Hong Kong Monetary Authority

MACROECONOMIC CONDITIONS AND BANKING PERFORMANCE IN HONG KONG: A PANEL DATA STUDY

Key points:

- *Using bank-level data, this paper examines the determinants of banking performance in Hong Kong, with a focus on the impact of macroeconomic developments on the net interest margin and asset quality – the two key drivers of profitability.*

- *Bank profitability fell following the Asian crisis. The reduced profitability was related to difficult macroeconomic conditions and increased competition. Performance varied across bank groups of different sizes with smaller banks recording larger declines in profits.*

- *The empirical analysis suggests that both the net interest margin and asset quality are affected by macroeconomic and financial developments. Smaller banks are more exposed to changes in economic conditions.*

- *The bursting of the property bubble also put banks under stress, but property-related loans remained relatively safe assets compared with other types of bank lending.*

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1.   Introduction

This paper provides a preliminary study of the determinants of retail bank profitability in Hong Kong, focusing particularly on net interest margins (NIM) and non-performing loans (NPL), two important measures of bank profitability.   The study is based on a data set collated by the HKMA for supervisory purposes.   It covers financial information on all the retail banks in Hong Kong between the years 1994 to 2002, excluding those whose main activities are offshore or of an wholesale nature and is thus representative of the retail banking business in Hong Kong. While the data set is rich in some dimensions (for instance, it includes information on many financial and income and expense ratios, such as non-performing loans and net interest margins), for confidentiality reasons, it does not contain any information that would allow us to identify individual banks. Thus, we do not know the value of an individual bank's assets, the size of its branch network or whether it is domestically or foreign-owned.   However, we can measure the size of banks' assets relative to each other, allowing us to categorise banks in our sample by size, into 'small', 'medium' and 'large'.

The focus of this study is on the effect of macroeconomic developments on retail bank profitability and, in particular, whether this differs across banks.   The paper is motivated by the fact that the banking sector plays a critical role in the economy.   A strong and profitable banking system promotes broader financial stability and increases the economy's resilience to adverse macroeconomic shocks.   At the same time, changes in macroeconomic conditions affect banks' performance and financial health.   It is therefore important for the authorities responsible for the maintenance of financial and monetary stability to be able to quantify the linkages between the macroeconomic developments and the banking sector.

In the case of Hong Kong, this interest is enhanced by the fact that the Hong Kong dollar is linked to the US dollar through a currency board system, which implies that local interest rates are effectively beyond the immediate control of the Hong Kong Monetary Authority (HKMA). While this system has provided a firm nominal anchor to the economy since its introduction in 1983, monetary policy can not be used to guard against large asset price swings. In particular, interest rates can not be adjusted in response to changes in the state of the banking system. The currency board system therefore requires careful use of regulatory policy and a strict regime of banking supervision.   The effectiveness of this approach is evidenced most strikingly by the fact that the banking system remains generally

sound despite a fall in residential property prices of almost 70% between 1997 and the first half of 2003.

There are a number of studies on banking performance in Hong Kong, most of which use aggregate data. In particular, Shu (2002) examines the impact of macroeconomic conditions on the average asset quality of banks. Peng *et al.* (2003) studies how changes in the Hong Kong dollar risk premium, measured by a widening of spreads between Hong Kong dollar and US dollar interest rates, may have influenced banks' net interest margins and asset quality. Gerlach and Peng (2003) finds that bank lending is closely related to economic growth and fluctuations in property prices, and that regulatory measures have helped to limit banks' exposure to the swings in the property market. Two studies by Kwan (2002), and Jiang *et al.* (2003), use panel data. Kwan considers how the cost efficiency of banks is related to an individual bank's characteristics. In a paper closely related to this one, Jiang *et al.* (2003) consider the effect of macroeconomic conditions on bank profitability. This study is more comprehensive than Jiang's, which covered listed banks only, and also extends existing empirical work by testing for asymmetric effects on bank profitability from changes in macroeconomic and financial conditions.

The rest of the paper is organised as follows. Section 2 provides some stylised facts about the performance of Hong Kong's banking sector in recent years, and its relationship with macroeconomic developments. We show that changes in profitability are closely linked to two components of profitability, the net interest margin, and the non-performing loan ratio which influences banks' loan loss provisioning. Section 3 outlines our empirical approach which is based on panel data techniques reflecting the fact that our data set covers a cross section of retail banks over a number of years. Although this is a common approach in the literature, there are few panel data studies on Hong Kong because of data limitations. Section 4 presents the estimation results. The main findings are that macroeconomic developments have an important and quantifiable influence on retail bank profitability in Hong Kong. The non-performing loan ratio of smaller banks appear to be less sensitive to movements in real GDP than that of larger banks, but their net interest margins appear to be relatively more sensitive. Somewhat surprisingly, we also find that the NPL ratio of banks that have a larger share of their loan portfolio in residential property loans is less sensitive to changes in residential property prices than that of banks with less exposure. Section 5 concludes.

2. Banking performance in Hong Kong: some stylised facts

As discussed, most of the empirical studies on Hong Kong bank profitability have used aggregate data. The focus of this paper, however, is to explore whether large and small banks are affected by macroeconomic conditions to a different extent. For this purpose, the retail banks in our sample are divided into three groups: 'large' banks, defined as having assets that account for more than 5% of total assets in this sector, 'medium' sized banks that have assets of between 5% and 1% of the sector, and 'small' banks with an asset size of less than 1% of the sector.

2.1 Profitability and the macroeconomic environment

It is useful to start by looking at a few key macroeconomic indicators, plotted in Chart 1. Following a pronounced expansion in the mid-1990s, the Hong Kong economy went into a recession following the Asian financial crisis, with real GDP declining by over 5% in 1998. The economy rebounded strongly in 2000, but the recovery ended with the global economic slowdown in 2001. Subsequently, overall growth has been generally sluggish, notwithstanding a strong performance in exports of goods and services. These developments have affected the unemployment rate, which rose sharply from 2% to 3% in the pre-crisis period to over 7% in 2002. Affected by both cyclical and structural factors, deflation started in 1998, and has persisted for over five years.

These macroeconomic developments affect bank profitability through a number of channels. Potentially, the most important one is through residential property prices. Since the Asian financial crisis in 1997, property prices have declined by over 60% in Hong Kong, exerting a significantly negative wealth effect on domestic demand. Declines in property prices can also have direct effects on bank profitability through deteriorating credit quality of property-related assets such as mortgage loans, and a reduced demand for credit more generally. Deflation in general prices may also have affected bank profitability. Because bank loans are typically fixed in nominal terms, an unexpected decline in the price level will increase the real debt burden faced by borrowers which may affect their ability to repay the loan, leading to an increase in banks' non-performing loans.

The sharp rise in interest rates during the crisis, reflecting an increased risk premium, also cut into banks' profits.[1] Empirical estimates suggest that the spike in interest rates in 1997-98 reduced banks' net interest margins because of a faster and more complete pass-through to deposit rates than to retail lending rates (Peng *et al.*, 2003). Thereafter, interest rates stabilised in response to better global market conditions as well as a number of measures taken by the HKMA to strengthen the currency board system (the seven technical measures, see HKMA (1998) for details). In recent years, nominal interest rates have come down sharply following the easing of monetary policy in the United States, but real interest rates in Hong Kong have risen and remained high reflecting the deflation in general prices. This has depressed bank credit growth.

These difficult macroeconomic developments coincided with HKMA measures to liberalise bank interest rates. Starting from 1994, the HKMA gradually relaxed the rules governing the interest rates set by banks – the so-called Interest Rate Rules. These were lifted in several stages and were abolished altogether in July 2001. The lifting of the IRRs, together with a reduced demand for credit, has resulted in an increase in competition among retail banks. This is evidenced by a downward trend in the Herfindahl-Hirschman index of market competition among retail banks (Chart 2A).[2] Increased competition has also resulted in a decline in bank lending spreads, particularly in the mortgage loan market.[3] While 84% of new residential mortgages were contracted at rates above the best lending rate at the beginning of 1997, nearly all new mortgage loans were at rates some 2.5 percentage points below it by 2002 (HKMA, 2002).

2.2   *Developments in profitability*

As a preliminary to the discussion of profitability below, it is useful to note that, in an accounting sense, bank profitability can be decomposed into four components:

(1) $$\frac{BTP}{TA} = \frac{NI}{TA} + \frac{NII}{TA} - \frac{OV}{TA} - \frac{PROV}{TA},$$

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[1] Since we plot annual data, the chart does not show the sharp increase in interest rates that occurred during the episode of severe speculative pressures in the autumn of 1998.

[2] The Herfindahl-Hirschman index is an indicator of market concentration. It is calculated as the sum of the squares of individual banks' market shares.

[3] Chart 2A includes a measure of the lending spread, which is calculated as the difference between the rate on new mortgage loans and a (weighted) average of deposit rates.

where *BTP* denotes before-tax profits, *TA* total assets, *NI* net interest income, *NII* non-interest income, *OV* overhead costs, and *PROV* loan loss provisioning. Much attention is given to two ratios, that of net interest income to total assets (commonly referred to as the net interest margin (NIM)), and that of non-performing loans to total loans (the NPL ratio).[4]

Chart 2B shows movements in overall profitability and its constituents. The profitability of retail banks fell sharply from around 1.8% during the boom period in 1994 to 1997 to 1% in 1999. It subsequently rebounded and reached about 1.4% in 2002.

Variations in profitability appear to have been mainly driven by changes in net interest income and loan loss provisions. NIMs fell significantly in 1997-1998, as the economy contracted and banks' funding costs soared. They recovered moderately between 1999 and 2000, but the subsequent economic slowdown and intense competition in the sector restrained any further improvement. Profitability was also affected by a sharp increase in banks' loan loss provisions between 1998 and 1999, as a result of a substantial deterioration in asset quality, as evidenced by an increase in the NPL ratio. The sharp slowdown of the economy and higher borrowing costs caused severe financial difficulties for many corporate and individual borrowers, and the collapse of a number of large Mainland companies in 1998 exacerbated the situation. The NPL ratio and loan loss provisions declined over the period from 2000 to 2002 (Chart 2C), reflecting a recovery in economic growth in 2000 and a more cautious lending stance by banks, but remained higher than in the years before the crisis. The other two components of bank profitability, non-interest income and overhead costs, have remained relatively stable.

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[4] The NIM is the ex-post spread, that differs from the ex-ante spread, calculated as the difference between the contractual rates charged on loans and rates paid on deposits. The ex-post spread is more useful as it controls for the fact that banks with high-yield, risky credits are likely to face more defaults. Other things being equal, higher *NIM*s as a result of, for example, a fall in loan defaults, will increase bank profits, and thus improve the stability of the banking sector. However, a higher *NIM* may also reflect high intermediation costs due to insufficient competition or other institutional characteristics, and thus indicate inefficiency of the system.

2.3   Bank groups of different sizes

The developments in bank profitability vary across different size groups. Chart 3A shows that, while the average profitability of each size group is similar over the whole of our sample period, the sensitivity of bank profitability to the state of the economy appears to be related to bank size, with small banks experiencing the largest swings in their profits. Thus, during the boom period between 1994 and 1997, small banks were more profitable than larger ones. By contrast, during the period from 1998 to 2002, when economic conditions were generally weaker, small banks experienced the largest declines in profitability on average. Even though the profitability of smaller banks appears to have been volatile, the striking aspect of Chart 3A is that banks across all groups have, in general, remained profitable despite the very difficult market conditions in recent years.

Chart 3B looks at NIMs by bank size, and shows that, on average, smaller banks maintained higher NIMs than larger ones, but experienced the largest declines after the Asian financial crisis in 1997. A number of factors may explain the fact that smaller banks tend to maintain higher average NIMs. First, they tend to have lower funding costs, as reflected in a higher average capital base. This is perhaps related to the observation that their profits tend to be more volatile than those of larger banks, indicative of a higher degree of business risk. Second, they tend to rely on more traditional lending business on the asset side, which generates relatively high interest income as a share of total income (Table 1). Third, higher NIMs may well be associated with a higher risk profile of loans, which raises the operating costs entailed in monitoring and controlling these. This is supported by the observation that the small bank group in our sample recorded higher average operating costs. The sharp decline in NIMs for smaller banks in recent years may reflect that an increase in competition among banks has required smaller banks to offer higher interest rates to attract customer deposits, thereby reducing net interest income.

Turning to the *NPL* ratio, Chart 3C shows that loan quality worsened considerably for all three size groups between 1998 and 2002 relative to the preceding three years. Medium-sized banks saw the largest deterioration, while large banks recorded a slightly larger rise in NPLs than small banks. The bursting of the property "bubble" has probably put asset quality of the sector under significant stress given the significant exposure of banks across all size groups to

property lending, which accounted for around 50% of their portfolio during 1994-2002. The degree of exposure to property lending varies among banks, but there appears to be no systematic pattern by bank size. Several factors help to mitigate the concentration risk for banks which have a large exposure to the property sector. These are banks' observance of the HKMA's recommended loan-to-value ratio of 70% for residential mortgages, the low gearing ratio of property developers, and the practice of pre-selling a large number of units (IMF, 1999). As a result, the delinquency ratio of residential mortgage loans has remained low relative to that of other domestic credits despite the large decline in property prices since 1997.

Chart 3D indicates that non-interest income net of operating costs increased for large and medium-sized banks between 1998 and 2002 relative to the previous three years, but declined for the small bank group. This suggests that larger banks have managed to raise their non-interest income and reduce their operating costs in an attempt to stabilise profits in the face of declining net interest income and increasing loan loss provisions.

Table 2 shows the dispersion of profitability, asset quality and net interest margins for the banks in our sample. The cross-bank dispersion of these variables increased in 1998, but began to fall in 2002.

2.4   Summary

The analysis in this section suggests three broad conclusions. First, overall bank profitability dropped sharply in the years following the Asian financial crisis and, notwithstanding some recovery in recent years, has remained below its pre-crisis levels.   Reduced profitability can be explained by difficult macroeconomic conditions and an increase in competition in the banking sector. Second, changes in bank profitability have been mainly driven by changes in net interest margins and loan loss provisions that are, in turn, related to changes in asset quality. Third, smaller banks have, on average, recorded a relatively larger decline in profits, attributable to a sharper fall in net interest margins and an increase in operating costs.

3.   Empirical framework and methods

The rest of this paper reports the results of econometric analysis on the effect of macroeconomic and financial conditions on net interest margins and the NPL ratio. Since we are interested in the behaviour of individual banks, we adopt a panel approach, which is described below.

Following Demirgüç-Kunt and Huizinga (1999, 2000) and similar studies in this area, asset quality is measured by NPLs for bank i at time t ($NPL_{i,t}$) and is related to a number of macroeconomic and financial factors as well as the individual bank's characteristics, as follows:

$$(2) \qquad NPL_{i,t} = f(MACRO_t, FIN_t, BANK_{i,t}) + error_{i,t},$$

where NPL is the ratio of non-performing loans to total loans, MACRO denotes a set of macroeconomic variables reflecting the state of the economy, such as growth and inflation, FIN denotes a set of financial variables, which includes interest rates and changes in property prices, and BANK are bank-specific variables, such as the asset size and sectoral concentration in lending, in particular, the number of property-related and consumer loans as a share of total loans.

There is no obvious reason why macroeconomic and financial conditions should have the same impact on all banks and so we allow for interaction terms in our empirical work. These test whether the impact of macroeconomic and financial variable varies in a systematic way across small, medium and large banks. We also interact changes in property prices with the share of property-related lending in the individual bank's portfolio to test whether the effect of changes in property prices on bank profitability varies according to their exposure to the real estate sector.

We model net interest margins (NIMs) in a similar way as follows:

$$(3) \qquad NIM_{i,t} = g(MACRO_t, FIN_t, BANK_{i,t}) + error_{i,t}.$$

For this equation, we also consider a number of bank-specific variables that can be divided into three groups: (a) variables capturing the structure of assets and liabilities; (b) variables capturing the structure of income and expenses; and (c)

sector concentration. As in equation (2), interactive terms are included, between bank size on the one hand, and macroeconomic and financial variables on the other.

4. Empirical findings

4.1 Asset quality

The results for the NPL equation are shown in Table 3. We estimate all equations twice, first with a common intercept and then allowing for fixed effects.[5] The last two lines of Table 3 report the test statistic and its associated p-value for a test for a common intercept.[6] As can be seen, the hypothesis is rejected in all cases. Consequently, we only report results for the fixed effects regressions.

We first estimate the most general specification (Model 1) which encompasses all of the macroeconomic, financial and bank variables, but does not allow for any interactive terms. The results indicate that the variables measuring the share of property-related, and consumer, loans in total loans (denoted by PROP SHARE and CONS SHARE) are not significant. In Model 2, when we exclude these two variables, all macroeconomic and financial variables are highly significant and have the expected signs. Increases in GDP growth (GDP), inflation (INF) and the rate of change of property prices (PROP) reduce the NPL ratio, while increases in short-term interest rates (denoted by HIBOR) increase it.

While interesting, this model does not allow for any interactive terms. In Model 3 therefore we allow for interaction between macroeconomic and

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[5] The inclusion of a lagged dependent variable renders both the pooled and fixed effects estimators biased. Although, in our case, the time series dimension is not very small relative to the cross sectional dimension, the bias can still be sizeable (Judson and Owen, 1999). Various methods have been developed to address this issue. Anderson and Hsiao (1981) suggest an instrumental variable (IV) estimation method that will lead to consistent estimates. Arellano and Bond (1991) propose a generalised method of moment (GMM) procedure that is more efficient than that of Anderson and Hsiao (1981). This literature is further generalised and developed by Ahn and Schmidt (1995), Arellano and Bover (1995), and Blundell and Bond (1998). In future work on more detailed data we intend to explore the importance of better estimation techniques.

[6] The test for a common constant for a panel model is often referred to as the test for fixed or individual effects. It is carried out by performing an F-test:

$$F = \frac{(RRSS - URSS)/(N-1)}{URSS/(Obs. - N - K)} \sim F_{N-1, Obs-N-K}.$$

The restricted model is the pooled regression, while the unrestricted model is the fixed effects model. *RRSS* and *URSS* are the residual sum of squares of the restricted and unrestricted models respectively, *N* is the number of banks, *Obs.* the number of observations, and *K* the number of regressors. If the null hypothesis of a common intercept is rejected, the fixed effects model should be chosen for estimation.

financial variables, on the one hand, and bank size on the other - arguably the single most important bank characteristic. This general model has a higher adjusted R^2 compared with the two previous models, indicating that inclusion of the interactive terms improves the fit of the equation. However, a number of variables are not significant. In Model 4, we interact property price inflation with the share of property lending instead of SIZE. This specification further improves the fit of the NPL model as evidenced by the increase in the adjusted R^2, from 0.91 in Model 3 to 0.94. The final specification, Model 5, is obtained by eliminating the two insignificant variables in Model 4, which are INF*SIZE and HIBOR*SIZE. Although the adjusted R^2 of Model 5 is lower than for Model 4, all of the remaining variables are highly significant.

Based on the specification of Model 5, a number of observations are worth noting. First, although GDP has a positive sign suggesting, counter-intuitively, that an increase in growth raises the NPL ratio, the interactive term, GDP*SIZE, is significant as well.[7] However, since the parameter on the interactive term is negative, suggesting that growth affects the NPL ratio of larger banks more than that of smaller banks. This matches poorly with our earlier observation that the asset quality of smaller banks deteriorated by a larger extent than that of large banks in recent years. However, small banks differ from large banks in other ways besides size, and we return to this issue below.

Second, inflation has a negative effect on the NPL ratio. This can be explained by the effect of inflation on the real debt burden of borrowers: higher inflation erodes the real debt burden thereby making it easier for borrowers to meet their obligations. Furthermore, under Hong Kong's currency board regime, nominal interest rates are closely tied to US interest rates, implying that increases in inflation reduce the real interest rate. Inflation also tends to be positively correlated with the state of the business cycle, and might be interpreted as an additional indicator of the state of the economy.

Third, nominal interest rates are positively related to the NPL ratio: declines in interest rates reduce the debt-servicing burden, thereby helping to protect asset quality.

Fourth, rises in property prices reduce the NPL ratio. One would expect the size of the impact to be related to bank's exposure to the real estate

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[7] As noted above, for confidentiality reasons we only have series of the weighted average asset size for the three groups, and their averages across time are used in calculating the impact of the growth variable.

sector. However, we find a positive sign on the interactive term between changes in property prices and the share of property lending which suggests that the impact is smaller for a larger exposure. An alternative interpretation is that property prices are a good barometer of general economic conditions, and that property lending is less sensitive to changes in economic conditions than other types of bank credit.[8] Thus, during economic downturns, declining property prices will have less of an effect on those banks with a higher share of their loan portfolio linked to property. To see this more clearly, suppose that the NPL ratio is determined as:

$$(4) \qquad NPL_t = \beta \cdot (1-\omega) \cdot X_t + \delta \cdot \omega \cdot X_t + ...,$$
$$\qquad\qquad\qquad (-) \qquad\qquad (-)$$

where:

X_t: changes in property prices

ω: fraction of loans related to the property sector

β: sensitivity of NPLs among non-property loans to property prices

δ: sensitivity of NPLs among property loans to property prices.

The above equation can be re-written as:

$$(5) \qquad NPL_t = \beta \cdot X_t + (\delta - \beta) \cdot \omega \cdot X_t + ...$$

This equation suggests that the impact of changes in property prices varies with ω, and is given by $\beta + (\delta - \beta)\omega$. The term $(\delta - \beta)$ captures the relative sensitivity (riskiness) of property loans. Specifically, property loans are less risky (sensitive to property price changes) than other types of lending if $\delta - \beta > 0$, which is the case for Hong Kong according to our estimates.

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[8]   This accords with our earlier observation that despite declining property prices and weak economic conditions, the default rate of residential mortgage loans has remained low relative to that for most other bank lending.

4.2 Net interest margin

Table 4 shows the results from estimating an equation for bank's NIMs. As before, we first include all the *MACRO*, *FIN*, and *BANK* variables (Model 1).[9] As the model is probably overfitted, only *GDP*, *INF* and *NIEXPENSE* (which we interpret as a measure of banks' operating costs) are significant and have the expected signs. Dropping insignificant variables leads to Model 2, in which *GDP*, *INF*, *HIBOR* and *NIEXPENSE* remain important and *HIBOR* is also significant. However, the adjusted R-squared declines, suggesting that this model fits less well. In Model 3 we interact *SIZE* with the *MACRO* and *FIN* variables, which gives a higher adjusted R^2 indicating a better fit. All of the interactive terms in the equation are highly significant, and have the expected signs. This provides strong evidence that the NIMs of smaller and larger banks respond differently to changes in economic conditions than for larger banks. Finally, the test statistics in the last row of the table confirm that fixed effects should be allowed for in estimation.

The estimates of Model 3 indicate that economic growth and inflation lead to higher NIMs, probably by reducing NPLs as suggested by our earlier estimates. In addition, loan demand is likely to rise in a period of expansion, giving banks more pricing power in lending. These results suggest that sluggish economic growth and deflation in recent years may have reduced NIMs.

The significance of the interactive terms suggests that the effects of macroeconomic developments on NIMs vary according to bank size, with smaller banks being more affected. One interpretation is that, during economic upturns when loan demand increases, smaller banks may be more prepared to expand lending more aggressively than larger banks, taking on riskier projects with higher returns.

Changes in interest rates also appear to have asymmetric effects across banks of different sizes. The interactive term between the interest rate and *SIZE* suggest that smaller banks are more affected by changes in interest rates than larger ones. One explanation for this finding is that the smaller banks have a higher capital base, which reduces overall funding costs. As a result, they can sustain higher NIMs when interest rates rise. To test this hypothesis, an interactive term between the interest rate and the capital base variable is added (Model 4), which turns out to be significant and of the expected sign.

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[9] It is difficult to measure changes in the degree of competition in the banking sector. We experimented with some measures, such as asset concentration ratios, but these were not significant.

Finally, operating costs are found to be positively related to NIMs. There are two possible explanations. First, banks may be able to pass changes in operating costs onto customers by varying lending spreads. Second, a higher NIM may be associated with a higher risk profile of loans, which, in turn, raises the operating costs entailed in monitoring and risk control.

5.   Conclusion

Using a bank-level data set, this paper has examined the determinants of banking performance in Hong Kong, with a focus on the impact of macroeconomic developments on two components of profitability – net interest margins and the non-performing loan ratio. Corroborating other studies in the literature, our results suggest that macroeconomic developments and financial conditions have significant effects on banks' performance.

A specific focus of the paper was to explore whether bank-specific factors may lead to asymmetric effects of macroeconomic developments among banks. In general, the evidence suggests that the NIMs of smaller banks are more affected by changes in GDP growth than for larger banks, whereas their NPL ratio is less affected. Understanding the reasons for these differences should be high on the research agenda.

The estimates also suggest that the sharp decline in property prices in Hong Kong since 1997 may have lowered bank profitability due to their exposure to property-related lending. However, property loans appear to be less risky than other types of loans, in that their quality is less sensitive to fluctuations in macroeconomic conditions and property prices. This reflects a combination of factors that mitigate the risks associated with property lending, including the HKMA's guideline of a maximum loan-to-value ratio of 70% for residential mortgage loans, and the low gearing ratio of property developers.

This is a preliminary study, and more work is required. Several extensions seem natural and useful. First, it would be of interest to use quarterly data to obtain a clearer sense of the dynamic responses of bank profitability to movements in real GDP growth and inflation. If real economic growth rebounds in Hong Kong, will profitability respond after two, four or eight quarters? The annual data used here are too coarse to permit such an analysis. Second, it would be interesting to explore which macroeconomic time series have the strongest

influence on bank profitability. We have focused on real GDP growth, property prices and CPI inflation in this study, but other macroeconomic time series (such as unemployment and consumption spending) may be more relevant. Third, it would be desirable to sharpen the estimates by taking into account a greater variety of bank characteristics. For instance, do banks with a large number of branches have higher costs and lower profits? Or do banks with a strong retail network obtain funds more cheaply and have greater profits? In future work we hope to shed some light on these issues.

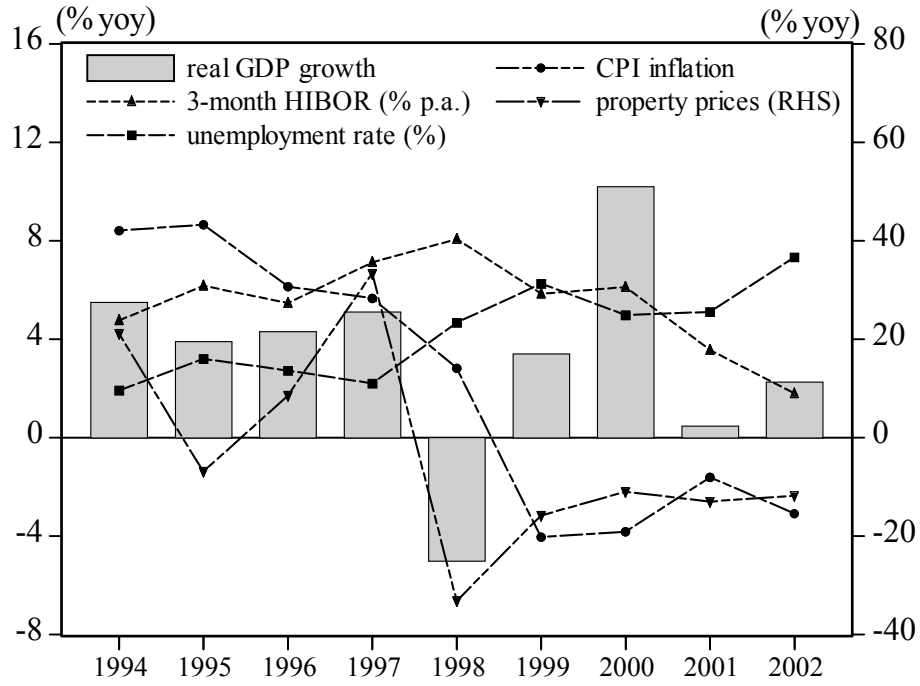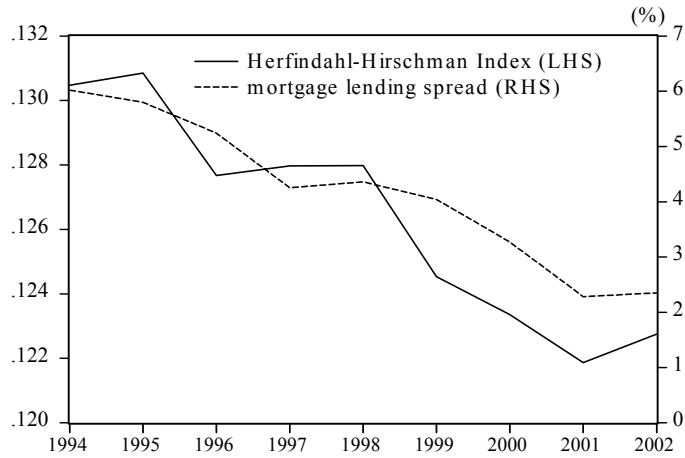**Chart 1. Macroeconomic Indicators**

Chart 2. Bank Indicators

A. Market Concentration and Competition

Herfindahl-Hirschman Index (LHS)
mortgage lending spread (RHS)

B. Decomposition of Profitability

profitability   OV/TA
NIM   PROV/TA
NII/TA

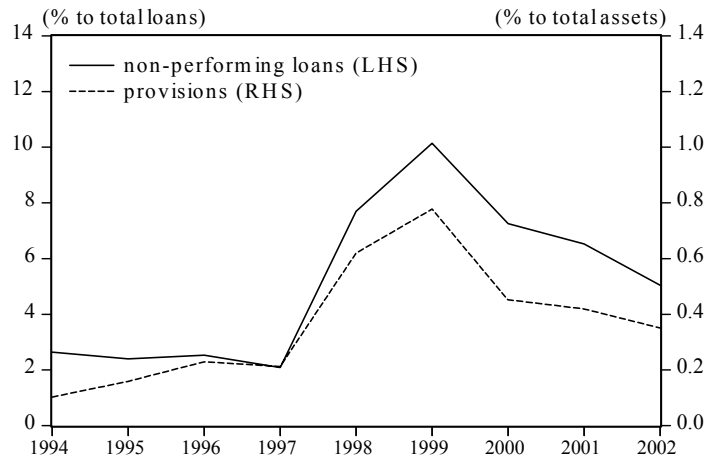## C. Provisions and NPLs
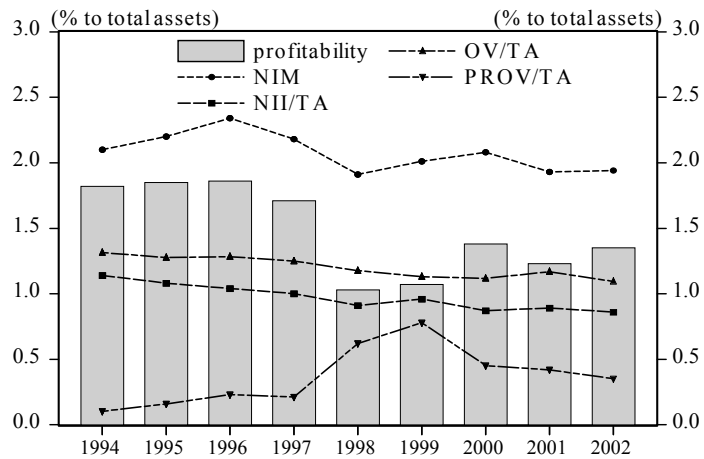
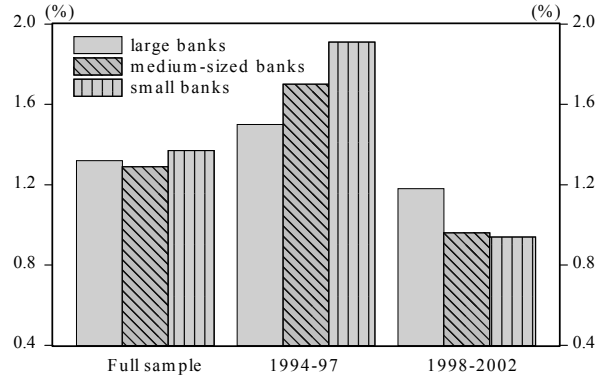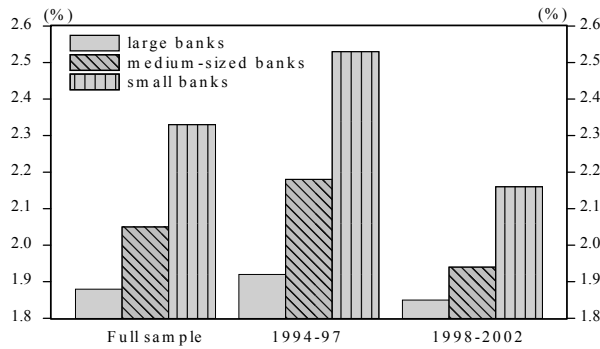non-performing loans (LHS)
provisions (RHS)

Chart 3. Profitability, NIM, NPLs and Bank Size

A. Profitability

B. Net Interest Margin

C. Nonperforming Loans
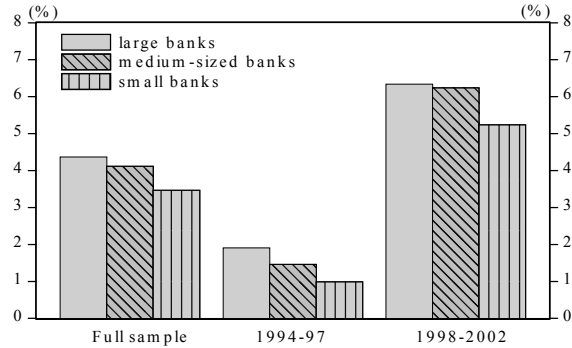
D. Noninterest Income net of Operating Cost
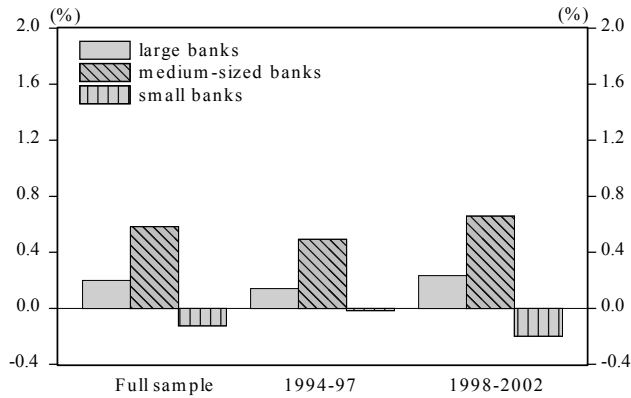
Table 1. Retail Banks' Business Structure (1994-2002)

	All	Large	Medium-sized	Small
Asset Portfolio				
Equity capital/total assets	13	4	10	18
Loans/total assets	46	40	49	46
Deposits/total assets	66	73	67	64
Income and Expense				
Operating expenses/total expenses	25	25	21	29
Interest income/total income	87	85	88	88
Provisions/total loans	2	2	3	2
Lending Portfolio				
Property loans/total loans	50	51	51	48
Consumer lending/total loans	7	7	6	9

Table 2. Dispersion of Profitability, NIMs and NPLs

Bank Specific	Profitability				Net Interest Margin				Non-performing Loans			
Variables	Mean	Sd	Max	Min	Mean	Sd	Max	Min	Mean	Sd	Max	Min
1994	1.9	0.7	3.9	0.5	2.3	0.8	4.6	0.6	1.1	1.1	5.5	0.1
1995	1.9	0.7	3.6	0.6	2.4	0.8	4.3	0.6	1.1	1.0	4.4	0.1
1996	1.8	0.7	3.4	0.3	2.4	0.8	4.8	0.5	1.5	1.2	4.2	0.0
1997	1.8	0.7	3.0	-0.1	2.4	0.8	4.2	0.7	1.3	0.9	3.9	0.1
1998	1.1	0.9	2.7	-0.8	2.2	0.7	3.4	0.7	6.2	5.5	29.0	0.9
1999	0.9	1.0	2.7	-2.8	2.2	0.7	3.4	0.3	8.7	6.6	31.3	0.5
2000	1.4	1.1	6.0	0.2	2.3	1.0	6.8	1.0	6.6	4.1	16.3	0.5
2001	0.9	0.9	2.1	-2.5	2.0	0.5	3.3	0.6	4.7	2.9	12.4	0.6
2002	0.9	0.7	2.3	-1.1	1.8	0.5	3.1	0.8	3.5	1.8	8.5	0.7

Table 3. Determinants of NPLs

(Sample period: 1995-2002)

	Model 1	Model 2	Model 3	Model 4	Model 5
NPL $_{t-1}$	0.33***	0.36***	0.36***	0.33***	0.34***
	(5.34)	(5.89)	(5.90)	(5.71)	(5.88)
GDP $_t$	-0.15***	-0.15***	0.59	0.81***	0.82***
	(-4.49)	(-4.84)	(1.54)	(3.24)	(3.14)
(GDP*SIZE) $_t$	-	-	-0.04**	-0.05***	-0.05***
	-	-	(-1.90)	(-4.02)	(-3.37)
INF $_t$	-0.32***	-0.30***	-0.82**	-0.50**	-0.32***
	(-8.19)	(-8.52)	(-2.23)	(-2.03)	(-9.61)
(INF*SIZE) $_t$	-	-	0.03	0.01	-
	-	-	(1.44)	(0.73)	-
PROP $_t$	-0.03***	-0.02***	0.03	-0.13***	-0.12***
	(-3.55)	(-3.50)	(0.27)	(-4.24)	(-4.28)
(PROP*SIZE) $_t$	-	-	0.00	-	-
	-	-	(-0.54)	-	-
(PROP*PROP SHARE) $_t$	-	-	-	0.19***	0.20***
	-	-	-	(3.39)	(3.48)
HIBOR $_t$	0.55***	0.57***	1.14*	0.83	0.58***
	(10.91)	(11.44)	(1.69)	(1.44)	(13.22)
(HIBOR*SIZE) $_t$	-	-	-0.03	-0.01	-
	-	-	(-0.85)	(-0.44)	-
PROP SHARE $_t$	0.00	-	-	-	-
	(0.01)	-	-	-	-
CONS SHARE $_t$	-0.06	-	-	-	-
	(-1.61)	-	-	-	-
Adjusted R^2	0.88	0.89	0.91	0.94	0.92
Number of banks	27	27	27	27	27
Number of observations	209	209	209	209	209
Test for common intercept	1.92	2.08	2.13	2.23	2.37
p-value	[0.01]	[0.00]	[0.00]	[0.00]	[0.00]

Note: t-values are in ( ), p-values in [ ]. *,** and *** indicate that variables are significant at 10%, 5% and 1% levels respectively.

Table 4. Determinants of the Net Interest Margin
(Sample period: 1995-2002)

	Model 1	Model 2	Model 3	Model 4
NIM $_{t-1}$	0.39***	0.38***	0.30***	0.27***
	(6.32)	(6.36)	(5.38)	(4.62)
GDP $_t$	0.02***	0.02***	0.14***	0.12***
	(4.68)	(6.10)	(3.13)	(2.78)
(GDP*SIZE) $_t$	-	-	-0.01***	-0.01**
	-	-	(-2.71)	(-2.38)
INF $_t$	0.01**	0.01**	0.15***	0.15***
	(2.41)	(2.93)	(3.60)	(3.69)
(INF*SIZE) $_t$	-	-	-0.01***	-0.01***
	-	-	(-3.53)	(-3.59)
PROP $_t$	0.00	-	-	-
	(-0.80)	-	-	-
HIBOR $_t$	0.01	0.04***	0.73***	0.59***
	(1.22)	(4.69)	(7.12)	(5.02)
(HIBOR*SIZE) $_t$	-	-	-0.04***	-0.03***
	-	-	(-6.99)	(-5.13)
(HIBOR*EQUITY) $_t$	-	-	-	0.18**
	-	-	-	(2.42)
NII $_t$	-0.01**	-	-	-
	(-2.02)	-	-	-
NIEXPENSE $_t$	0.60***	0.56***	0.58***	0.55***
	(7.65)	(7.41)	(8.29)	(7.80)
PROP SHARE $_t$	0.00	-	-	-
	(-0.27)	-	-	-
CONS SHARE $_t$	-0.00	-	-	-
	(-1.05)	-	-	-
Adjusted R^2	0.97	0.96	0.98	0.98
Number of banks	29	29	29	29
Number of observations	232	232	232	232
Test for fixed effects	4.61	4.31	5.06	5.20
p-value	[0.00]	[0.00]	[0.00]	[0.00]

Note: t-values are in ( ), p-values in [ ]. *,** and *** indicate that variables are significant at 10%, 5% and 1% levels respectively.

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List of Variables

Dependent variables

NPL	:	ratio of classified loans to total loans
NIM	:	ratio of net interest income to total assets

Macroeconomic variables

GDP	:	GDP growth
INF	:	CPI inflation

Financial variables

PROP	:	changes in property prices
HIBOR	:	three-month HIBOR

Bank variables

SIZE	:	logarithm of asset size
EQU	:	ratio of equity capital to total assets
PROVISION	:	ratio of provisions to total assets
NII	:	ratio of non-interest income to total assets
NIREXPENSE	:	ratio of non-interest expenses to total assets
PROP SHARE	:	ratio of property loans to total loans
CONS SHARE	:	ratio of consumer loans to total loans