5. Banking sector performance

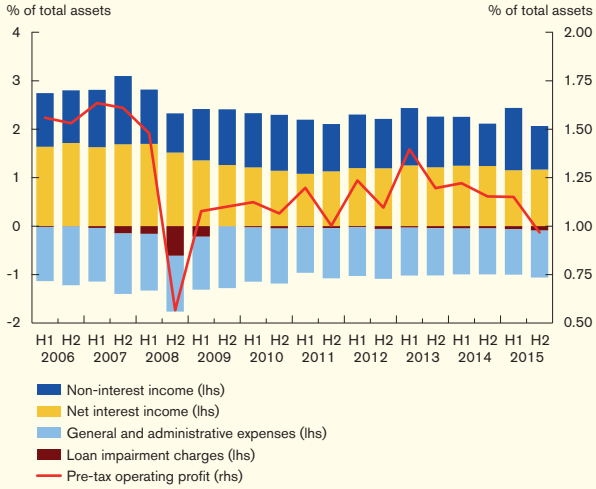
Retail banks recorded thinner profit in the second half of 2015 mainly due to lower non-interest income. Meanwhile, the banking sector witnessed the first contraction in loan book since the global financial crisis, alongside slight deterioration in asset quality. Nevertheless, capital and liquidity positions remained structurally robust and strengthened further. Looking ahead, the banking sector faces challenges on various fronts. Banks should pay close attention to the impacts of more volatile interest rates and possible capital outflows amid normalisation of US interest rates. This coupled with potential global economic slowdown and financial market turbulence could put pressure on the credit quality of banks' assets in general. In particular, credit risk in relation to corporate exposures may increase further as corporates' leverage and debt-servicing burdens continued to rise. Banks should maintain prudent credit risk management in this more challenging operating environment.

5.1 Profitability and capitalisation

Profitability

The profitability of retail banks[35] declined in the second half of 2015 mainly due to lower non-interest income, while rises in operating costs and higher loan impairment charges also contributed. With pre-tax operating profit of retail banks reducing by 15.5%, their return on assets[36] receded to 0.97% in the second half of 2015 from 1.15% in the first half (i.e. the red line in Chart 5.1).

Chart 5.1
Profitability of retail banks



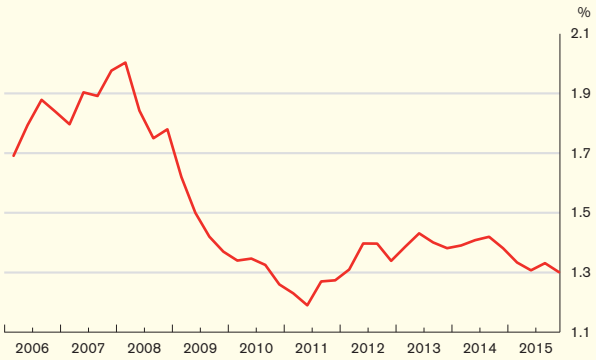
Note: Semi-annually annualised figures.
Source: HKMA.

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

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

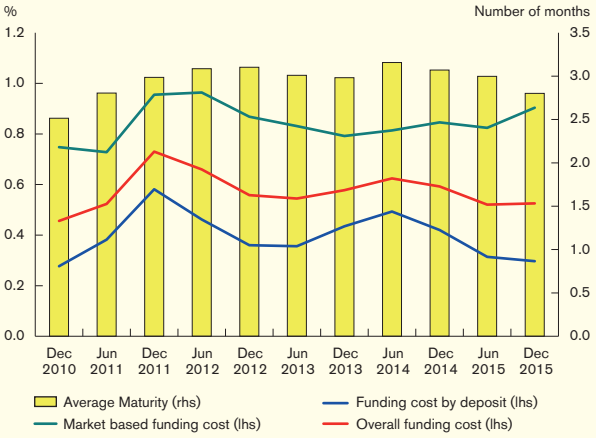
The net interest margin of retail banks hovered in a narrow range and stayed at 1.30% in the fourth quarter of 2015 (Chart 5.2) attributable partly to stable funding conditions. For licensed banks as a whole, overall funding costs remained steady at 0.53% at the end of December 2015 (Chart 5.3).[37] Meanwhile, the composite interest rate, a measure of the average cost of Hong Kong dollar funds for retail banks, declined slightly by 3 basis points during the second half of 2015 to 0.26% at the end of December 2015 (Chart 5.4). Hong Kong interbank interest rates remained largely steady in the second half of 2015, before seeing some notable upward adjustments from low levels in January 2016.

Chart 5.2
Net interest margin of retail banks



Note: Quarterly annualised figures.
Source: HKMA.

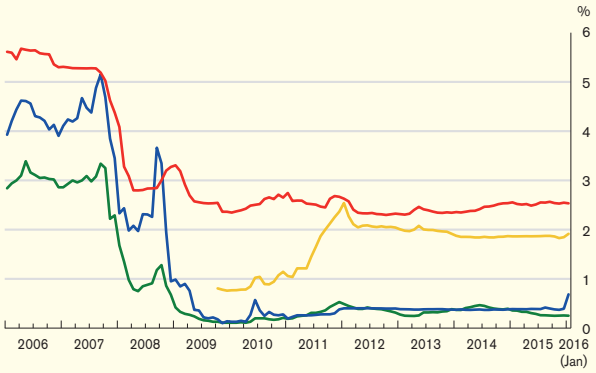
Chart 5.3
Hong Kong and US dollar funding cost and maturity of licensed banks



Source: HKMA.

HIBOR-based and the best lending rate based (BLR-based) mortgage rates were also broadly stable (Chart 5.4). However, the share of the former amongst the newly approved mortgage loans dropped to 79.7% at the end of 2015 from 85.8% at the end of June, partly reflecting the market response to the anticipated normalisation of HIBORs following the rise in US interest rates.

Chart 5.4
Interest rates



Notes:
(a) End of period figures.
(b) Period-average figures for newly approved loans.
Sources: HKMA and staff estimates.

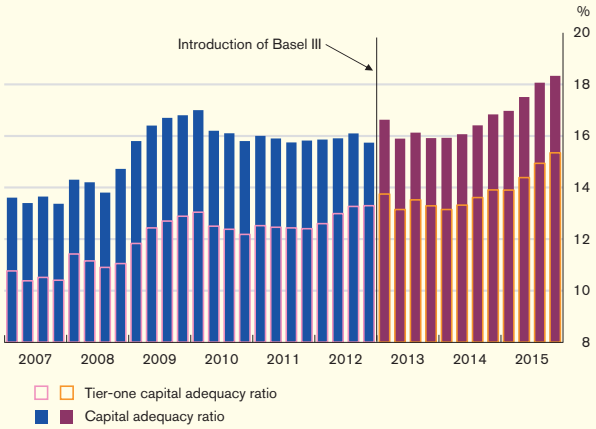
Capitalisation

Capitalisation of the banking sector continued to be strong and remained well above the minimum international standards. The consolidated capital adequacy ratio of locally incorporated AIs rose to 18.3% at the end of December from 17.5% at the end of June (Chart 5.5), while the tier-one capital adequacy ratio[38] increased to 15.3% from 14.4%. The strong capital position suggests that the Hong Kong banking sector is well positioned to meet the countercyclical capital buffer requirement, which came into effect from 1 January 2016.

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

[38] The ratio of tier-one capital to total risk-weighted assets.

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

The liquidity position of the banking sector, as measured by the Basel III Liquidity Coverage Ratio (LCR)[39] requirement, continued to be favourable and strengthened further during the review period. The average LCR of category 1 institutions rose to 142.9% in the fourth quarter of 2015, while the average Liquidity Maintenance Ratio (LMR) of category 2 institutions also increased to 53.9% (Table 5.A). Both ratios remained well above their regulatory minimums,[40] suggesting that the Hong Kong banking sector is able to withstand potential liquidity risks arising from possible capital outflows from Hong Kong.

Table 5.A
Liquidity ratios

Quarterly average ratios (%)	2015 Q1	2015 Q2	2015 Q3	2015 Q4
Liquidity Coverage Ratio (Consolidated) — Category 1 institutions	129.9	131.7	136.4	142.9
Liquidity Maintenance Ratio (Consolidated) — Category 2 institutions	50.8	53.4	53.6	53.9

Source: HKMA.

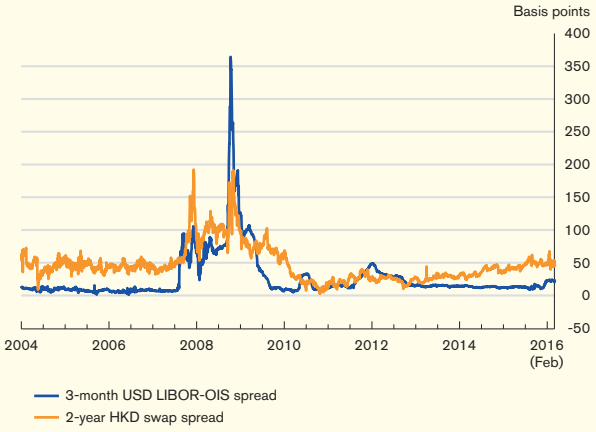
Mainly reflecting market concerns about European banks' exposure to the energy and commodity sectors and the associated potential impact on their default risks, credit default swap spreads for some European banks have widened notably coupled with falls in prices of their contingent convertible bonds since February 2016. Nevertheless, the increase in European banks' counterparty risk so far has had only a limited impact on bank funding liquidity. The spread between three-month US dollar LIBOR and its corresponding overnight index swap (OIS) rate widened moderately to 24 basis points by the end of February 2016 (Chart 5.6). In the domestic market, funding liquidity remained broadly stable, with the two-year Hong Kong dollar swap spread little changed at around 48 basis points.[41]

[39] The Basel III LCR requirement, phased-in from 1 January 2015, is designed to ensure that banks have sufficient high-quality liquid assets to survive a significant stress scenario lasting 30 calendar days. In Hong Kong, AIs designated as category 1 institutions adopt the LCR; while category 2 institutions adopt the LMR, which is a modified form of the original statutory liquidity ratio requirement.

[40] For a category 1 institution, the minimum requirement for LCR began at 60% on 1 January 2015, rising in equal annual steps of 10 percentage points to reach 100% on 1 January 2019. A category 2 institution must maintain an LMR of not less than 25% on average in each calendar month.

[41] The determinants of variations in the Hong Kong dollar swap spreads were investigated in C. Hui and L. Lam (2008), "What drives Hong Kong dollar swap spreads: Credit or liquidity?", *HKMA Working Paper* 10/2008.

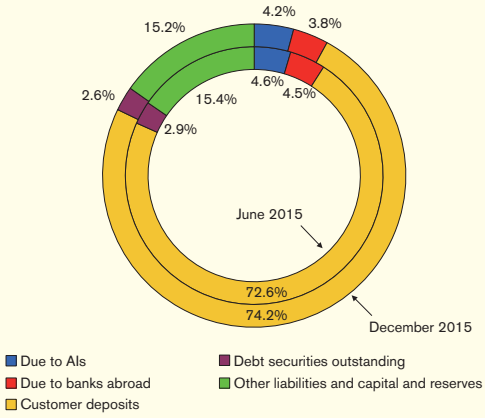
Chart 5.6
3-month US dollar LIBOR-OIS spread[42] and 2-year Hong Kong dollar swap spread[43]



Source: Bloomberg.

Customer deposits continued to be the primary funding source for retail banks. The share of customer deposits to banks' total liabilities edged up to 74.2% at the end of December 2015 (Chart 5.7) from 72.6% six months earlier. The share of other funding sources remained broadly stable during the review period.

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.

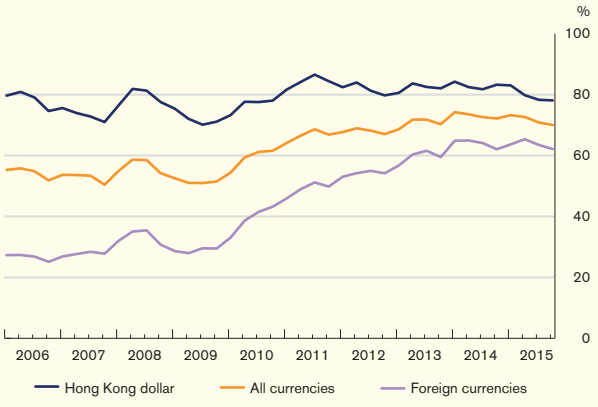
As total loans and advances declined and deposits increased moderately during the review period, the all-currency loan-to-deposit (LTD) ratio of all AIs declined by 2.6 percentage points to 70.1% at the end of December. The Hong Kong dollar LTD ratio of all AIs fell by 1.7 percentage points to 78.2% (Chart 5.8), while the foreign-currency LTD ratio dropped more significantly by 3.2 percentage points to 62.2%.

The LTD ratios of retail banks exhibited a similar picture (Chart 5.9). The Hong Kong dollar LTD ratio declined slightly by 0.6 percentage points to 71.5% at the end of December, while the foreign-currency LTD ratio fell by 1.5 percentage points to 37.8%. As a whole, the all-currency LTD ratio of retail banks reduced to 56.5% at the end of December from 57.8% six months earlier.

[42] An OIS is an interest rate swap in which the floating leg is linked to an index of daily overnight rates. The two parties agree to exchange at maturity, on an agreed notional amount, the difference between interest accrued at the agreed fixed rate and interest accrued at the floating index rate over the life of the swap. The fixed rate is a proxy for expected future overnight interest rates. As overnight lending generally bears lower credit and liquidity risks, the credit risk and liquidity risk premiums contained in the overnight index swap rates should be small. Therefore, the LIBOR-OIS spread generally reflects the credit and liquidity risks in the interbank market.

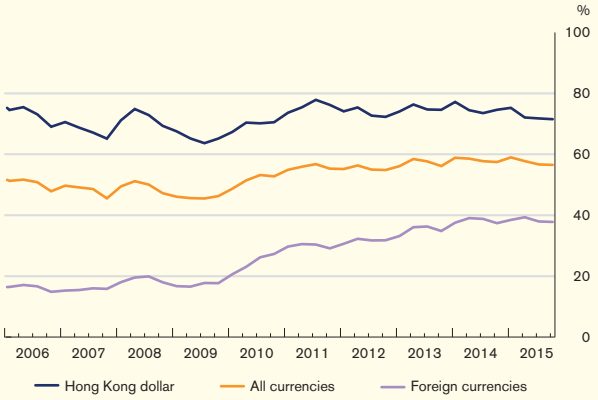
[43] Swap spreads are differences between "fixed-for-floating" interest rate swap rates and corresponding Exchange Fund paper yields of the same maturity.

Chart 5.8
Average loan-to-deposit ratios of all AIs



Source: HKMA.

Chart 5.9
Average loan-to-deposit ratios of retail banks

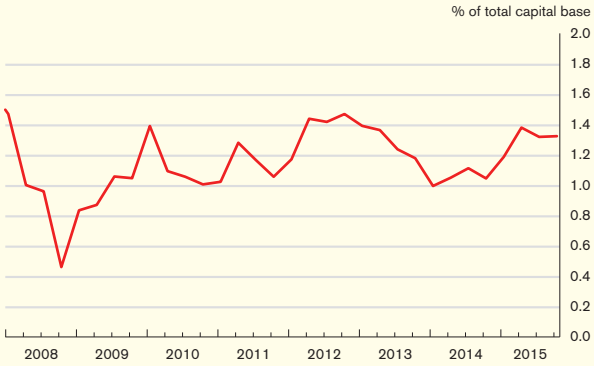


Source: HKMA.

Interest rate risk

Interest rate risk exposure of retail banks remained low compared to their strong capital positions. It is estimated that under a hypothetical shock of an across-the-board 200-basis-point increase in interest rates, the economic value of retail banks' interest rate positions could be subject to a decline equivalent to 1.32% of their total capital base as of December 2015 (Chart 5.10). Nevertheless, given the high uncertainty about the pace and timing of further US interest rate rises, banks should pay close attention to their interest rate risk management.

Chart 5.10
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[44], expressed as a percentage of the total capital base of banks.

Source: HKMA staff estimates.

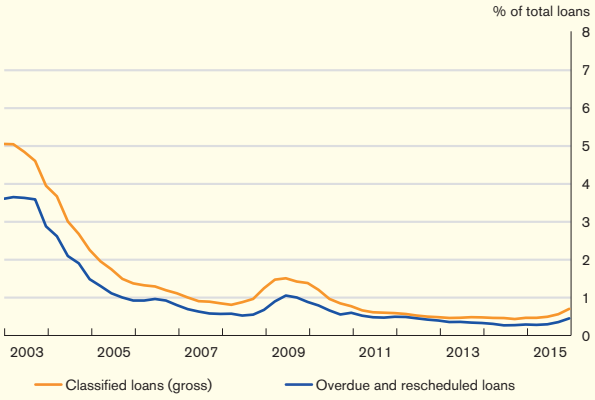
Credit risk

The asset quality of retail banks remained healthy, although there have been clearer signs of deterioration. The classified loan ratio increased to 0.70% at the end of December[45] from 0.49% at the end of June, while the ratio of overdue and rescheduled loans rose to 0.45% from 0.29% (Chart 5.11). Nevertheless, both ratios stayed at low levels by historical standards.

[44] 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.

[45] Figures prior to December 2015 are related to retail banks' Hong Kong offices and overseas branches. Starting from December 2015, the coverage was expanded to include locally incorporated retail banks' major overseas subsidiaries. The classified loan ratio covering retail banks' Hong Kong offices and overseas branches was 0.63% at the end of December 2015.

Chart 5.11
Asset quality of retail banks



Notes:
1. Classified loans are those loans graded as "sub-standard", "doubtful" or "loss".
2. Figures prior to December 2015 are related to retail banks' Hong Kong offices and overseas branches. Starting from December 2015, the coverage was expanded to include the banks' major overseas subsidiaries as well.

Source: HKMA.

The weakening global economic outlook raises a question mark on how banks' asset quality would fare if the macro risk intensifies. Stress-testing exercises are one useful tool for such assessments. In an attempt to provide a more comprehensive and realistic assessment, Box 5 develops a macro stress-testing framework with macro-financial feedback linkages. Theoretically, deterioration in banks' asset quality arising from an economic slowdown could lead banks to curtail lending and/or raise lending rates. The resulting tighter credit conditions could further worsen economic fundamentals, amplifying the initial macro shock. We show in a stress-scenario analysis that the macro-financial feedback effect alone could in some extreme cases lead to a notable increase in the stressed classified loan ratio after the occurrence of an initial macro shock. One implication for the current juncture is that while the recent deterioration in asset quality is not alarming, banks should remain vigilant and prepare for the possible worsening of asset quality associated with the macro-financial feedback effect.

Domestic lending[46] of the banking sector reversed its significant growth of 5.0% in the first half of 2015 and registered a mild contraction of 1.1% in the second half. The decline was primarily driven by lower demand for corporate loans, which dropped by 3.0% in the second half. Meanwhile, household loan[47] growth decelerated to 3.6% in the second half of 2015 from 5.0% in the first half.[48]

Looking ahead, the weaker credit demand may persist in the near term, as the HKMA Opinion Survey on Credit Condition Outlook of December 2015 revealed that all surveyed AIs expected that loan demand in the next three months would either remain the same or decrease (Table 5.B).

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

% of total respondents	Mar-15	Jun-15	Sep-15	Dec-15
Considerably higher	0	0	0	0
Somewhat higher	10	0	0	0
Same	86	95	86	86
Somewhat lower	5	5	14	14
Considerably lower	0	0	0	0
Total	100	100	100	100

Note: Figures may not add up to total due to rounding.
Source: HKMA.

Household exposure

Credit risk of household loans stayed low during the review period. Banks' mortgage portfolios remained healthy, with the delinquency ratio staying low at 0.03% at the end of 2015. Moreover, the average loan-to-value ratio of new mortgage loans approved decreased further to

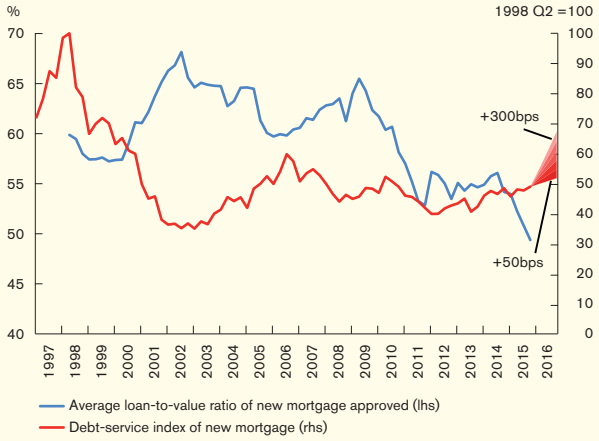
[46] Defined as loans for use in Hong Kong plus trade-financing loans.

[47] 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 2015, the share of household lending in domestic lending was 30.3%.

[48] For detailed analysis of loans to different economic sectors, see chapter 4.

49.4% in the fourth quarter of 2015 from 52.2% in the second quarter (the blue line in Chart 5.12).

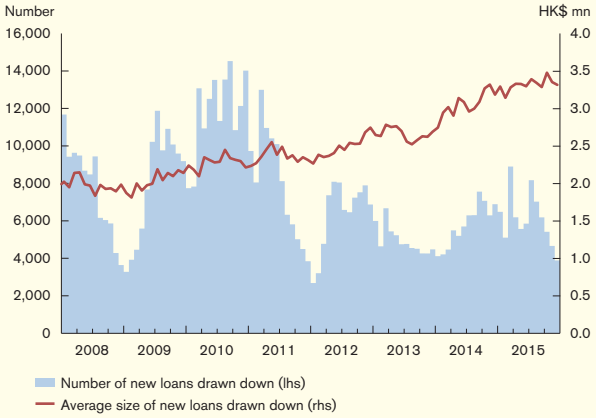
Chart 5.12
Average loan-to-value ratio and household debt-servicing burden in respect of new mortgages



Note: The calculation of the index is based on the average interest rate for BLR-based mortgages.
Sources: HKMA and staff estimates.

Mainly reflecting further rises in the average size of new mortgage loans (Chart 5.13), the debt-service index of new mortgages[49] edged up to 49.0 in the fourth quarter of 2015, from 48.1 in the second quarter (i.e. the red line in Chart 5.12). However, a sensitivity test shows that the debt-service index could rise significantly to 67.4 in a four-quarter period if interest rates were to increase by 300 basis points[50] and other things being constant. Banks should therefore be vigilant to the risks associated with rising debt-servicing burden amid interest rate normalisation.

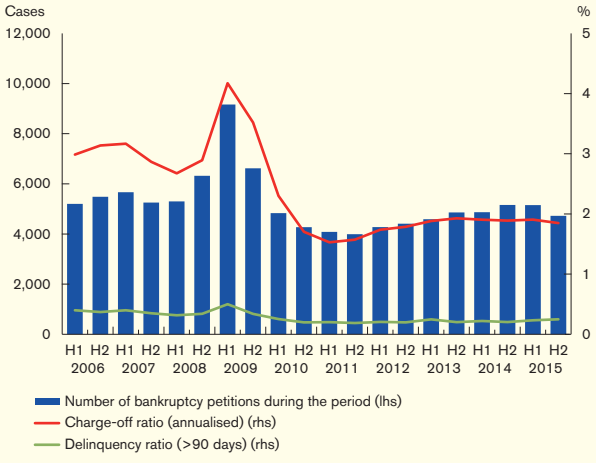
Chart 5.13
New mortgage loans of surveyed AIs



Source: HKMA Residential Mortgage Survey.

Credit risk of unsecured household exposure remained contained. Both the annualised credit card charge-off ratio and the delinquency ratio were largely unchanged at 1.88% and 0.25% respectively in the second half of 2015 (Chart 5.14). The number of bankruptcy petitions also stayed at a relatively low level.

Chart 5.14
Charge-off ratio and delinquency ratio for credit card lending and bankruptcy petitions



Sources: Official Receiver's Office and the HKMA.

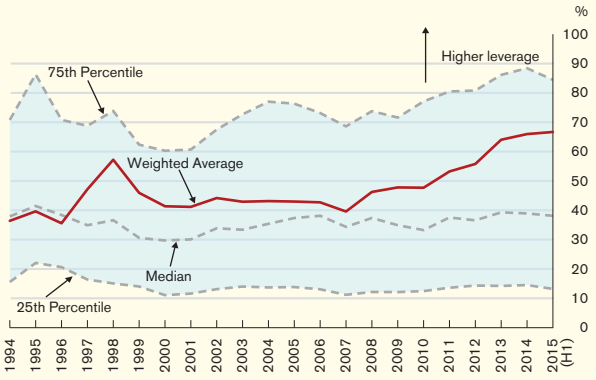
[49] A higher value of the debt-service index indicates that there is either a drop in household income, or an increase in interest rates, or an increase in the average mortgage loan amount drawn by households. Historical movements in the index suggest that a sharp rise in the index may lead to deterioration in the asset quality of household debt.

[50] The assumption of a 300-basis-point rise in interest rates is consistent with the prudential measure that requires AIs to have a 3-percentage-point mortgage rate upward adjustment for stress testing property mortgage loan applicants' debt servicing ability.

Corporate exposure[51]

The path of US interest rate normalisation remained one key factor affecting credit risk of corporate exposure, given the rising trends of the corporate sector's leverage and debt-servicing burden. The leverage of the corporate sector, as measured by the weighted average of debt-to-equity ratio, edged up further to 66.7% in the first half of 2015 (Chart 5.15), though there were tentative signs of improvement for higher leveraged corporates (i.e. the 75th percentile line). The general rise in debt-service ratio, as measured by total interest expenses divided by earnings before interest and taxes (EBIT), suggested a broad-based deterioration in the debt-servicing ability for local corporates (Chart 5.16).

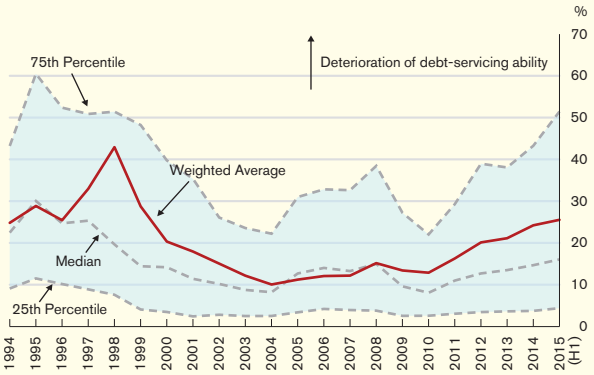
Chart 5.15
Leverage ratio of listed non-financial corporations in Hong Kong



Notes:
1. The leverage ratio is defined as the ratio of debt to equity. A higher value indicates higher leverage.
2. All non-financial corporations listed on the Hong Kong Stock Exchange are selected.
3. Figures are calculated based on information up to end-February 2016.

Source: HKMA staff estimates based on data from Bloomberg.

Chart 5.16
Debt-service ratio of listed non-financial corporations in Hong Kong



Notes:
1. Debt-service ratio is calculated by the total interest expenses divided by the earnings before interest and tax (EBIT). Companies with negative EBIT are excluded from the calculation.
2. All non-financial corporations listed on the Hong Kong Stock Exchange are selected.
3. Figures are calculated based on information up to end-February 2016.

Source: HKMA staff estimates based on data from Bloomberg.

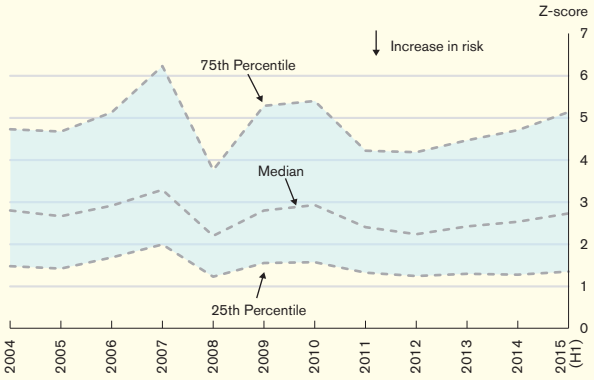
Nevertheless, the Altman's Z-score, which is a more comprehensive credit risk measure based on five key accounting ratios[52], showed an upward trend till the first half of 2015 for firms with lower default risks (above the median line in Chart 5.17), suggesting a further improvement in their default risk.

However, it should be borne in mind that the time lag in availability of accounting data precludes a timely assessment on how the recent rise in US interest rates and financial market turmoil would affect the corporate sector's fundamentals and thus default risk. On the one hand, corporates with significant US dollar exposure may begin, or quicken, their deleveraging processes amid the US interest rate normalisation, which may ultimately lead to healthier balance sheets. On the other hand, the recent financial market turmoil may reflect weaker global growth prospects, which may adversely affect corporates earnings. The net impact on the corporate sector's default risk remained highly uncertain.

[51] Excluding interbank exposure. At the end of 2015, the share of corporate loans in domestic lending was 69.4%.

[52] These accounting ratios are (i) working capital/tangible assets, (ii) retained earnings/tangible assets, (iii) EBIT/tangible assets, (iv) market value of equity/book value of total liabilities, and (v) sales/tangible assets.

Chart 5.17
Altman's Z-score: A bankruptcy risk indicator of listed non-financial corporations



Notes:
1. A lower Z-score indicates a higher likelihood of a company default.
2. All non-financial corporations listed on the Hong Kong Stock Exchange are selected.
3. Figures are calculated based on information up to end-February 2016.

Source: HKMA staff estimates based on data from Bloomberg.

Corporates' currency mismatches are another key factor to watch for. The prolonged low interest rate environment in major advanced economies over the past years may have encouraged corporates to take on excessive foreign exchange exposure without regard to the possible impact on the currency mismatch between their assets and liabilities.[53] Such currency mismatch could translate into significant losses and thus increase their default risk if exchange rates move unfavourably. In particular, corporates with higher leverage and debt-servicing burdens would be more vulnerable to US interest rate hikes and concurrent US dollar appreciation, as they may face a double-hit in the form of rising interest repayments and foreign exchange losses with thin capital. Banks should remain vigilant to corporates' currency mismatch risk.

[53] Under the Linked Exchange Rate System, Hong Kong dollars and US dollars are regarded as the same currency in the context of foreign exchange risk. For example, a company that earns mainly Hong Kong dollar-denominated revenues and is funded by US dollar-denominated debt does not result in significant foreign exchange risks.

Mainland-related lending and non-bank exposures

During the review period, the banking sector's Mainland-related lending began to decline. Total Mainland-related lending decreased by 4.5% to HK$3,326 billion (15.5% of total assets) at the end of 2015 from HK$3,485 billion (15.9% of total assets) at the end of the second quarter (Table 5.C). Other Mainland-related non-bank exposures also dropped by 4.2% to HK$1,033 billion (Table 5.D).

Table 5.C
Mainland-related lending

HK$ bn	Mar 2015	Jun 2015	Sep 2015	Dec 2015
Mainland-related loans	3,438	3,485	3,376	3,326
Mainland-related loans excluding trade finance	3,052	3,112	3,060	3,050
Trade finance	387	373	316	276
By type of AIs:				
Overseas-incorporated AIs	1,467	1,475	1,447	1,432
Locally-incorporated AIs*	1,420	1,453	1,380	1,358
Mainland banking subsidiaries of locally-incorporated AIs	551	557	549	536
By type of borrowers:				
Mainland state-owned entities	1,575	1,548	1,418	1,401
Mainland private entities	652	652	673	655
Non-Mainland entities	1,212	1,285	1,285	1,271

Notes:
1. * Including loans booked in the Mainland branches of locally-incorporated AIs.
2. Figures may not add up to total due to rounding.

Source: HKMA.

Table 5.D
Other Mainland-related non-bank exposures

HK$ bn	Mar 2015	Jun 2015	Sep 2015	Dec 2015
Negotiable debt instruments and other on-balance sheet exposures	620	669	668	646
Off-balance sheet exposures	365	409	406	386
Total	985	1,078	1,073	1,033

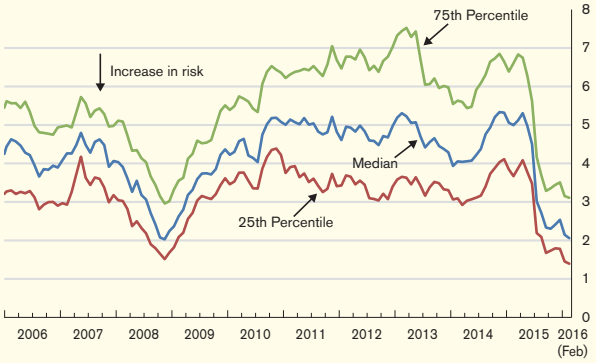
Note: Figures may not add up to total due to rounding.

Source: HKMA.

While the decline in Mainland-related lending may be mainly attributable to the slowdown of the Mainland economy, unwinding US dollar debt by some Mainland corporates to reduce the foreign currency risk arising from RMB depreciation was also one contributor.

The recent turbulence in the Mainland stock markets may signal higher credit risk associated with the Mainland-related exposure of banks. The distance-to-default index[54], a market based default risk indicator, points to a broad-based increase in the credit risk of the Mainland corporate sector since June 2015 to similar levels recorded during the global financial crisis (Chart 5.18). The increase in default risk for the Mainland corporate sector, however, was largely driven by heightened financial market volatility rather than an abrupt increase in the leverage ratio of the Mainland corporate sector (Chart 5.19).

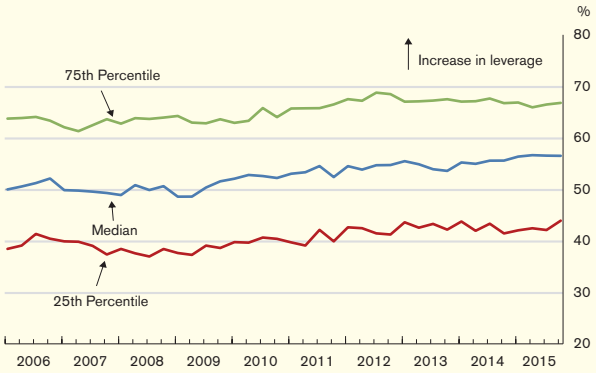
Chart 5.18
Distance-to-default index for the Mainland corporate sector



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 5.19
Leverage ratio for the Mainland corporate sector



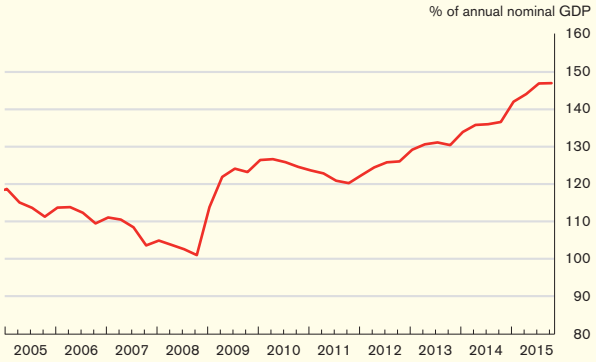
Notes:

1. The leverage ratio is defined as the ratio of total liabilities to total assets.
2. It 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 based on data from Bloomberg.

Banks should remain attentive to the credit risk management of their Mainland-related lending in view of the rising default risk of Mainland corporates, a possible further slowdown of the Mainland economy, and the relatively high level of credit-to-GDP ratio (Chart 5.20).

Chart 5.20
Credit-to-GDP ratio in Mainland China



Note: Credit-to-GDP ratio is defined as the ratio of total bank loans (all currencies) to the sum of quarterly nominal GDP for the latest four quarters.

Sources: CEIC and HKMA staff estimates.

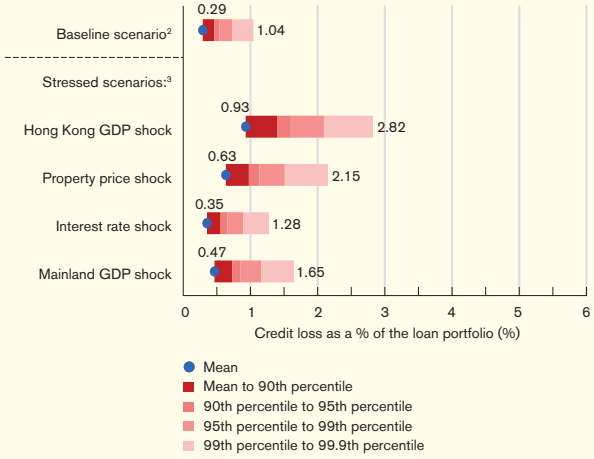
[54] The distance-to-default is a market based default risk indicator based on the framework by R. Merton (1974), "On the pricing of corporate debt: the risk structure of interest rates", *Journal of Finance*, Vol. 29, pages 449 - 470, in which equity prices, equity volatility, and companies' financial 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.

Macro stress testing of credit risk[55]

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 5.21 presents the simulated future credit loss rate of retail banks in the fourth quarter of 2017 under four specific macroeconomic shocks[56] using information up to the fourth quarter of 2015.

Taking account of tail risk, banks' credit losses (at the confidence level of 99.9%) under the stress scenarios range from 1.28% (Interest rate shock) to 2.82% (Hong Kong GDP shock), which are significant, but smaller than the estimated loan loss of 4.39% following the Asian financial crisis.

Chart 5.21
The mean and value-at-risk statistics of simulated credit loss distributions[1]



Notes:

1. The assessments assume the economic conditions in 2015 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 2016 Q1 to 2016 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 2016 Q1 to 2016 Q4.

   Interest rate shock: A rise in real interest rates (HIBORs) by 300 basis points in the first quarter (i.e. 2016 Q1), followed by no change in the second and third quarters and another rise of 300 basis points in the fourth quarter (i.e. 2016 Q4).

   Mainland GDP shock: Slowdown in the year-on-year annual real GDP growth rate to 4% in one year.

Source: HKMA staff estimates.

The Countercyclical capital buffer (CCyB) for Hong Kong

The CCyB is part of the internationally agreed Basel III standards and is designed to enhance the resilience of the banking sector against system-wide risks associated with excessive aggregate credit growth. Hong Kong is implementing the CCyB in line with the Basel III implementation schedule. The Monetary Authority announced on 14 January 2016 that the CCyB for Hong Kong will increase to 1.25%

[55] Macro stress testing refers to a range of techniques used to assess the vulnerability of a financial system to "exceptional but plausible" macroeconomic shocks. The credit loss estimates presented in this report are obtained based on a revised framework from J. Wong et al. (2006), "A framework for stress testing banks' credit risk", *Journal of Risk Model Validation*, Vol. 2(1), pages 3 - 23. All estimates in the current report are not strictly comparable to those estimates from previous reports.

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

with effect from 1 January 2017, from the current 0.625%.[57] This is reflective of the fact that under the Basel III phase-in arrangements, the maximum CCyB under Basel III will increase to 1.25% of banks' risk-weighted assets on 1 January 2017 from 0.625% effective from 1 January 2016.[58]

In setting the CCyB rate, the Monetary Authority considered a series of indicators (Table 5.E), including an "indicative buffer guide" (which is a metric providing a guide for CCyB rates based on credit-to-GDP and property price-to-rent gaps[59]). Based on the information considered on the last announcement date, both the credit-to-GDP gap and the property price-to-rent gap narrowed to 15.3% and 13.1% respectively, compared to 20.8% and 16.0% in the second quarter of 2015, suggesting a slower pace of credit growth and initial signs of easing in the property market. However, both gaps remained at elevated levels and the risks associated with credit and property market conditions have not abated. A simple mapping from the indicative buffer guide (absent any phase-in arrangement) would signal a CCyB of 2.5%, remaining unchanged at the upper end of the Basel III range.

In addition, the information drawn from other reference indicators[60] was, in the view of the Monetary Authority, consistent with the signal from the indicative buffer guide.

Table 5.E
Information related to the Hong Kong jurisdictional CCyB rate

	27-Jan-15	Q2-2015	14-Jan-16
Announced CCyB rate	0.625%		1.25%
Date effective	01/01/2016		01/01/2017
Indicative buffer guide	2.5%	2.5%	2.5%
Basel Common Reference Guide	2.5%	2.5%	2.5%
Property Buffer Guide	2.5%	2.5%	2.5%
Composite CCyB Guide	2.5%	2.5%	2.5%
Indicative CCyB Ceiling	None	None	None
Primary gap indicators			
Credit/GDP gap	32.8%	20.8%*	15.3%
Property price/rent gap	14.2%	16.0%	13.1%
Primary stress indicators			
3-month HIBOR spread (percentage points)	0.17%	0.18%	0.30%
Quarterly change in classified loan ratio (percentage points)	-0.01%	0.01%	0.07%

Notes:

1. The values of all CCyB guides, the Indicative CCyB Ceiling and their respective input variables are based on public data available prior to the corresponding decision, and may not be the most recent available as of each quarter end. (Refer to SPM CA-B-1 for explanations of the variables). If there is a CCyB announcement, the date of the announcement is shown at the top of the respective column. If there is no CCyB announcement, the quarter in which a CCyB review takes place (normally close to quarter end) is shown at the top of the column.
2. *This gap was calculated based on end-Q1 2015 credit data excluding from the credit measure IPO loans of HK$201 billion at end-March 2015. If such loans are included, the Credit/GDP gap increases to 28.9%. See press release at: http://www.hkma.gov.hk/eng/key-information/press-releases/2015/20150430-5.shtml

Source: HKMA.

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

[57] Further details of the decision may be found in the press release "Monetary Authority Announces Countercyclical Capital Buffer for Hong Kong" issued on 14 January 2016 which is available on the HKMA website.

[58] Under the Basel III phase-in arrangements, the maximum CCyB rate was capped at 0.625% on 1 January 2016, with the cap rising by 0.625 percentage points each subsequent year until it reaches 2.5% on 1 January 2019.

[59] The gaps between the ratio of credit to GDP and its long term trend, and between the ratio of residential property prices to rentals and its long-term trend.

[60] These included measures of bank, corporate and household leverage; debt servicing capacity; profitability and funding conditions within the banking sector and macroeconomic imbalances.

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

	Dec 2014	Sep 2015	Dec 2015
Interest rate			
1-month HIBOR fixing[2] (quarterly average)	0.23	0.24	0.22
3-month HIBOR fixing (quarterly average)	0.38	0.39	0.39
BLR[3] and 1-month HIBOR fixing spread (quarterly average)	4.77	4.76	4.78
BLR and 3-month HIBOR fixing spread (quarterly average)	4.62	4.61	4.61
Composite interest rate[4]	0.39	0.26	0.26
		Retail banks	
Balance sheet developments[5]			
Total deposits	2.0	-0.1	0.1
Hong Kong dollar	0.9	-1.9	0.5
Foreign currency	3.4	2.3	-0.4
Total loans	1.6	-2.0	-0.1
Domestic lending[6]	1.2	-0.8	0.2
Loans for use outside Hong Kong[7]	3.2	-6.8	-1.7
Negotiable instruments			
Negotiable certificates of deposit (NCD) issued	-4.6	-20.2	3.9
Negotiable debt instruments held (excluding NCD)	-2.9	4.2	-0.9
Asset quality			
As a percentage of total loans[8]			
Pass loans	98.44	98.08	97.86
Special mention loans	1.10	1.36	1.44
Classified loans[9] (gross)	0.46	0.56	0.70
Classified loans (net)[10]	0.32	0.40	0.50
Overdue > 3 months and rescheduled loans	0.29	0.35	0.45
Classified loan ratio (gross) of Mainland related lending[11]	0.57	0.81	0.78
Profitability			
Loan impairment charges as percentage of average total assets[12]	0.05	0.07	0.08
Net interest margin[12]	1.40	1.32	1.32
Cost-to-income ratio[13]	43.4	44.2	45.4
		All AIs	
Liquidity ratios (quarterly average, consolidated)[14]			
Liquidity Coverage Ratio — category 1 institutions	n.a.	136.4	142.9
Liquidity Maintenance Ratio — category 2 institutions	n.a.	53.6	53.9
		Surveyed institutions	
Asset quality			
Delinquency ratio of residential mortgage loans	0.03	0.03	0.03
Credit card lending			
Delinquency ratio	0.20	0.24	0.25
Charge-off ratio — quarterly annualised	1.85	1.90	1.86
— year-to-date annualised	1.83	1.89	1.82
		All locally incorporated AIs	
Capital adequacy (consolidated)			
Common Equity Tier 1 capital ratio	13.7	14.3	14.6
Tier 1 capital ratio	13.9	14.9	15.3
Total capital ratio	16.8	18.1	18.3

Notes:

1. Figures are related to Hong Kong offices 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 prior to December 2015 are related to retail banks' Hong Kong offices and overseas branches. Starting from December 2015, the coverage was expanded to include locally incorporated retail banks' major overseas subsidiaries. Under the expanded coverage, the classified loan ratio (gross) was 0.52% at end-December 2014 and 0.65% at end-September 2015.
9. Classified loans are those loans graded as "substandard", "doubtful" or "loss".
10. Net of specific provisions/individual impairment allowances.
11. Figures are related to retail banks' Hong Kong offices, Mainland branches and subsidiaries.
12. Year-to-date annualised.
13. Year-to-date figures.
14. A new data series was introduced for liquidity ratios which are defined in accordance with the Basel III framework starting from January 2015. For a category 1 institution, the minimum requirement for Liquidity Coverage Ratio began at 60% on 1 January 2015, rising in equal annual steps of 10 percentage points to reach 100% on 1 January 2019. A category 2 institution must maintain a Liquidity Maintenance Ratio of not less than 25% on average in each calendar month.

Box 5
A stress-testing framework with macro-financial feedback linkages

Introduction

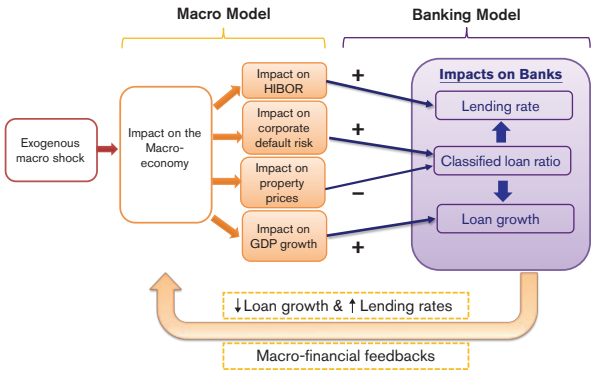
Macro stress-tests have become more popular among central banks as a main tool to assess key vulnerabilities of banks since the global financial crisis. This tool, however, is not without limitations. In particular, although most of the existing stress-testing frameworks are capable of analysing how macro-economic shocks would affect a banking system or individual banks, the potential feedback effect from the banking sector to the real sector is generally not considered. Theoretically, such feedback effect may exist in most financial systems. For example, banks would experience significant deterioration in their asset quality due to an economic slowdown, and in response, they would curtail lending and/or raise lending rates. The resulting tighter credit conditions could further worsen economic fundamentals, amplifying the initial macro shock.[61] Therefore, ignoring the feedback loop between the financial and real sectors in stress-testing exercises may be prone to underestimation of risks.

This box aims to shed light on this issue by developing a stress-testing framework with macro-financial feedback linkages. We then apply the framework on the Hong Kong banking sector and assess the economic significance of the feedback effect.

The stress-testing framework

The stress-testing framework consists of two main building blocks, namely the macro model and the banking model (Chart B5.1).

Chart B5.1
Structure of the stress-testing framework with the macro-financial feedback effect



Note: The inflation rate variable is not shown in the chart, as estimation results find that the variable is not a significant determinant of the banking variables. Nevertheless, we still keep the inflation rate variable in the macro model because the variable may affect the dynamics of other macro variables.

The macro model (highlighted in orange in Chart B5.1) is a vector autoregressive model that describes the dynamics and the interdependences of five key macro variables of Hong Kong. These variables include nominal GDP growth rate, inflation rate, interbank interest rates, market-based default probability for the Hong Kong corporate sector (CPD) and property price growth rate (PP). The model also includes some exogenous variables: world GDP growth[62], the VIX index, aggregate loan growth and lending rate in Hong Kong. The seemingly-unrelated regression method is adopted to estimate the model using data from the first quarter of 1999 to the second quarter of 2015.[63]

By construction of the macro model, a shock on any macro variable would propagate to others in two specific ways: First, the shock will transmit

[61] There are other channels through which an initial macro-economic shock could be amplified. For example, the interaction between credit and liquidity risks of banks, inter-connectedness among financial institutions via interbank and derivative markets, and asset fire sales among banks. For details, see BIS (2015), "Making supervisory stress tests more macro-prudential: Considering liquidity and solvency interactions and systemic risk", *BCBS Working Papers* No. 29.

[62] World GDP growth is included in the macro model to facilitate the assessment of external macro shocks, such as slowdown of the Mainland economy. Specifically, changes in Mainland GDP growth would feed into changes in World GDP growth, which in turn affects all other macro variables through the macro model.

[63] This method takes into account the contemporaneous correlation of error terms between the five key endogenous variables.

directly to those macro variables that are estimated to be explained by the lagged shock variable in the regression equations. Second, the shock will also affect other macro variables indirectly through the interactions between shocks that are captured by the estimated variance-covariance matrix of the error terms. This modelling structure aims to estimate self-consistent impacts on the five macro variables of an initial macro shock.

For instance, a negative shock on nominal GDP growth is estimated to directly produce a downward movement of PP as lagged nominal GDP growth is estimated to be statistically significant in the PP equation. Meanwhile, the GDP shock would produce an indirect impact on other macro variables (e.g., interbank interest rates and CPD) through the empirical relationships between GDP and other macro variables captured by the estimated variance-covariance matrix.

Apart from the estimated dynamics between the five key macro variables, estimation results of the macro model show that tighter credit conditions in Hong Kong would adversely affect the macroeconomic conditions. Specifically, it is estimated that lower lagged aggregate loan growth (LG) would reduce GDP growth in Hong Kong, while a higher lagged aggregate lending rate (LR) would worsen corporate default risk and drive down property prices (see Panel A of Table B5.A).

Meanwhile, empirical findings from the banking model, which is estimated using a panel dataset of 19 locally incorporated banks in Hong Kong[64], reveal that an unfavourable macroeconomic environment could lead banks in Hong Kong to curtail lending and increase lending rates. Specifically, the banking model (highlighted in purple in Chart B5.1) contains three empirical equations, which describe how individual banks' lending rates and their loan growth would respond directly to changes in the macro variables in the macro model and indirectly through impacts on banks' classified loan ratios. Estimation results (summarised in Panel B of Table B5.A) show that higher corporate default risk (proxied by a rise in CPD) and household default risk (proxied by a fall in PP) would increase banks' classified loan ratios, which in turn would reduce banks' loan growth and increase their lending rates (i.e. the indirect impact). Estimation results also reveal that banks' loan growth and lending rates would respond directly to GDP growth and interbank interest rates respectively.

Table B5.A
Key estimation results of the macro and banking models

Panel A: The estimated effect of banking variables on macro variables in the macro model			
Explanatory variables	Dependent variables		
	HK GDP growth	Corporate default probability	Property price growth
Aggregate loan growth	+ve		
Aggregate lending rate		+ve	-ve
Panel B: The estimated effect of macro variables on banking variables in the banking model			
Explanatory variables	Dependent variables		
	Individual banks' classified loan ratios	Individual banks' loan growth	Individual banks' lending rates
Classified loan ratio		-ve	+ve
Corporate default probability	+ve		
Property price growth	-ve		
HK GDP growth		+ve	
Interbank interest rates			+ve

Note: +ve (-ve) refers to an estimated positive (negative) relationship between the variables.
Source: HKMA staff estimates.

[64] Panel data are used instead of aggregate data for the banking model as responses of banks' asset quality, credit growth and lending rates to the changes of macro variables may vary significantly across banks, depending on their balance sheet characteristics.

Stressed scenario analysis

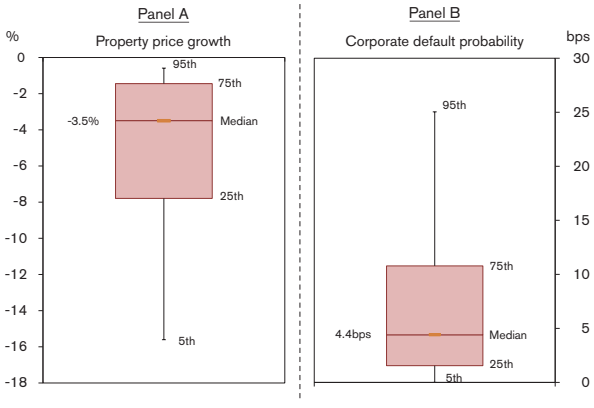
The estimation results from the macro and banking models together show that a macro-financial feedback linkage that is similar to the example discussed in *Introduction* does exist. Based on the empirical results, we further assess the economic significance of the feedback effect and how this would affect stress-test estimates. To this end, we compare stress-testing estimates between two cases (with and without the feedback effect) under a stress scenario. The stress scenario assumes a four-quarter GDP shock similar to that which occurred during the Asian financial crisis.[65] We generate our estimates using information up to the second quarter of 2015 and assume an eight-quarter stress horizon starting from the third quarter of 2015 to the second quarter of 2017.

A Monte Carlo simulation (MC) method with a sequential updating procedure is adopted to obtain the stress-testing estimates with the feedback effect. In each quarter, with the assumed GDP shock, the MC method is employed to simulate other macro variables by 10,000 trials using the macro model. For each trial, the simulated macro variables are used to estimate the impact on banks' classified loan ratios, loan growth and lending rates based on the banking model. We further compute the aggregate LG and LR by taking a weighted average of individual banks' estimates.[66] We then put the resulting LG and LR as inputs in the macro model for the next quarter simulation. The sequential updating procedure is repeated for the remaining quarters up to the second quarter of 2017.

For the case without the feedback effect, the simulation procedure is similar, except that LG and LR in the simulation are not updated sequentially, but using the actual time series for time points up to the second quarter of 2015 and assuming unchanged thereafter.

Panel A of Chart B5.2 presents the difference in the simulated cumulative impact on property prices in the second quarter of 2017 between the two cases (defined as the estimate with the feedback effect minus that without the feedback effect). As revealed from the distributional statistics, the feedback effect would significantly amplify property price declines in the stress scenario, with the median additional drops in property prices being 3.5%. In some extreme cases (i.e. at the 5th percentile or below), the feedback effect would produce an additional decline in property prices by more than 15% as compared to the estimate without the feedback effect, indicating that the feedback effect is significant. Panel B of Chart B5.2, which compares the results for simulated corporate default probability, also exhibits a similar picture such that the feedback effect would significantly intensify the deterioration in corporate default risk in the stress scenario.[67]

Chart B5.2
Difference in the simulated impacts between the framework with and without the feedback effect for property price growth and corporate default probability



Note: Difference in the simulated impact is defined as the estimate with the feedback effect minus that without the feedback effect.
Source: HKMA staff estimates.

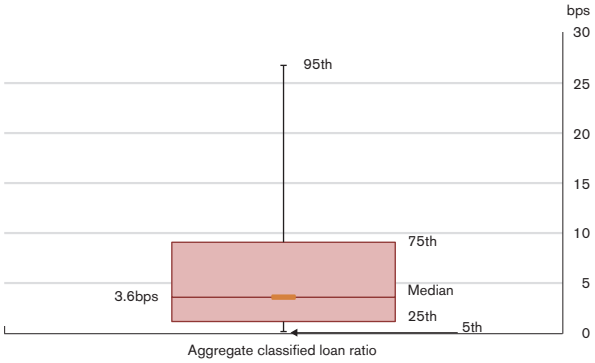
[65] As a reference, the four-quarter cumulative decline in real GDP during the Asian financial crisis was 8.1%, while that for nominal GDP was 7.2% during the same period.

[66] Weighted by individual banks' outstanding loans at the end of the second quarter of 2015.

[67] The 95th percentile estimate suggests that the feedback effect could in extreme cases produce an additional increase of around 25 basis points in the corporate default probability relative to the case without the feedback effect, which is significant given the corporate default probability was at a low level of 29 basis points at the end of the second quarter of 2015.

Finally, we present the result for the aggregate classified loan ratio in Chart B5.3. As expected, the aggregate classified loan ratio is found to be higher under the framework with feedback effect than that without the feedback effect by around 4 basis points at the median and by 27 basis points at the 95th percentile. The difference is regarded as substantial given that the aggregate classified loan ratio was at a low level of 0.70% at the end of the fourth quarter of 2015.[68]

Chart B5.3
Difference in the simulated aggregate classified loan ratio between the framework with and without the feedback effect



Note: Difference in the simulated impact is defined as the estimate with the feedback effect minus that without the feedback effect.
Source: HKMA staff estimates.

Conclusion

This box provides a feasible way to incorporate macro-financial feedback channels based on a conventional macro stress-testing framework adopted by central banks. The refined framework would allow for a more comprehensive and realistic assessment of the impact of different macro shocks on the resilience of banks. Our stress scenario analysis also shows that the feedback effect alone could in some extreme cases lead to an additional increase in the stressed classified loan ratio by 27 basis points, which is comparable to 40% of the current classified loan ratio of 0.70%. Although the large estimated percentage change may be partly due to a low-base effect, the implications of macro-financial feedback linkages for financial stability analysis should not be dismissed.

[68] Figures prior to December 2015 are related to retail banks' Hong Kong offices and overseas branches. Starting from December 2015, the coverage was expanded to include locally incorporated retail banks' major overseas subsidiaries. The classified loan ratio covering retail banks' Hong Kong offices and overseas branches was 0.63% at the end of December 2015.