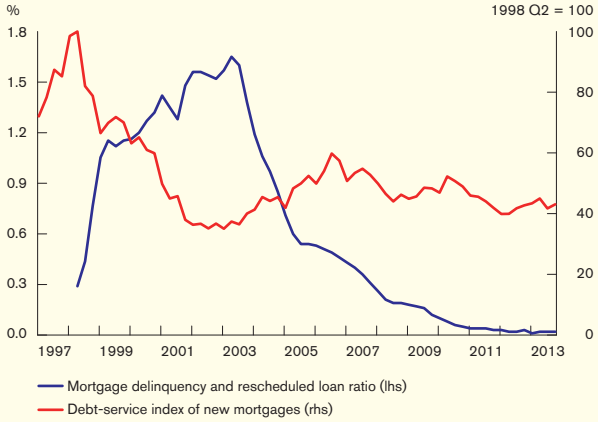
**Chart 5.13**
**Charge-off ratio for credit card lending and bankruptcy petitions**




Sources: Official Receiver's Office and HKMA.

Meanwhile, banks' mortgage portfolios remained healthy, with the delinquency ratio staying at 0.02% and the debt-service index of new mortgages improving slightly to 43 in December 2013 from 45 six months earlier (Chart 5.14). The improvement in the debt-service index mainly reflected lower mortgage rates and the reduced size of an average mortgage loan.

**Chart 5.14**
**Delinquency ratio of banks' mortgage portfolios and household debt-servicing burden in respect of new mortgages**




Note: The calculation of the index is based on the average interest rate for BLR-based mortgages.

Sources: HKMA and staff estimates.

Looking forward, despite the recent slowdown in household loan growth, household indebtedness is still at relatively high levels[46] and could come under pressures as global monetary conditions normalise and interest rates increase. Banks should be vigilant about the impact of a rise in interest rates on their mortgage portfolios.

### *Corporate exposure*[47]

Domestic loans to corporations[48] grew at a slower pace of 3.2% in the second half of 2013, after a 13.2% increase in the first half. At the end of December 2013, corporate loans accounted for 70.4% of domestic lending.

There are some initial signs that the credit risk of banks' corporate exposures may be building up. While the number of compulsory winding-up orders of companies and the Altman's Z-score[49]

46 For details, see Section 4.2 of this report.

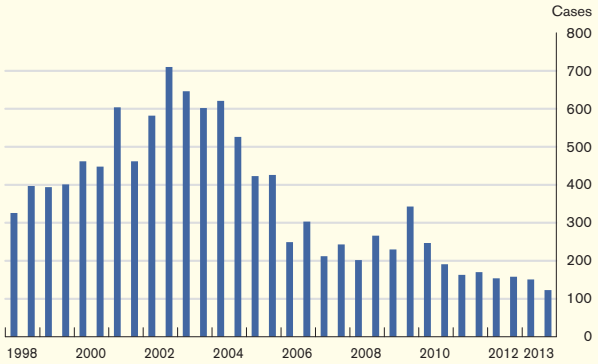
47 Excluding interbank exposure.

48 Loans to corporations comprise domestic lending except lending to professional and private individuals.

49 Altman's Z-score is a credit risk measure based on accounting data. It is a typical credit risk measure to assess the health of the corporate sector based on an array of financial ratios reported in companies' financial statements. The accounting ratios used to derive the Z-score are working capital/total assets, retained earnings/total assets, earnings before interest and taxes/total assets, market value of equity/book value of total liabilities, and sales/total assets.

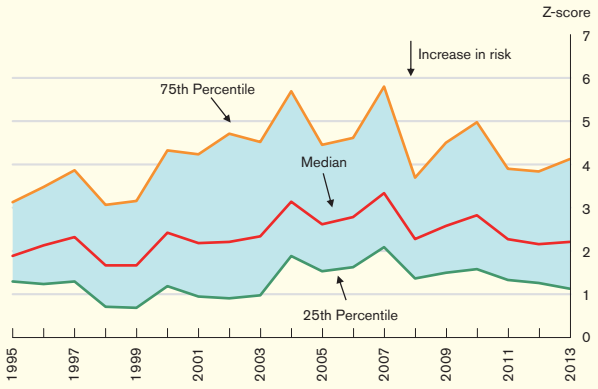
remained broadly steady (Charts 5.15 and 5.16), the debt leverage of the corporate sector has increased in recent years, with the ratio of assets to shareholders' fund reaching 1.79 times at the end of June 2013 (Chart 5.17). Meanwhile, the interest coverage ratio of local corporations, which gauges their abilities to cover interest expenses by earnings, has in general deteriorated. These indicators suggest that the debt-servicing ability of the corporate sector could be under test when interest rates rise.

**Chart 5.15**
**Number of winding-up orders of companies**




Source: Official Receiver's Office.

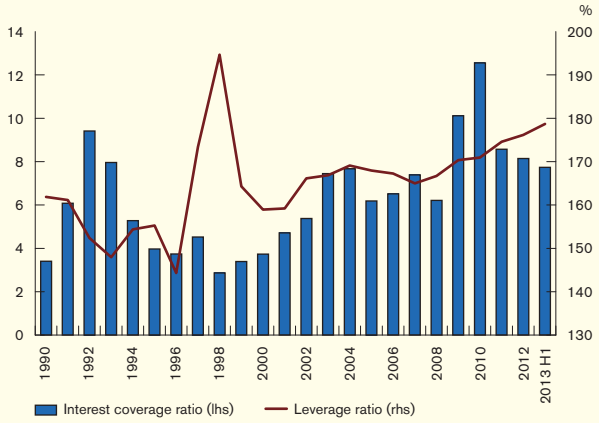
**Chart 5.16**
**Altman's Z-score: A bankruptcy risk indicator of listed non-financial companies**




Note: A lower Z-score indicates a higher likelihood of a company default.

Source: HKMA staff estimates based on data from Bloomberg.

**Chart 5.17**
**Leverage ratio and interest coverage ratio of listed non-financial companies in Hong Kong**




Notes:

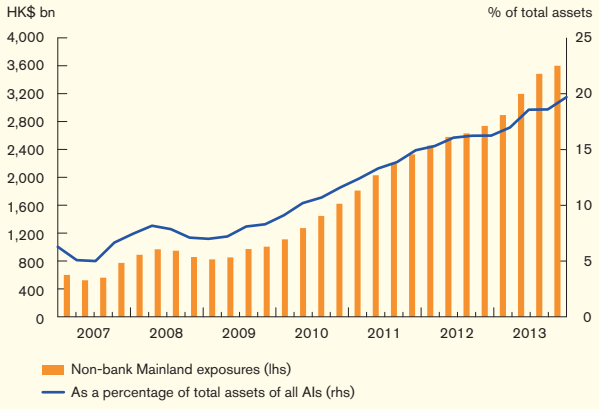
1. The leverage ratio is defined as the ratio of total assets to shareholders' funds. A higher value indicates higher leverage.
2. Interest coverage ratio is defined as the ratio of earnings before interest and taxes to interest expense.

Source: HKMA staff estimates based on data from Bloomberg.

## *Mainland exposure*

The credit exposure of the domestic banking sector to Mainland-related business continued to grow. The total non-bank Mainland exposure of all AIs reached HK$3,602 billion (19.7% of total assets) at the end of 2013, from HK$3,197 billion (18.6% of total assets) six months earlier (Chart 5.18). Of this, retail banks' non-bank Mainland exposure [50] rose to HK$2,279 billion (19.8% of total assets) from HK$2,003 billion (18.2% of total assets).

**Chart 5.18**
**Non-bank Mainland exposures of all AIs**



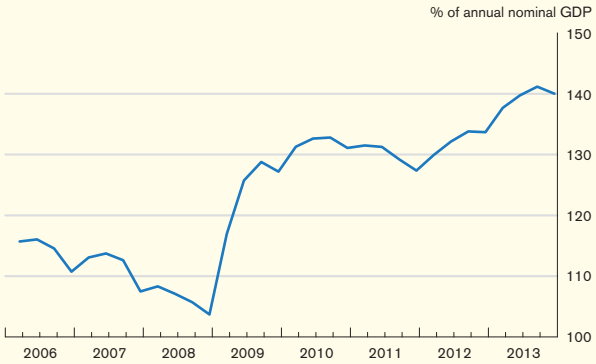

Note: Figures include exposures booked in AIs' banking subsidiaries in Mainland China.

Source: HKMA.

[50] Including exposure booked in retail banks' banking subsidiaries in Mainland China.

The rising share of banks' Mainland exposure continues to be a key risk factor to watch for. While a significant share of the non-bank Mainland exposure is backed by guarantees or collateralised, in view of the Mainland's high level of credit-to-GDP ratio (Chart 5.19), the recent deterioration of the aggregate distance-to-default index[51] of Mainland's corporate sector (Chart 5.20) and the rise in the amount of non-performing loans in its banking system (Chart 5.21), it is important for Hong Kong banks to maintain their stringent prudential management of their Mainland exposure. To step up surveillance of such activities, the HKMA required all banks to report more granular information on their non-bank Mainland exposures by introducing a new quarterly Return of Mainland Activities. In addition, the HKMA required banks active in such activities to conduct thematic review on their risk management and internal controls.

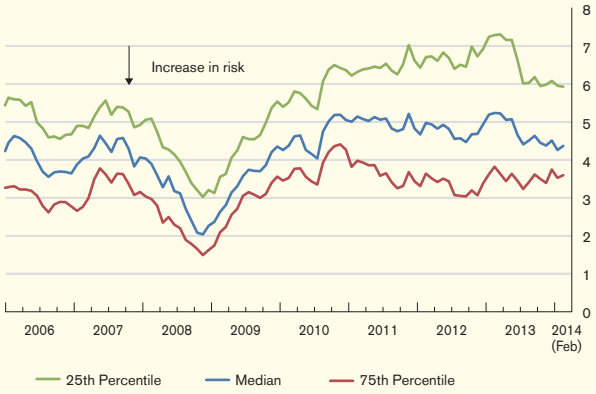
**Chart 5.19**
**Credit-to-GDP ratio in Mainland China**




Note: Credit-to-GDP ratio is defined as the ratio of claims on private sector to the sum of quarterly nominal GDP for the latest four quarters.

Sources: IMF International Financial Statistics and CEIC.

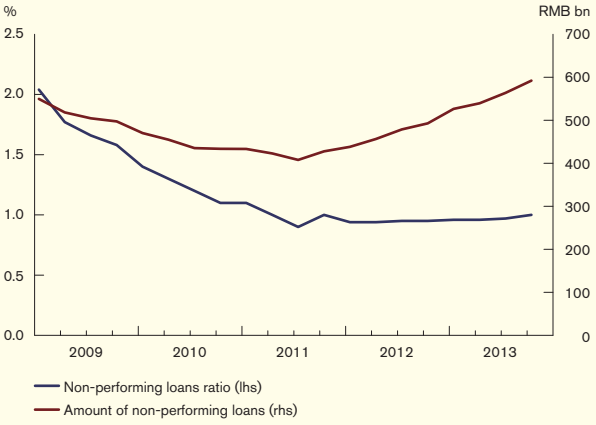
**Chart 5.20**
**Distance-to-default index for the Mainland corporate sector**




Note: Distance-to-default index is calculated based on the non-financial constituent companies (i.e. excluding investment companies and those engaged in banking, insurance and finance) of the Shanghai Stock Exchange 180 A-share index

Source: HKMA staff estimates.

**Chart 5.21**
**Non-performing loans in Mainland China**




Source: China Banking Regulatory Commission.

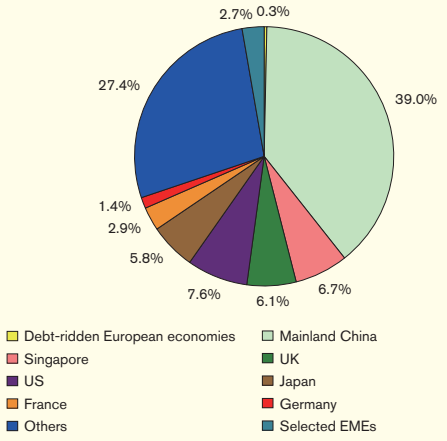
### *Impact of possible contagion from emerging market economies*

Concerns about the vulnerability of emerging market economies (EMEs) with large current account deficits have escalated in recent months. In this regard, it is noteworthy that direct exposure of Hong Kong's banking sector to these economies is not substantial (Chart 5.22), and

[51] The distance-to-default is a market-based default risk indicator based on the framework by R. Merton (1974), "On the pricing of corporate debt: the risk structure of interest rates", *Journal of Finance*, Vol. 29, pages 449 - 470, in which equity prices, equity volatility, and companies' financial liabilities are the determinants of default risk. In essence, it measures the difference between the asset value of a firm and a default threshold in terms of the firm's asset volatility.

together they accounted for 2.7% of banks' overall external claims at the end of December.

**Chart 5.22**
**External claims of the Hong Kong banking sector on major economies (all sectors) at the end of December 2013**




Notes:
1. Figures may not add up to 100% due to rounding.
2. Debt-ridden European economies refer to Greece, Ireland, Italy, Portugal and Spain.
3. Sample of EMEs with large current account deficits refer to Brazil, India, Mexico, Indonesia, Turkey, Poland, Argentina, South Africa and Colombia.

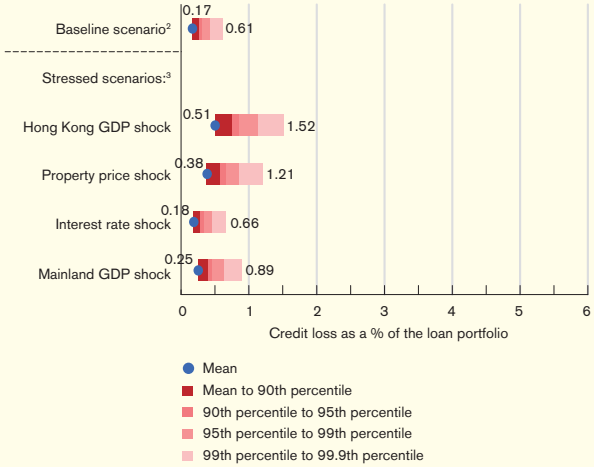
Source: HKMA.

## *Macro stress testing of credit risk* [52 & 53]

Results of the latest macro stress testing on retail banks' credit exposure suggest that the Hong Kong banking sector remains resilient and should be able to withstand rather severe macroeconomic shocks, similar to those experienced during the Asian financial crisis. Chart 5.23 presents the simulated future credit loss rate of retail banks in the fourth quarter of 2015 under four specific macroeconomic shocks[54] using information up to the fourth quarter of 2013. The expected credit losses for retail banks' aggregate loan portfolios two years after the different hypothetical macroeconomic shocks are estimated to be moderate, ranging from 0.18% (interest rate shock) to 0.51% (Hong Kong GDP shock).

Taking account of tail risk, banks' maximum credit losses (at the confidence level of 99.9%) under the stress scenarios range from 0.66% (interest rate shock) to 1.52% (Hong Kong GDP shock), which are significant, but smaller than the loan loss of 4.39% following the Asian financial crisis.

**Chart 5.23**
**The mean and value-at-risk statistics of simulated credit loss distributions[1]**




Notes:
1. The assessments assume the economic conditions in 2013 Q4 as the current environment. The Monte Carlo simulation method is adopted to generate the credit loss distribution for each scenario.
2. Baseline scenario: no shock throughout the two-year period.
3. Stressed scenarios:
   **Hong Kong GDP shock:** reductions in Hong Kong's real GDP by 2.3%, 2.8%, 1.6%, and 1.5% respectively in each of the four consecutive quarters starting from 2014 Q1 to 2014 Q4.
   **Property price shock:** Reductions in Hong Kong's real property prices by 4.4%, 14.5%, 10.8%, and 16.9% respectively in each of the four consecutive quarters starting from 2014 Q1 to 2014 Q4.
   **Interest rate shock:** A rise in real interest rates (HIBORs) by 300 basis points in the first quarter (i.e. 2014 Q1), followed by no change in the second and third quarters and another rise of 300 basis points in the fourth quarter (i.e. 2014 Q4).
   **Mainland GDP shock:** Slowdown in the year-on-year annual real GDP growth rate to 4% in one year.

Source: HKMA staff estimates.

52 Macro stress testing refers to a range of techniques used to assess the vulnerability of a financial system to "exceptional but plausible" macroeconomic shocks. Details of the model adopted in this exercise can be found in J. Wong et al. (2006), "A framework for stress testing banks' credit risk" *Journal of Risk Model Validation*, Vol. 2(1), pages 3 - 23. An updated framework is used for the current estimations.

53 All estimates of credit loss for the overall loan portfolio of Hong Kong banks presented in this report are based on a revised stress testing framework. They are not strictly comparable to those estimates from the past framework that appeared in previous reports due mainly to different definitions of credit losses in these two frameworks. Specifically, credit losses in two years after any shock under the revised framework are measured by the estimated specific provision ratio at the end of the second year plus 50% of the estimated specific provision ratio at the end of the first year after the shock, while credit loss estimates from the past framework are derived based on an estimated delinquency ratio at the end of the second year multiplied by a loss-given-default estimate, which is determined by the simulated property price change over the two-year horizon.

54 These shocks are calibrated to be similar to those that occurred during the Asian financial crisis, except the Mainland China GDP shock.

Given the strong presence of global banks, the liquidity and funding conditions of the Hong Kong banking sector cannot be immune to inward spillovers of shocks from global banks' home countries. Box 6 examines factors determining the extent of shock transmission through intra-group funding activities of global banks and the associated impact on the operation of foreign bank branches in Hong Kong. The findings suggest that while funding shocks of parent banks could exert significant pressure on the credit availability and loan pricing in host countries, the ongoing regulatory reform may help reduce the adverse effect.

*Key performance indicators of the banking sector are provided in Table 5.C.*

# Table 5.C
# Key performance indicators of the banking sector[1] (%)

| | Dec 2012 | Sep 2013 | Dec 2013 |
|---|---|---|---|
| **Interest rate** | | | |
| 1-month HIBOR fixing[2] (quarterly average) | 0.28 | 0.21 | 0.21 |
| 3-month HIBOR fixing (quarterly average) | 0.40 | 0.38 | 0.38 |
| BLR[3] and 1-month HIBOR fixing spread (quarterly average) | 4.72 | 4.79 | 4.79 |
| BLR and 3-month HIBOR fixing spread (quarterly average) | 4.60 | 4.62 | 4.62 |
| Composite interest rate[4] | 0.32 | 0.32 | 0.39 |
| | | **Retail banks** | |
| **Balance sheet developments**[5] | | | |
| Total deposits | 3.1 | 4.9 | 5.3 |
| Hong Kong dollar | 3.5 | 4.9 | 1.5 |
| Foreign currency | 2.7 | 4.9 | 10.0 |
| Total loans | 2.8 | 3.5 | 2.6 |
| Domestic lending[6] | 2.6 | 3.0 | 2.6 |
| Loans for use outside Hong Kong[7] | 3.7 | 5.9 | 2.7 |
| Negotiable instruments | | | |
| Negotiable certificates of deposit (NCD) issued | -2.8 | 5.3 | 10.5 |
| Negotiable debt instruments held (excluding NCD) | 6.8 | 8.8 | 3.7 |
| **Asset quality**[8] | | | |
| As a percentage of total loans | | | |
| Pass loans | 98.16 | 98.25 | 98.33 |
| Special mention loans | 1.36 | 1.27 | 1.20 |
| Classified loans[9] (gross) | 0.48 | 0.48 | 0.48 |
| Classified loans (net)[10] | 0.32 | 0.35 | 0.34 |
| Overdue > 3 months and rescheduled loans | 0.39 | 0.34 | 0.33 |
| **Profitability** | | | |
| Bad debt charge as percentage of average total assets[11] | 0.04 | 0.03 | 0.04 |
| Net interest margin[11] | 1.36 | 1.41 | 1.40 |
| Cost-to-income ratio[12] | 45.8 | 41.9 | 42.2 |
| **Liquidity ratio (quarterly average)** | 42.6 | 38.6 | 39.6 |
| | | **Surveyed institutions** | |
| **Asset quality** | | | |
| Delinquency ratio of residential mortgage loans | 0.02 | 0.02 | 0.02 |
| Credit card lending | | | |
| Delinquency ratio | 0.20 | 0.22 | 0.20 |
| Charge-off ratio — quarterly annualised | 1.82 | 2.09 | 1.85 |
| — year-to-date annualised | 1.70 | 1.93 | 1.84 |
| | | **All locally incorporated AIs** | |
| **Capital adequacy ratio (consolidated)**[13] | 15.7 | 16.1 | 15.9 |

Notes:

1. Figures are related to Hong Kong office(s) only except where otherwise stated.
2. The Hong Kong dollar Interest Settlement Rates are released by the Hong Kong Association of Banks.
3. With reference to the rate quoted by The Hongkong and Shanghai Banking Corporation Limited.
4. The composite interest rate is a weighted average interest rate of all Hong Kong dollar interest-bearing liabilities, which include deposits from customers, amounts due to banks, negotiable certificates of deposit and other debt instruments, and Hong Kong dollar non-interest-bearing demand deposits on the books of banks. Further details can be found in the HKMA website.
5. Quarterly change.
6. Loans for use in Hong Kong plus trade finance.
7. Including "others" (i.e. unallocated).
8. Figures are related to retail banks' Hong Kong office(s) and overseas branches.
9. Classified loans are those loans graded as "substandard", "doubtful" or "loss".
10. Net of specific provisions/individual impairment allowances.
11. Year-to-date annualised.
12. Year-to-date figures.
13. With effect from 1 Janurary 2013, a revised capital adequacy framework (Basel III) was introduced for locally incorporated authorized institutions.

# Box 5
# Liquidity stress tests of the Hong Kong banking sector

## *Introduction*

This Box assesses the liquidity risk of the Hong Kong banking sector using a model-based framework that incorporates interactions between market and credit risks (henceforth referred to as "the model-based framework").[55] The assessment contains two parts. In the first part, we will discuss the stress-testing result using data up to mid-2013. To complement the analysis, we rerun another set of tests for the end-2007 position and compare them with the mid-2013 result. Some possible factors contributing to the change in banks' resilience to liquidity risk during the period will then be identified by examining banks' balance sheets. In the second part of this Box, sensitivity tests will be conducted to assess how the banking sector would fare in various hypothetical stressed scenarios that capture different paces of normalisation of interest rates.

## *The liquidity stress testing result*

In the model-based framework, the cash flow pattern of banks is determined endogenously by asset price shocks in a one-year stress horizon. These hypothetical shocks lead prices of corporate bonds, equities and structured financial securities to decline significantly.[56] Other assumptions of shocks include an interest rate hike by 125 basis points (bps) and an increase in the classified loan ratio by 200 bps.

The liquidity stress test results are evaluated by the ratio of cumulative cash inflows to cumulative cash outflows at the end of one-year stress horizon (i.e. the cash flow ratio) for 17 local banks. Cash shortage occurs if the cash flow ratio is below 100%. No cash shortage is found in the liquidity stress test based on mid-2013 data, suggesting that the Hong Kong banking sector would be able to weather severe liquidity shocks.

## *Developments in the post-crisis period*

To assess how the ability of the Hong Kong banking sector to weather liquidity shocks has evolved after the global financial crisis (GFC), we compare the mid-2013 result to that of end-2007. The end-2007 result is obtained by repeating the test using the same dataset in our previous assessment in 2009.[57] The dataset contains financial information of 12 listed Hong Kong

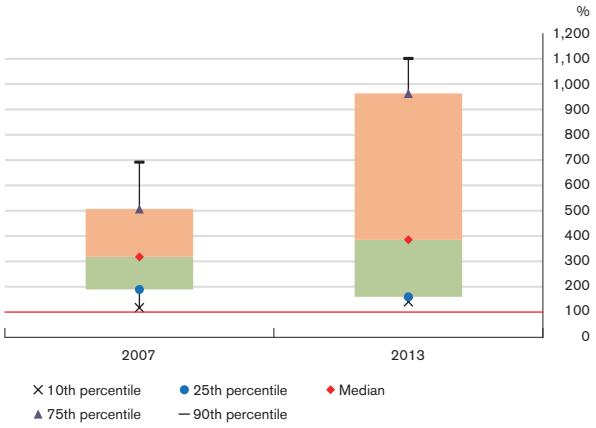
[55] The model-based framework was developed by Wong, E. and Hui, C. (2009), "A Liquidity Risk Stress-Testing Framework with Interaction between Market and Credit Risks", HKMA Working Paper 06/2009. The framework captures how mark-to-market losses on banks' holding of risky assets due to a prolonged period of negative asset price shocks would increase banks' solvency risk and reduce the ability to generate liquidity from asset sales.

[56] Most asset price shocks are generated from pre-defined distributions, including shocks on the risk-free interest rate. At the 90th percentile, the credit spreads of corporate bonds with credit ratings of "AA" or higher, "A" and "BBB" are assumed to rise by 0.4, 1.7 and 1.74 percentage points respectively. The credit spread of non-investment grade and unrated corporate bonds is assumed to rise by 10.5 percentage points. Equity prices and the market value of structured financial securities are assumed to fall by 27% and 32% respectively. Further, it is assumed that cash inflow from income drops by 10%, and 15% of committed credit lines are granted to special investment vehicles, with drawdown rate negatively correlated with the price of structured financial securities. The model-based framework does not take into account any possible mitigation measure by parent banks and central banks.

[57] See footnote 55.

banks at the end of 2007. The results of the two stress tests (Chart B5.1) are broadly consistent[58] and suggest that severe asset price shocks coupled with a moderate pace of monetary tightening would not pose significant systemic liquidity risk to the Hong Kong banking sector. As revealed from the estimated distributions of the cash flow ratio, some banks are found to have a higher cash flow ratio than before, indicating an improvement in the ability to withstand liquidity shocks.

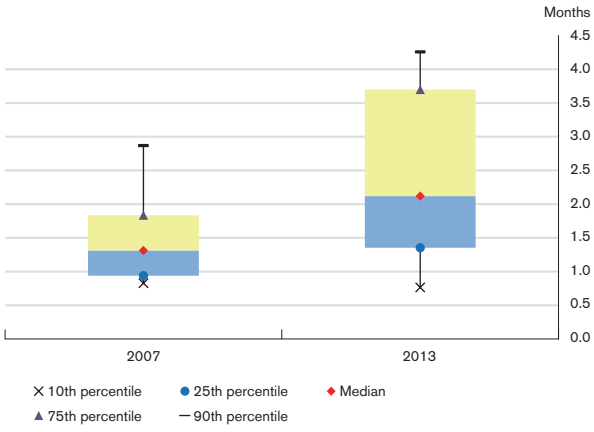
**Chart B5.1**
**Cash flow ratio at the end of a one-year stress period**




Source: HKMA.

Some balance sheet developments may be conducive to the improvement. In particular, many sample banks have taken deposits with longer average maturities than before (Chart B5.2), which may reduce their vulnerability to deposit outflows in times of stress.

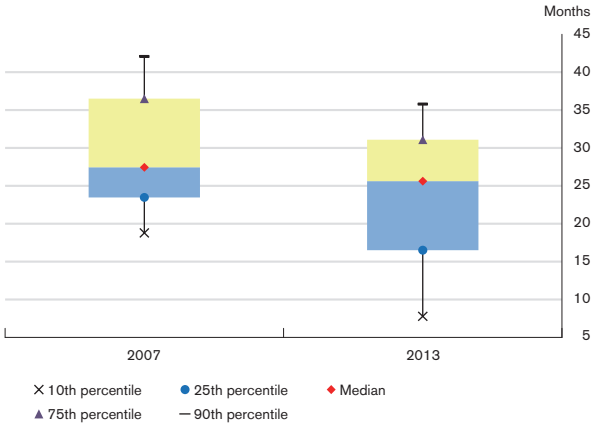
**Chart B5.2**
**Weighted average maturity of deposits**




Source: HKMA staff estimates based on banks' financial information.

Another notable development is that banks have reduced their holdings of debt securities. The aggregate amount of debt securities held was 16% of total assets of the sample banks in mid-2013, down from 20% in end-2007. The maturities of debt securities held are also found to be shorter than before (Chart B5.3). All else equal, debt securities with shorter maturities are less sensitive to changes in interest rates. In other words, the decline in prices of debt securities resulting from an interest rate hike would be more moderate than before. For those

**Chart B5.3**
**Weighted average maturities of debt securities**

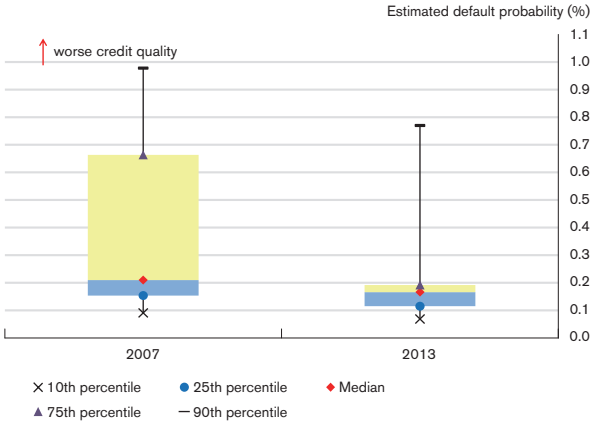



Source: HKMA staff estimates based on banks' financial information.

[58] Comparison based on end-2007 and mid-2013 positions should be interpreted with caution due to different sample sizes and availabilities of information.

corporate debt securities held by banks with credit ratings, the average credit quality has also improved (Chart B5.4). These factors together may explain why some banks have a higher estimated cash flow ratio after the GFC.

**Chart B5.4**
**Weighted average credit rating-implied default probability of corporate debt securities**




Notes:
1. Weighted average credit rating-implied default probabilities are derived from historical default rates estimated by Standard and Poor's.
2. For mid-2013 position, the amounts of corporate debt securities by rating held by bank are actual figures; for end-2007 position, the corresponding amounts are estimated due to insufficient information.

Source: HKMA staff estimates based on banks' financial information.

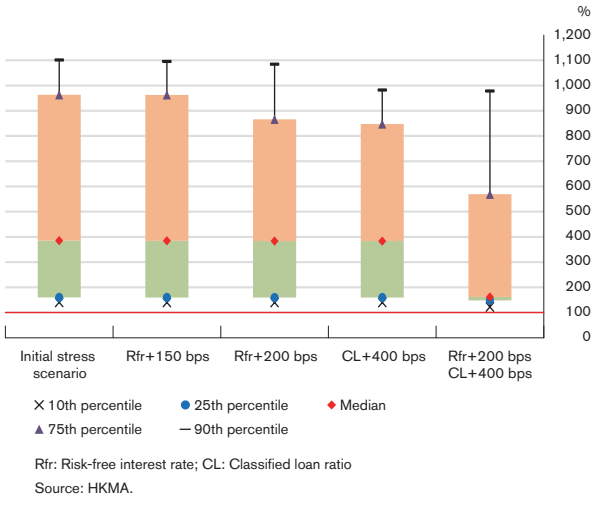
However, development of some risk factors may merit attention. First, the share of unrated corporate debt securities held by banks has increased.[59] The credit quality and marketability of these unrated debt securities are less clear. From a liquidity management perspective, banks could face significant difficulties in selling these unrated debt securities to raise liquidity during market turmoil. Second, contingent liabilities and commitments have grown. The amount averaged 32% of total assets for the sample banks in 2013, compared with 27% in 2007. This could expose banks to significant contingent liquidity risk.

[59] In our samples, unrated corporate debt securities is estimated to increase to around 5% of total debt securities held in mid-2013 from around 2% in end-2007. This observation is consistent with the findings of the Survey on Selected Debt Securities that the share of unrated non-structured debt securities in total non-structured debt securities held by AIs rose to 9.1% in June 2013 from 4.9% in December 2008 (see the HKMA Quarterly Bulletin).

### *Sensitivity tests*

In the model-based framework, the movement of the risk-free interest rate is one key risk factor determining the mark-to-market losses of banks. For the stress scenario considered above, a hypothetical hike of 125 bps in the risk-free rate is assumed. We conduct some sensitivity tests by considering interest-rate hikes of 150 bps and 200 bps. Consistent with the more drastic interest rate hikes, we assume that the classified loan ratio increases by 400 bps, a more drastic increase than that in the initial stress scenario. Chart B5.5 depicts the result of sensitivity tests. As expected, banks' cash flow ratios deteriorate when more severe shocks are imposed. In particular, a scenario of a 200-basis-point hike coupled with a jump of 400 bps in the classified loan ratio is expected to result in a more pronounced drop in the cash flow ratio. However, even in such severe scenario, no bank is found to experience cash shortage in the one-year horizon.

**Chart B5.5**
**Cash flow ratio under sensitivity tests**




Rfr: Risk-free interest rate; CL: Classified loan ratio

Source: HKMA.

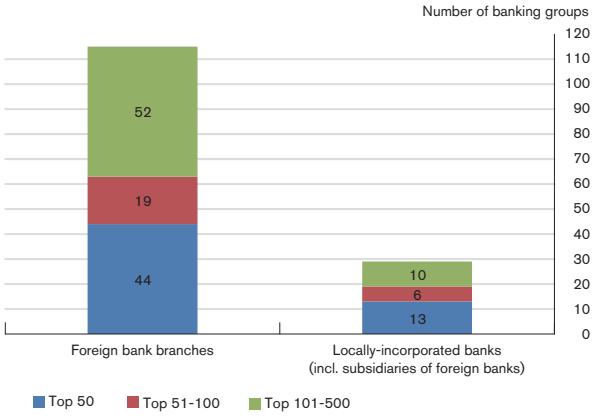
### *Conclusion*

The liquidity stress test shows that the systemic liquidity risk of Hong Kong banking sector would be contained in the face of severe economic and financial shocks. Although the result of the sensitivity tests points to the same conclusion, it highlights that banks' liquidity risks are sensitive to the movement of interest rates. Banks should therefore be vigilant for the potential effect and pace of normalisation of interest rates.

# Box 6
# Implications of liquidity management of global banks for the Hong Kong banking sector

The global financial crisis (GFC) highlights a pivotal role of global banks in transmitting financial shocks internationally. The strong presence of global banks (Chart B6.1) in Hong Kong implies that the local banking sector is not immune to inward spillovers[60] of shocks from global banks' home countries. Indeed, 27 out of the 29 global systemically important banks (G-SIBs)[61] operated in Hong Kong at the end of 2013 in the form of bank branches. Many of these branches played a significant funding role before the GFC, and their intra-group funding activities (i.e. internal capital markets) are one channel through which financial shocks are propagated. This Box provides empirical evidence regarding factors determining the extent of shock transmission through this channel and the associated impact on the operation of foreign bank branches in Hong Kong.

**Chart B6.1**
**Presence of global banks in Hong Kong by consolidated asset size and mode of operation**



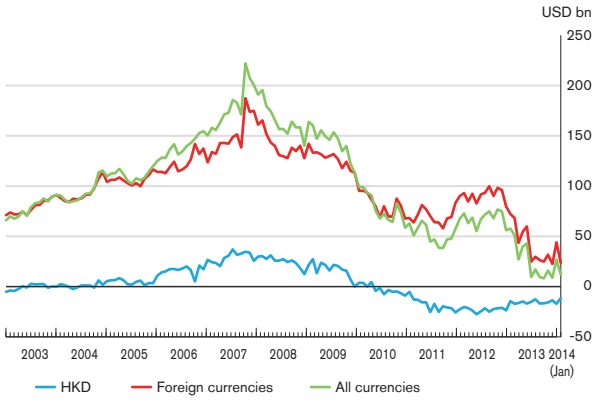

Note: The rank is based on consolidated asset size in 2013. Some global banks operate both branches and subsidiaries in Hong Kong.

Source: HKMA.

## *Internal capital markets of global bank branches in Hong Kong*

Reflecting largely strong demand for US-dollar liquidity by global banks, total supply of cross-border banking funds by the Hong Kong banking sector, on a net basis, increased rapidly before the GFC and reached its peak at US$222 billion in October 2007 (Chart B6.2). To provide perspective on the scale of these cross-border flows, the peak amount of US$222 billion is comparable to 40% of the peak outstanding amount of the Federal Reserve's central bank liquidity swap lines recorded in the fourth quarter of 2008.

**Chart B6.2**
**Hong Kong banking sector's net amount due from banks abroad #**




\# "Net amount due from banks abroad" refers to the amount due from banks abroad less the amount due to banks abroad. A positive (negative) figure means that the Hong Kong banking sector is a net lender (borrower).

Source: HKMA.

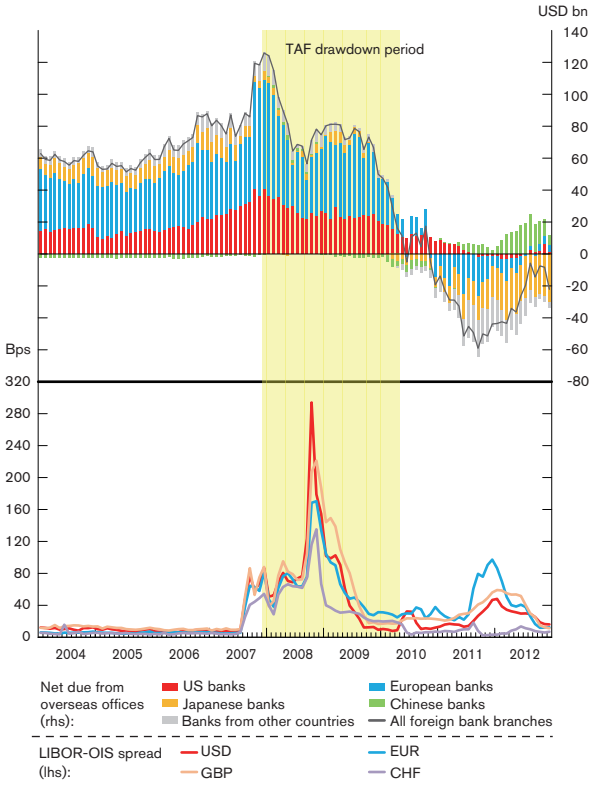
These cross-border funding flows are driven largely by intra-group funding flows of global banks' branches in Hong Kong. The cyclical movement of their foreign-currency "net due from overseas offices" (*NDF*), defined as "due from overseas offices" minus "due to overseas

[60] Inward spillover of shocks refers to a situation that the Hong Kong banking sector is a receiver of external financial shocks emerging from home countries of global banks.

[61] The 29 G-SIBs were identified by the Financial Stability Board in November 2013.

offices", is shown in Chart B6.3. By definition, a positive (negative) *NDF* means that Hong Kong branches are net lenders (borrowers) to the rest of their respective banking groups. We break down the aggregate *NDF* by country group based on their headquarter locations. The chart shows that in the run-up to the GFC, European banks and to a lesser extent US banks increasingly channelled funds from Hong Kong through their internal capital markets to support their parents' funding needs. Importantly, the increase in *NDF* was broadly associated with the first spike in funding stress in the second half of 2007 measured by the spread between interbank rate and overnight indexed swap rate (i.e. LIBOR-OIS spread). This observation suggests that in response to a parent-bank funding shock in home country, global banks buffered parents' liquidity by activating internal fund transfer from branches overseas.

**Chart B6.3**
**Foreign-currency net due from overseas offices of foreign bank branches in Hong Kong and Libor-OIS spreads**

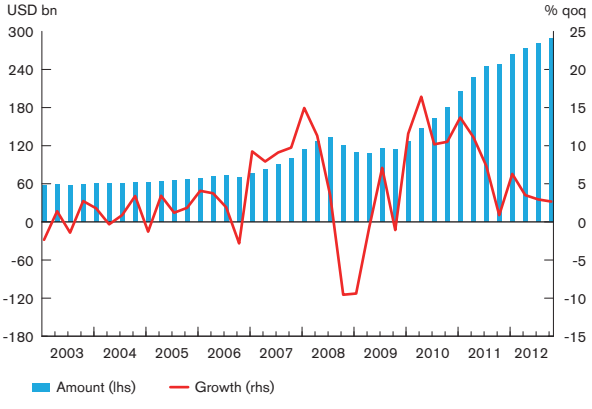



Sources: HKMA, data of LIBOR-OIS spreads are contributed by the International Banking Research Network.

The scale of internal fund transfer from Hong Kong branches, however, has dropped since the fourth quarter of 2007. The timing is in line with the launch of the Term Auction Facility (TAF) by the Federal Reserve in December 2007. As global banks gained access to liquidity measures by the Federal Reserve, their Hong Kong branches have played a less important funding role, contributing to a reversal of the funding pattern as early as mid-2010. Since then, many foreign bank branches in Hong Kong have become net recipients of internal funds (i.e. negative *NDF*).

The change in the funding pattern is particularly clear for European and Japanese banks, which is consistent with Shin's (2011)[62] hypothesis that non-US banks, by taking advantage of central bank liquidity measures during the crisis from the Federal Reserve, channelled US-dollar liquidity to emerging market economies. Indeed, published bank-level data by the Federal Reserve show that many global banks with branches in Hong Kong had access to the TAF. The ample liquidity of global banks due to unprecedented central bank measures arguably is one important contributor to the sharp foreign-currency loan growth in Hong Kong since 2010 (Chart B6.4).

**Chart B6.4**
**Foreign-currency loans and advances to customers of the Hong Kong banking sector**




Source: HKMA.

62 See H.S.Shin (2011) "Global Liquidity", remarks at the IMF conference on "Macro and Growth Policies in the Wake of the Crisis", Washington DC, 7-8 March 2011.

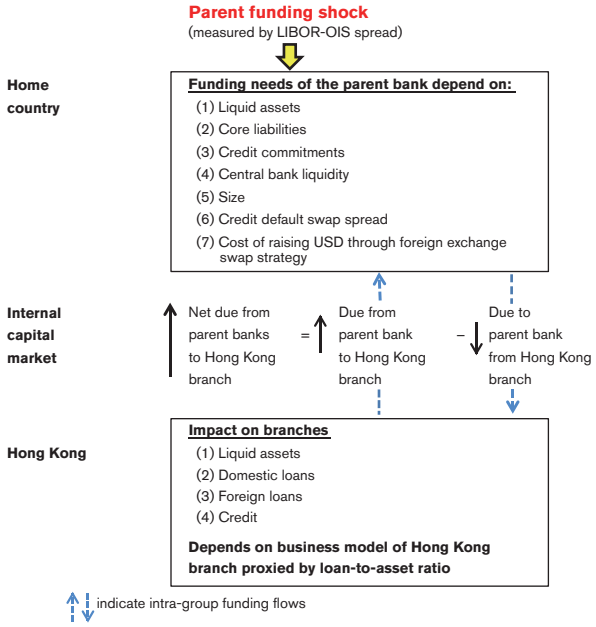
These observations together support the hypothesis that global banks propagate home-country funding shocks and central bank liquidity to host countries through their internal capital markets, which in turn affects the loan supply of their branches in Hong Kong. We test this hypothesis econometrically in the next section.

### *The empirical model and estimation results*

To test the hypothesis, we adopt a two-stage econometric approach similar to that in Cetorelli and Goldberg's (2012) study.[63] The empirical strategy can be broadly described as follows: In the first-stage regression, we estimate how the parent's funding needs drive the change in *NDF* of its Hong Kong branch (*ΔNDF*). The predicted value of *ΔNDF*, which by construction captures the part of *ΔNDF* that is driven by the parent's funding needs, is then used as an instrumental variable in the second-stage regression to explain the branch operation, including the adjustment for liquid assets, (foreign and domestic) loans and credit (i.e. the sum of loans and credit commitments).

Instead of detailing the econometric specification of the model, we provide the economic intuition of the model using an example of a European bank. The structure of the model is also shown by Chart B6.5. Consider an exogenous liquidity shock in the euro area that leads to a sharp rise in the euro LIBOR-OIS spread. To cope with the parent's funding needs, European global banks would activate their internal capital markets by increasing the net internal funding flows from their overseas branches, with the intensity presumably being more pronounced for those banks that at the consolidated level hold less liquid assets and core liabilities (i.e. the sum of customer deposits and equity), and have more credit commitments. Size is also conjectured to be a significant determinant.

**Chart B6.5**
**Structure of the empirical model**




Note: In the model, the amount due from (to) parent bank to (from) Hong Kong branch is proxied by the amount due from (to) overseas offices to (from) Hong Kong branch.

We further assume that the parent takes into account the business model of its Hong Kong branch when adjusting *NDF*. Specifically, the parent tends to withdraw more internal funding from those overseas branches that *ex ante* play a more obvious funding role, contribute less to loan intermediation and investment activities, and price loans less favourably.

In addition, those global banks that gain access to central bank liquidity tend to reduce their reliance on internal funding support from branches overseas. Finally, the ability to raise external funding (measured by its credit default swap spread) and the cost of raising funds through swapping home-country currency to US dollars also affect the scale of internal funding support from overseas branches.

[63] See Cetorelli, N. and L.S. Goldberg (2012), "Follow the Money: Quantifying Domestic Effects of Foreign Bank Shocks in the Great Recession", *American Economic Review*, 102(3), pages 213-218.

From the perspective of a Hong Kong branch, branch assets would need to be adjusted to counterbalance the "withdrawal" of internal funding by the parent. The adjustment would take various forms, including selling liquid assets, cutting domestic and foreign loans. The branch would also be cautious about granting credit commitments. How the adjustment is distributed across asset types is assumed to be dependent on the business model of the Hong Kong branch, which is proxied by a loan-to-asset ratio of the branch.

The models are estimated using a panel dataset of 37 foreign bank branches in Hong Kong, covering from the first quarter of 2006 to the fourth quarter of 2012. Branch-level variables are constructed using regulatory data filed by these branches to the HKMA, while parent-level variables are constructed using data of their respective parents from *Bankscope*. All dependent variables are defined using US-dollar denominated balance sheet items. So, the estimation results allow us to understand better how global banks managed their US-dollar liquidity during the GFC.

The preliminary estimation result is broadly in line with our expectations and supports the hypothesis. Key findings are summarised as follows:

(1) Global banks are found to react to a parent-bank funding shock by increasing the net internal funding from their Hong Kong branches, with the intensity being more pronounced for those parents holding less liquid assets.

(2) Global banks that gained direct access to central bank liquidity are found to rely less on internal funding from their Hong Kong branches, suggesting a significant effect of central bank liquidity measures in alleviating funding pressure of global banks during the GFC.

(3) The estimation results support the *locational pecking order* hypothesis (Cetorelli and Goldberg, 2012).[64] Specifically, a parent would withdraw more internal funding from Hong Kong if its Hong Kong branch is regarded as core from a funding perspective. By contrast, the parent is more likely to commit stable internal funding to its Hong Kong branch if loan prices in Hong Kong are more attractive.

(4) Regarding the impact on branch operation, the estimation result indicates that higher internal fund transfer in support of the parent reduces loan supply of global banks' Hong Kong branches, with the adjustment being more intense for those branches that operate with a higher loan-to-asset ratio. Comparatively, the branch reduces the supply of US-dollar loans for use outside Hong Kong[65] more than that of US-dollar loans for use in Hong Kong. An even more drastic downward adjustment is found for credit commitments, suggesting that the parent funding shock would produce a prolonged effect on the branch's loan supply.

### *Conclusion*

Our study finds that global banks' cross-border internal funding flows, and thus their foreign branches' loan supply are significantly responsive to central bank liquidity. Therefore, normalisation of liquidity in advanced economies, even assuming a limited impact on interest rates, could in theory change the pattern of internal funding flows of global banks and thus lead to a significant loan curtailment in host

[64] Cetorelli, N. and L.S. Goldberg (2012), "Liquidity management of US global banks: Internal capital markets in the great recession", Journal of International Economics, pages 299-311.

[65] Including US-dollar loans for trade finance.

countries. The resulting pressure on credit availability and loan pricing (particularly for foreign-currency loans) in host countries could be significant. The potential impact on the real economy merits close attention.

Nevertheless, our findings support the view that the ongoing regulatory reform may act as a dampening factor that helps to reduce the extent of cross-border transmission of financial shocks through the channel of global banks' internal capital markets. Specifically, our finding indicates that from a liquidity management perspective, liquid assets held by parents and internal funding from their Hong Kong branches are regarded as close substitutes by global banks. Therefore, liquidity requirements of Basel III, which requires banks to hold adequate high-quality liquid assets to cover their cash outflows, may reduce global banks' reliance on cross-border internal funding support in times of stress.