



DETERMINANTS OF THE PERFORMANCE OF BANKS IN HONG KONG

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Abstract

This paper develops a model to identify the major determinants of a bank's profit, and the general level of profitability of a banking market. It found that in Hong Kong's case, market structure, such as market concentration and market shares of banks, is not a major contributory factor. Cost efficiency of banks, which measures the ability of banks to optimise their input mix for producing outputs, is a major determinant of banks' profitability. Since larger banks are found to be in general more cost efficient than smaller banks in our previous study on banks' efficiency, larger banks can offer services at lower prices to compete with smaller banks, yet attaining a similar or even higher level of profits. Smaller banks may, therefore, be more vulnerable to intense competitions in the loan market than larger banks, particularly in cut-throat price wars.

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Executive Summary:

- *Using the Berger-Hannan approach and a panel dataset of retail banks in Hong Kong covering the period 1991-2005, this paper examines what factors determine the performance of banks, particularly how banks' profits and their pricing behaviour are affected by market structure and efficiency.*
- *Empirical evidence finds that market structure, as measured by market concentration and market shares of banks, is either not a significant determinant of banks' performance or, to the extent that market consolidation in recent years have hampered competition and thus enhancing banks' profitability, its adverse effect has been largely offset by regulatory liberalisation and technological progress during the same period. The emergence of a number of larger banks through mergers and acquisitions, which should be more capable of competing with existing large banks, may also have contributed.*
- *This is in line with findings in previous studies that banks' in Hong Kong have been operating competitively, despite market consolidation in recent years, resulting in increased market concentration. Nevertheless, with bank consolidation expected to continue, how market concentration may impact on competition in the years to come needs to be closely monitored.*
- *Cost efficiency is found to be positively correlated with banks' profitability and negatively correlated with the interest rate spread of loans. Combined with findings in previous studies that larger banks are more cost efficient in general, this suggests that larger banks can offer services at lower prices to compete with smaller banks, yet attaining a similar or even high level of profits. Smaller banks may, therefore, be more vulnerable to intense competition in the loan market than larger banks, particularly in cut-throat price wars.*

I. INTRODUCTION

What factors determine the performance of banks in general, and how banks' profits and pricing behaviours are affected by market structure in particular, have been extensively studied. Amongst the various approaches, a number of studies have focused on the structure-performance relationship of banks, with the structure-conduct-performance (SCP) hypothesis and the efficient-structure (EFS) hypothesis widely tested.² In general, banks' profitability and pricing power are hypothesized to be determined by market structure of the banking industry, such as the number of participating banks in the market and the market shares of banks, and bank-specific factors, such as cost efficiency, scale efficiency, and the risk attitude of banks. Macroeconomic factors, such as real GDP growth and unemployment, may also be important determinants.

As for the structure-performance relationship of banks, empirical results have been mixed. In some studies, market structure of the banking sector was found to be one of the main determinants of banks' performance. Specifically, banks' profitability was found to be positively related to the level of market concentration. This was interpreted as profitability being enhanced by a higher degree of price coordination which was facilitated by fewer competitors. This suggests that concentration could have an adverse effect on the competitive environment of the industry. Likewise, some studies found that banks with larger market shares possessing strong market power could earn supernormal profits, which would hamper competition and could affect the health of other smaller banks. On the other hand, other studies found that the relationship between banks' performance and concentration/market power is spurious, with efficiency being the principal determinant of both profitability and market structure. Individual banks' relative performance and the sector's profitability were more dependent on the production efficiency of banks, in addition to other operating factors and macroeconomic conditions. Which of these hypotheses is valid thus points to different implications of increased concentration (and thus of mergers and acquisitions) for the banking industry. Understanding the cross relationships among market structure, production efficiency and banks' performance in Hong Kong is therefore useful to policy makers. This is in particular so, in view of recent market consolidations resulting in fewer banks and new larger banks, and the fact that larger banks appear to have generally performed better than smaller banks.³

² For a detailed summary of the studies published on or before 1983, see Gilbert (1984). For studies published after 1983, see Smirlock et al. (1984, 1986), Smirlock (1985), Allen and Hagin (1989), Timme and Yang (1991) and Berger (1995), for example.

³ Using the panel set of retail banks in Hong Kong covering the period 1991-2005, a regression of banks' return on assets on their asset sizes shows that the two variables are positively related.

Our previous studies using the Panzar-Rosse approach in Wong et al. (2006b) and the conjectural variation approach in Wong et al. (2007) have shown that the banking sector in Hong Kong operated with a high degree of competition without any significant sign of collusive pricing. As part of our series of projects examining the market structure and competitive environment of Hong Kong's banking industry, this paper further examines the issue through identifying the key determinants of banks' relative performance. Based on the approach proposed by Berger and Hannan (1993) and with the aid of a panel dataset of retail banks covering the period 1991-2005, this paper examines what factors determine the performance of banks, and tests whether market concentration and efficiency are among the main factors contributing to the profitability of banks in Hong Kong. It also evaluates possible policy implications of what effects these and other determinants may have on banks' performance.

The rest of the paper is organised as follows. A literature review, particularly the Berger-Hannan approach, will be presented in the next section. Sections III and IV describe the empirical specifications, and data and estimation methods respectively. Section V presents the estimation results. Section VI concludes.

II. LITERATURE REVIEW

The structure-performance relationship of banks has been extensively studied for the US banking industry.⁴ Earlier studies on the structure-performance relationship of the banking industry have usually been based on regression analyses in which indicators of bank performance, such as bank profitability and prices, were regressed on indicators of market structure such as the concentration index of the banking industry and market shares of individual banks. While a positive correlation between banks' performance and market concentration (or market shares) was frequently found, the interpretation of this result, and hence the policy implication, varied among the studies: Some authors interpreted it as support of the SCP hypothesis, which asserts that banks in a concentrated market are more likely to engage in some form of non-competitive behavior such as collusions, consequently setting less favorable prices to customers and earning higher profits.⁵ Others viewed it as support of the EFS hypothesis, which states that efficient firms increase in size and market share because of their abilities to generate higher profits, which usually leads to increased concentration of markets and higher market shares of individual banks.⁶ The ambiguity in interpreting the result indicates the significant limitation of the approach.

⁴ See Footnote 2.

⁵ See Berger and Hannan (1989) and Hannan (1991).

⁶ For example, see Demsetz (1973,1974) and Peltzman (1977).

Berger and Hannan (1993) tackled the problem by explicitly incorporating two efficiency indicators, which measure the X-efficiency and scale efficiency of banks, as explanatory variables in the regression equations, together with two market structure indicators, which are proxied by market concentration and market shares of banks. In Berger and Hannan (1993), profit rates and prices are employed as the dependent variables to proxy for banks' performance. The X-efficiency variable, which is computed from an estimated efficient cost frontier from the data, aims to measure the closeness of cost of banks to the minimum that could be achieved on the efficient cost frontier which is defined by the best-practice banks in the sample. The scale-efficiency variable, which is derived from an estimated cost-function of banks from the data, aims to measure the closeness of cost for the bank's actual output level to the cost of the bank's minimum average cost output. Other factors such as the population of the state where the banks' headquarters locate, branching restrictions of banks and the business failure rate were included in the estimation to control for the differences in market size, regulatory restrictions and business conditions respectively.

Four important hypotheses that relate to the performance of the US banking industry were tested in Berger and Hannan (1993). In addition to the SCP, Berger and Hannan (1993) also tested the relative market power (RMP) hypothesis which asserts that banks with larger market shares are able to exercise market power to earn higher profits. Since the SCP and RMP hypotheses assert that higher profits are associated with anti-competitive pricing behaviours in the markets, prices should be positively related to market concentration and market shares of banks. The remaining two hypotheses tested by Berger and Hannan (1993) relate to the EFS hypothesis: Under the X-efficient hypothesis (ESX), banks with superior management of costs for a given output level should attain higher profits. Under the scale efficient hypothesis (ESS), banks operating at optimal economies of scale should have the lowest average costs, resulting in higher profits. Both ESX and ESS implies that efficiency is positively related to banks' profitability. It is also expected that efficient banks can offer more favourable prices to bank customers, leading to a negative relationship between efficiency and prices. Empirically, Berger and Hannan (1993) found that market concentration (i.e. the SCP hypothesis) better explains bank profits and prices than efficiency (i.e. the ESX and ESS hypotheses) and market share (i.e. the RMP hypothesis) do. Goldberg and Rai (1996) later applied the Berger-Hannan approach on 11 European banking industries, but found that cost efficiency was the main determinant of banks' performance in some low-market-concentration European countries, while scale efficiency and market structure only played a little role.

III. THE EMPIRICAL SPECIFICATION

In this paper, we employ the approach of Berger and Hannan (1993) to examine how banks' performance is determined, by including direct measures of efficiency in the empirical analysis, along with variables representing market structures and other controlling factors. Two equations are specified as follows:

$$\Pi_{it} = \beta_0 + \beta_1 \text{CONC}_t + \beta_2 \text{MS}_{it} + \beta_3 \text{DUM}_t + \beta_4 \text{CIE}_{it} + \beta_5 \text{SIE}_{it} + \beta_6 \mathbf{z}_{it} + f(e_{it}), \quad (1)$$

and

$$P_{it} = \beta_7 + \beta_8 \text{CONC}_t + \beta_9 \text{MS}_{it} + \beta_{10} \text{DUM}_t + \beta_{11} \text{CIE}_{it} + \beta_{12} \text{SIE}_{it} + \beta_{13} \mathbf{z}_{it} + f(e_{it}), \quad (2)$$

where i and t index bank and time respectively; Π and P are the profitability and pricing ability of banks, which are adopted as the measures of banks' performance; CONC is market concentration and MS is banks' market shares, which represent market structure of the banking sector; DUM is the dummy variable which is introduced to quantify the impact of regulatory liberalisation; CIE and SIE denote cost inefficiency (i.e. X-inefficiency) and scale inefficiency of banks respectively.⁷ \mathbf{z} is a vector of control variables and $f(e_{it})$ consists of autoregressive terms of a white noise process to capture autocorrelation in residuals.

Profitability of banks Π is measured by the return on assets (ROA), which is defined as the ratio of post-tax profits (or losses) to total net assets.⁸

The pricing ability P is proxied by the interest rate spread (IRS) of banks, which is defined as the average price of interest-bearing assets minus the average cost of interest-bearing liabilities. The former is adjusted to exclude the portion of interest incomes and assets contributed by inter-bank placements, so as to reflect more closely the price of loans to non-bank customers. A higher IRS may suggest greater market power, as banks with greater market power could charge loans with a higher spread over their interest costs.

CONC is proxied by the Herfindahl-Hirschman index (HHI), which is defined as the sum of the squared market shares of assets of individual banks, ranging from zero to one. A large number of banks, each with a small share, produce an HHI close to zero, while a single monopolist bank with a 100 percent share produces an

⁷ For estimation convenience, for the study of how cost efficiency and scale efficiency affect the performance of banks, the actual explanatory variables used in the regression analyses are cost inefficiency and scale inefficiency instead. This approach follows the specifications of Berger and Hannan (1993) and Goldberg and Rai (1995).

⁸ The total net assets are the total assets less provisions.

HHI of one. *MS* is measured as the ratio of individual banks' total assets for each period to the sum of assets of all banks for that period. Regarding the sign of the estimated coefficients of *CONC* and *MS*, the SCP hypothesis suggests a positive sign for *CONC* in equations (1) and (2), while the RMP hypothesis predicts a positive sign for *MS* in the two equations.⁹

DUM is defined as one after 2001 Q2, and zero otherwise. *DUM* is so specified as to examine the effect of a series of regulatory liberalisation measures in the banking sector taking place around 2001. The time point 2001 Q2 is so chosen to distinguish the two periods as major regulatory liberalisation measures either completed or took place around this time:

- (a) The interest rate deregulation was fully completed by July 2001, with interest rate restrictions on current and savings accounts also removed¹⁰;
- (b) the restriction on the number of branches and offices for foreign banks was completely removed in 2001; and
- (c) the market entry criteria have been relaxed since 2002.

Note that since the regulatory liberalisation was implemented almost at the same time when there was a sharp rise in *CONS* due to a number of mergers and acquisitions taking place, putting *CONS* and *DUM* in the same equations may subject the estimation to the problem of multicollinearity. This issue will be further discussed in the following sections.

The variable *CIE*, which is derived from a stochastic cost frontier, represents the cost inefficiency of banks. Cost inefficiency is an estimate of the percentage by which total production cost could have been reduced if the bank had operated on the stochastic cost frontier, holding the output levels and input prices constant. What cost inefficiency refers to is the situation in which the bank can reduce the production cost and still obtains the same quantities of outputs, given the input prices, but it has failed to do so. Theoretically, such a deviation occurs when the bank does not choose the right mix of inputs to produce the target output or employs excessive quantities of the factor inputs to produce the same amount of output. The estimate of *CIE* in this paper is equivalent to the variable *IE*

⁹ The SCP hypothesis suggests a positive sign for *CONC* in equations (1) and (2), as it asserts that banks in a concentrated market are more likely to engage in some form of noncompetitive behaviour which allows banks to set less favourable prices to customers and earn higher profits. The RMP hypothesis suggests a positive sign for *MS* in the two equations as it asserts that banks with larger market shares are able to exercise market power to earn higher profits.

¹⁰ The deregulation of interest rates in Hong Kong was undertaken in two phases. Phase 1 of the deregulation took place in July 2000 which removed the interest rate cap on time deposits with a maturity less than 7 days and the prohibition on benefits for all deposits with the exception of Hong Kong dollar current and savings accounts. Phase 2 of the deregulation took place in July 2001 which removed all interest rate rules over current and savings accounts.

(i.e. inefficiency estimate) in Wong et al. (2006a). Under the ESX hypothesis, the sign of the estimate coefficient for *CIE* is negative in equation (1) when *ROA* is the dependent variable, and is positive in equation (2) when *IRS* is the dependent variable.

Scale inefficiency *SIE* used in the regression analyses is computed from the parameters of the cost function estimated in Wong et al. (2006a), which is also adopted to calculate the *CIE*. *SIE* measures the absolute deviation of the bank's actual output level from its optimal-scale output level that has the minimum average cost. By definition, *SIE* ranges from zero to one. The lower the value of *SIE* is, the closer the bank operates to its optimal scale. Detailed derivations of the *CIE* can be found in Wong et al. (2006b) and the definition of *SIE* is provided in Appendix I. The coefficient estimate for *SIE* is expected to be negative in equation (1) and positive in equation (2), if the ESS hypothesis holds.

Some variables reflecting bank characteristics are incorporated to control for other heterogeneities in the samples. These include the ratio of loan loss provisions to total loans (*LLoss*), the ratio of total interest-bearing funds¹¹ to assets (*DEPASS*), and the capital adequacy ratio (*CAR*). *LLoss* is included in the estimation to capture differences in the quality of banks' loan portfolios. A higher *LLoss* of banks indicate a loan portfolio of poorer credit quality, which may lead to lower profits due to higher operating costs relating to credit risk and loan loss management¹². It may also trigger banks to shift to other assets with lower risks, resulting in lower *IRS*. *DEPASS* is adopted as a proxy for the leverage of banks. A higher *DEPASS* indicates that a greater portion of the bank's assets is funded by non-equity funds which could lead to higher funding costs, resulting in lower *ROA* and *IRS*. Such a relationship implies a negative estimated coefficient for *DEPASS* in regression equations (1) and (2). However, according to Goldberg and Rai (1995), a higher *DEPASS* may indicate that banks are more aggressive in asset-liability management which could lead to higher *ROA* and *IRS*. If this is the case, a positive sign for the coefficient estimate of *DEPASS* in equations (1) and (2) is expected. *CAR* is considered as a proxy for banks' risk attitude. The coefficient estimate is expected to be negative, as a more aggressive portfolio (with a lower *CAR* value) should normally require a higher *ROA* or *IRS* for compensation.

In addition to bank characteristics, we incorporate the real GDP growth rate (*GDP*) and the unemployment rate (*UR*) in Hong Kong into equations (1) and (2) to control for the influence of economic cycles. Generally, banks should generate higher profits and be able to charge higher prices under good economic conditions.

¹¹ Interest-bearing funds are defined as the sum of deposits from customers, inter-bank borrowings, and the amount payable under repos and negotiable debt instruments issued and outstanding.

¹² This includes, for example, cost relating to credit approval control, foreclosing bad loans, debt recovery expenses, and other loan-restructuring expenses

IV. DATA AND ESTIMATION METHOD

We employ in the estimation a panel data set that involves 38 retail banks in Hong Kong and covers the period from 1991 Q1 to 2005 Q4.¹³ Retail banks are the locally incorporated banks plus a number of the larger foreign banks whose operations are similar to those of the locally incorporated banks in that they operate a branch network and are active in retail banking. The banking data are obtained from the regulatory returns that the Authorized Institutions in Hong Kong must be filed with the Hong Kong Monetary Authority. Since our purpose is to examine the profit-structure relationship in Hong Kong, the data used in the study cover only Hong Kong offices of the banks.

After removing outliers and missing data, 1,418 observations are used for the study. Table 1 reports some descriptive statistics about the data set. Chart 1 depicts the average *ROAs* of retail banks for the study period. It shows that prior to 1998 Q4 (before the effect of Asian financial crisis was fully reflected), banks' profitability was usually higher than 0.4%. A sharp fall to the negative region of the *ROA* for the fourth quarter of 1998 indicates the lag effect of the Asian financial crisis. Although banks on average recovered from their quarterly loss after 1998 Q4, their *ROAs* were shown to have since stayed at a lower level of around 0.3%. The *IRS* exhibited a mild downward trend in the study period, suggesting that the pricing ability of banks was generally lower in recent years than previously.

¹³ Initially, there were a total of 45 banks in various periods covered by the study. After removing samples with missing information, 38 retail banks remained in the estimation. Note that the number of banks covered by the study varied in different periods. After the major mergers and acquisitions, the number fell from 38 during 2001 Q2 to 28 during 2005 Q4.

Table 1: General Features of the Data
(Sample Period: 1991Q1-2005Q4; No. of Observations: 1,418)

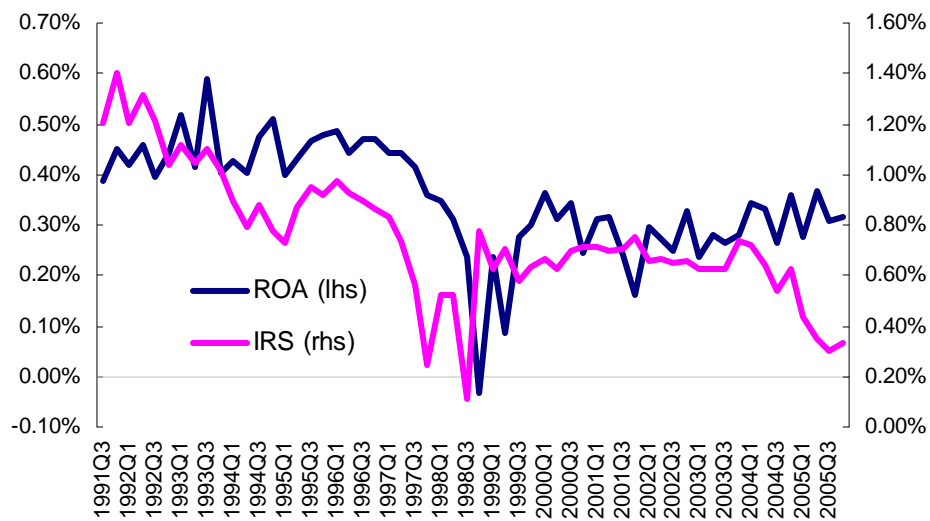
Variable	Mean	Median	Std. Dev.	Minimum	Maximum
ROA ^a	0.0036	0.0035	0.0030	-0.0263	0.0434
IRS ^a	0.0076	0.0074	0.0034	-0.0053	0.0377
CONC	0.0973	0.0869	0.0211	0.0790	0.1392
MS	0.0275	0.0101	0.0510	0.0001	0.2860
CIE	0.16	0.14	0.09	0.03	0.79
SIE	0.07	0.05	0.07	2.13e-05	0.45
LLoss	0.02	0.02	0.02	0.00	0.21
DEPASS	0.83	0.85	0.10	0.19	0.92
CAR	0.22	0.20	0.14	0.09	1.10
GDP Growth ^b	0.0110	0.0120	0.0158	-0.0390	0.0650
Unemployment rate	0.0440	0.0445	0.0215	0.0150	0.0860

Notes:

^a Quarterly figures, not annualised.

^b Seasonally adjusted Hong Kong real GDP growth rates, obtained from the Census and Statistics Department.

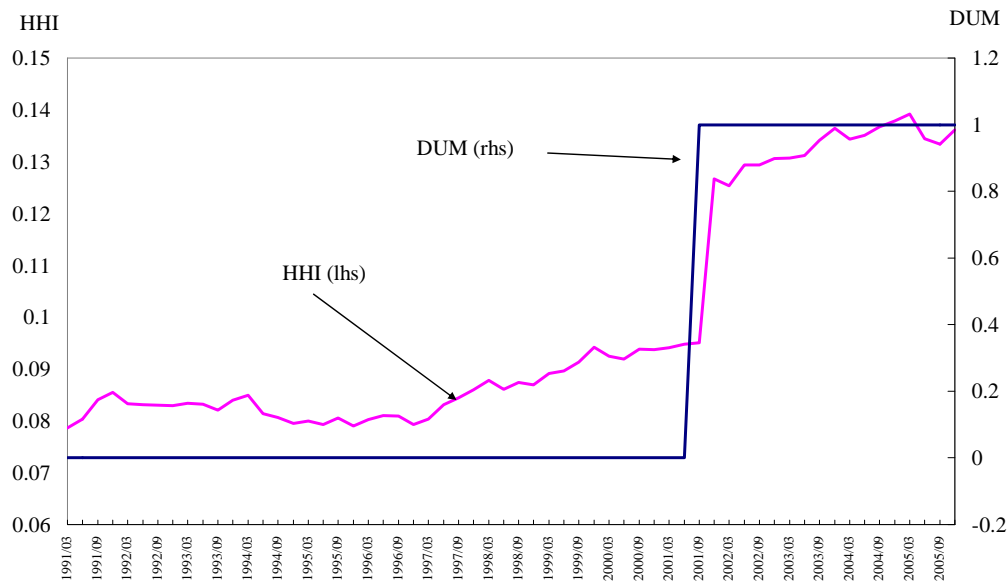
Chart 1. Time Series Plots of Average Quarterly ROA and IRS



Source: HKMA

The impact of industry consolidations on market concentration is apparent. As can be seen in Chart 2, the market concentration measured by the *HHI* increased sharply around the second half of 2001, reflecting merger and acquisition activities. As major regulatory liberalisation almost took place at the same time as market consolidations, the variable *DUM* is shown to be very similar to the evolution of market concentration. Such a close resemblance of the time series pattern of *CONS* and *DUM* suggests there may exist a degree of multicollinearity.

Chart 2. Market Concentration and Regulatory Liberalisation



Notes:

- (1) The HHI is the sum of the squared market shares of assets of all retail banks in the market, ranging from zero to one.
- (2) DUM is defined as one after 2001 Q2 and zero otherwise to capture the effect of regulatory liberalisation which took place around 2001.

Source: HKMA

Equations (1) and (2) are estimated by the least squares method. A fixed cross-sectional effect is specified in the estimation so as to capture unobserved idiosyncratic effects of different banks. To correct for the presence of cross-section heteroskedasticity, the cross-section weights are used in the estimation. The coefficient variances are derived by the White cross-section method so that the estimator is robust to cross equation correlation and different error variances in each bank.

V. ESTIMATION RESULTS

Estimation results are presented in Table 2 where Models A and B follow the specification in equations (1) and (2) respectively. The adjusted *R*-squared statistics of the two models, which measure the goodness of fit, are 0.46 and 0.41 in Models A and B respectively, indicating that the specifications are reasonably adequate. While not all variables included in Models A and B are statistically significant and obtain an expected sign, the *F*-statistics for both models reject the hypothesis that the set of selected variables do not give significant explanatory powers on *ROA* or *IRS*. Key findings are summarised as follows:

- (1) The estimated coefficients of *CONC*, *MS*, and *DUM* are found insignificant in the models (at the 5% significance level). It was also found that the sign and significance of the coefficient estimate for *CONC* change significantly when *DUM* is included in the estimation due to the problem of multicollinearity.¹⁴ Given this, the dummy variable is finally excluded in the specification of the equations (1) and (2). The estimated results for *CONC* and *MS* are therefore representing the net effect of increased market concentration in conjunction with the series of regulatory liberalisation. This empirical evidence suggests that market structure, as measured by market concentration and market shares of banks, is either not a significant determinant of banks' performance or, to the extent that market consolidations in recent years have hampered competition, thus enhancing banks' profitability, its adverse effect has been largely offset by regulatory liberalisation and technological progress during the same period. The emergence of a number of larger banks through mergers and acquisitions which should be more capable of competing with existing large banks may have also contributed. This is in line with the empirical results found in Wong et al. (2006b) and Wong et al. (2007) which showed that banks in Hong Kong operated in a competitive fashion in the loan market during the period 1991-2005 without any significant sign of collusion on pricing.¹⁵
- (2) For cost efficiency, the estimated coefficient of *CIE* is found to be negative in the *ROA* regression and positive in the *IRS* regression. *CIE* is statistically significant at the 5% and 1% level in the *ROA* and *IRS* regressions respectively. This suggests that banks with a higher level of cost efficiency are able to improve their profits through optimising the input mix to produce a given level of outputs, and to offer more favourable prices to customers. This empirical result is consistent with the *X-efficiency* hypothesis.

¹⁴ The correlation coefficient between *CONC* and *DUM* is around 0.95.

¹⁵ Despite that market consolidations in recent years have resulted in an increase in market concentration, which favours the development of collusions among banks.

- (3) Since larger banks have been found to be more cost efficient than smaller banks¹⁶, the above finding suggests that for the same product in the loan market, larger banks can offer lower prices to customers than smaller banks, yet attaining a similar or even higher level of profits. Therefore, to the extent that price competition squeezes interest margins and profits of banks, smaller banks are more likely than larger banks to find themselves operating with loss. This suggests that smaller banks are more vulnerable to intense price competition in the loan market.
- (4) For scale efficiency, the coefficient of *SIE* is found to be negative in the *ROA* regression but positive in the *IRS* regression. However, it is statistically significant only in the *IRS* regression. This suggests that while banks can offer more favourable prices to customers by optimizing their production scale, the effect of scale efficiency on profits is not significant.
- (5) Credit quality of loan portfolios, as expected, is found to be one of the determinants of banks' profitability. Banks with higher loan loss provisions to assets appear to earn less profits. A higher level of loan provisions suggests poorer credit quality of loan portfolios, which may call for higher operation costs relating to credit risk and loan loss management, such as credit approval control, foreclosing bad loans, debt recovery expenses, and other loan-restructuring expenses, leading to lower profits. On the other hand, the ratio of loan loss provisions to assets does not appear to be a significant determinant of loan prices.
- (6) *DEPASS* and *CAR*, which measure the risk attitude of banks, appear to be not significant determinants of banks' profitability. However, *DEPASS* is found to be positively correlated with the interest rate spread. This indicates that aggressive banks may be more likely to participate in markets with higher risks, where higher prices are charged.
- (7) With regard to macroeconomic factors, the real GDP growth rate and unemployment rate are found to be positively and negatively related to banks' profitability respectively, and the real GDP growth rate is found to be positively related to the interest rate spread of banks. This indicates that under good economic environments banks are more capable of charging higher prices in the loan markets and earn higher profits.

¹⁶ See Wong et al. (2006a)

Table 2. Estimation Results of ROA and IRS

Variable	ROA Model (1)	IRS Model (2)
Constant	0.0027	-0.0004
CONC _t	0.0046	-0.0346
MS _{it}	0.0040	-0.0088
CIE _{it}	-0.0068 **	0.0027 *
SIE _{it}	-0.0005	0.0051 *
LLoss _{it}	-0.0165 *	-0.0107
DEPASS _{it}	0.0035	0.0127 **
CAR _{it}	0.0015	-0.0025
GDP _t	0.0112 **	0.0287 *
UR _t	-0.0359 **	0.0027
Adj. R-squared	0.4573	0.4143
F-statistics	33.2766	24.8776

Note:

* and ** denote significance at the 5% and 1% levels respectively.

VI. CONCLUSIONS

Empirical evidence finds that market structure, as measured by market concentration and market shares of banks, is either not a significant determinant of banks' performance or, to the extent that market consolidations in recent years have hampered competition thus enhancing banks' profitability, that its adverse effect has been largely offset by regulatory liberalisation and technological progress during the same period. The emergence through mergers and acquisitions of a number of larger banks which should be more capable of competing with existing large banks may have also contributed. This finding is consistent with the empirical results of our previous studies¹⁷ which showed that the banking sector in Hong Kong operated with a high degree of competition without any significant sign of collusive pricing. Nonetheless, with bank consolidation expected to continue, how market concentration may impact on competition in the years to come needs to be closely monitored.

On the other hand, cost efficiency is found to be positively correlated with banks' profitability and negatively correlated with loan prices. Banks with a higher level of cost efficiency appear to be able to enhance their profitability and offer more attractive prices to customers. This suggests that bank with a lower production cost may earn higher profits through optimising the input mix to produce outputs. Since larger banks are found to be more cost efficient in general, as shown in Wong et al. (2006), larger banks can offer their services at lower prices to compete with smaller banks, yet attaining a similar or even higher level of profits. To the extent

¹⁷ See Wong et al. (2006b) and Wong et al. (2007).

that price competition squeezes interest margins and profits of banks, smaller banks are more likely than larger banks to incur loss. Smaller banks may, therefore, be more vulnerable to intense price competition in the loan market, particularly under an operating environment of cut-throat price wars.¹⁸

Empirical results also indicate that banks with a loan portfolio of lower credit quality earn less profits, probably due to higher operational costs relating to credit risk and loan loss management. Loan prices are observed to be sensitive to banks' risk attitude. Aggressive banks may be more likely to participate in markets with higher risks, where higher spreads are charged. In addition, banks' profitability and loan spreads are in general positively correlated with macroeconomic environments.

¹⁸ For illustration, we select 3 larger banks and 3 smaller banks to calculate the impact of cost efficiency on profits and *IRS*. Based on the dataset used in this study, the average XIEs of the three larger banks and three smaller banks in 2005 Q4 were 0.066 and 0.190 respectively. Using the estimated coefficients in Table 2, the difference in XIEs of larger banks and smaller banks has caused an annualised *ROA* gap of 0.34%, while the resulting gap on *IRS* is -0.13%. In other words, *ROA* of larger banks in general is larger than that of smaller banks by 0.34%, while their *IRS* is lower than that of smaller banks by 0.13% due to the difference in their cost efficiency. The differences are considered significant, given that the average values of annualised *ROA* and *IRS* of all banks in the dataset are 1.44% and 3.04% respectively.

Appendix I

Measures of scale inefficiency

The measure of scale efficiencies indicates how the scale of banks with a particular level of production and management technology deviates from their optimal economies of scale.¹⁹ It is given by:

$$S_i = \sum_{j=1}^J \frac{\partial \ln C_i}{\partial \ln y_{ji}} \\ = \sum_{j=1}^J \tau_j + \sum_{j=1}^J \sum_{l=1}^J \gamma_{jl} \log y_{li} + \sum_{k=1}^K \omega_{jk} \log w_{ki}.$$

The variable S_i is estimated for each of the banks at their respective output levels. Other notations can be referred to Wong et al. (2006a). Banks experience a constant return to scale when the estimate of S_i is equal to 1. If S_i is less than one, banks are operating below their optimal scale levels and they could lower costs by increasing output further. On the other hand, while S_i is greater than one, banks are required to downsize in order to achieve optimal input combinations. Both cases imply a degree of inefficiencies. A measure of scale inefficiency, SIE, is used in the actual regression:

$$SIE_i \begin{cases} = S_i - 1 & \text{if } S_i > 1 \\ = 1 - S_i & \text{if } S_i < 1 \end{cases} \quad (A1)$$

In such form, the smaller the SIE is, the closer the banks' scale is to the optimal level.

¹⁹ Detailed discussions of scale economies can be found in Murray et al. (1983).

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