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Abstract

This study investigates the net effects of sectoral loan concentration on banks in Hong Kong. Research in this area remains inconclusive, due to the potential trade-off between concentration risks and specialisation gains. Our empirical results, based on a regulatory panel dataset of licensed banks in Hong Kong, find support for the specialisation gain from higher loan concentration, which would more than offset the concentration risk after controlling for the differences in loan composition and common risk factors. While this finding may, to some extent, alleviate concerns about the rising sectoral concentration in banks' loan portfolios observed after the global financial crisis, it is important to note that the net impact on an individual bank's loan loss provision ratio also depends on how far the bank allocates its loan portfolio towards riskier sectors. A key implication is that changes in the sectoral concentration and composition in banks' loan portfolios should be monitored jointly to have a more balanced assessment of the risk and return of banks' loan portfolios.

Keywords: Banks, concentration, specialisation gains, bank risk, bank return
JEL Classification: C23, C43, G11, G21.

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1. INTRODUCTION

The effect of concentration versus diversification in banks' loan portfolios remains one of the unsettled debates in banking research. The conventional view in modern finance theory argues that a credit portfolio with high sectoral concentration tends to increase credit risks due to higher default correlations in those sectors (Bebczuk and Galindo, 2007; and Rossi *et al*., 2009). However, recent studies find that, by focusing lending on certain industries, banks can acquire industry-specific knowledge and improve their selection and monitoring abilities (Acharya *et al*. 2006, Jahn *et al*. 2016 and Tabak *et al*. 2011). This could help reduce banks' credit risks and thus improve their performance. Due to the possible trade-off between concentration risks and specialisation gains, the net effect of loan concentration is ambiguous. To help shed light on this important policy question, this study empirically investigates the net effect of loan sectoral concentration on the risk and returns of banks in Hong Kong.

Based on a regulatory panel dataset reported by licensed banks to the Hong Kong Monetary Authority, our empirical results find support for the specialisation gain hypothesis and the results are robust across three different measures of loan concentration. Specifically, the results suggest that a bank with a more concentrated loan portfolio tends to have a lower overall loan loss provision ratio after controlling for the differences in loan composition and common credit risk factors. In addition to a lower loan loss provision ratio, higher loan concentration is found to be associated with better bank performance, as measured by higher return on assets. Taking these together, a key implication is that the potential specialisation gains from higher loan concentration should be taken into consideration to have a more balanced assessment of banks' risks and return.

The remaining part of this paper is structured as follows: section two describes the data and empirical framework, section three discusses the estimation results and implications, and section four concludes.

2. DATA AND EMPIRICAL MODELS

In this section, we describe the construction of the measures for loan concentration and follow with empirical models to estimate the impact of loan concentration on banks' risk and return.

2.1 Measures of loan portfolio concentration ($M_{i,t}$)

Following the literature, three different concentration measures are constructed in this study as proxies for the sectoral concentration of a bank's loan portfolio. In particular, the normalised HHI ($hhi_{i,t}$) is used as our baseline measure. To construct the measure for each bank, we first calculate the share of bank *i*'s loan exposure in sector *j* to its total loan exposure at each quarter *t* (w_{ijt}). The share is squared and totalled across all loan sectors, which is subsequently normalised into a $[0, 1]$ scale. Specifically, the normalised HHI is calculated as:

$$hhi_{i,t} = \left(\sum_j w_{i,j,t}^2 - 1/N\right)/(1 - 1/N) \quad (1)$$

where N denotes the number of loan sectors that a bank can lend to. By construction, $hhi_{i,t}$ is equal to 1 if a bank fully concentrates its loan portfolio in one sector. Conversely, $hhi_{i,t}$ will attain its minimum value of 0 for a fully diversified loan portfolio (i.e. all economic sectors have the same loan share). In our dataset, N is equal to 34 if other loans for use outside Hong Kong is categorised as a sector. A detailed breakdown of the loan sectors and the corresponding loan share for all AIs in Hong Kong at the end of September 2017 is presented in Table 1.

Another widely used concentration measure is Shannon's (1948) entropy ($s_{i,t}$), which is calculated as:

$$s_{i,t} = \sum_j w_{i,j,t} \ln\left(1/w_{i,j,t}\right) \quad (2)$$

where a larger value of s_{it} refers to a less concentrated position.[1] To ensure all concentration measures point in the same direction, we multiply -1 to $s_{i,t}$ and rescale the measure to a $[0, 1]$ range. We define $\hat{s}_{i,t}$, the new measure, by:

$$\hat{s}_{i,t} = \left[-s_{i,t} + \ln(N)\right]/\ln(N) \quad (3)$$

where again $N = 34$. This construction is designed such that $\hat{s}_{i,t}$ will be equal to 0 when it is fully diversified and equal to 1 when it concentrates lending in one sector only.

We also consider a simpler measure of loan concentration, which is the share of the largest sector in the total loan amount ($mw_{i,t}$). For an easier comparison with the other two measures, we scale the measure into a $[0, 1]$ range. The third measure is

[1] If $w_{i,j,t} = 0$, $1/w_{i,j,t}$ would be undefined. We follow Theil (1972) to set $w_{i,j,t}\ln\left(1/w_{i,j,t}\right) = 0$ when $w_{i,j,t} = 0$ to avoid this problem.

then calculated as:

$$mw_{i,t} = \left(\max_j w_{i,j,t} - 1/N\right)/(1 - 1/N) \quad (4)$$

where $N = 34$. Chart 1 presents the median value of the three loan concentration measures over time. As can be seen in the chart, the three measures tend to move in tandem over time and exhibit an upward trend after the global financial crisis. This suggests that the loan portfolios of banks in Hong Kong, on average, have become more concentrated after the 2008 global financial crisis.

2.2 Empirical models

We then describe the empirical framework for examining the effect of higher loan portfolio concentration ($M_{i,t-1}$) on the credit risk of banks, where risk is measured by banks' overall specific loan loss provision to total loan ratios ($q_{i,t}$).[2] To single out the effect of banks' loan concentration on $q_{i,t}$, it is also important to control for differences in sectoral composition among banks' loan portfolios. This is because a bank that specialises in lending to riskier sectors is likely to result in a higher $q_{i,t}$ than another bank that specialises in lending to less riskier sectors, even though the two banks have the same level of concentration.

To account for this, we follow the empirical strategy in Jahn *et al*. (2016). We compute a variable that captures the credit risk differences which are due to differences in the loan composition among banks' loan portfolios. More specifically, the variable is computed in the following steps. First, a loan loss provision ratio of a hypothetical loan portfolio ($hq_{i,t}$) for a bank is constructed based on the bank's actual loan composition, but the banking-sector's average loan loss provision ratio for each loan sector ($Q_{j,t}$) is applied.

$$hq_{i,t} = \sum_j w_{i,j,t} Q_{j,t} \quad (5)$$

Second, $hq_{i,t}$ is then subtracted from and scaled by the average overall loan loss provision ratio of the banking sector (Q_t) (i.e. the benchmark portfolio) to construct the loan composition factor (Δhq_{it}):

$$\Delta hq_{i,t} = \left(hq_{i,t} - Q_t\right)/Q_t \quad (6)$$

[2] Another widely used measure for bank risk is Z-score (calculated as the sum of a bank's return on assets and its capital ratio, divided by the standard deviation of return on assets). However, since a large proportion of our sampled banks are foreign bank branches, this has prevented us from using Z-score as the bank risk measure, as these banks do not have capital ratio.

As the hypothetical and benchmark portfolio share the same average loan loss provision ratio for each loan sector, Δhq_{it} effectively reflects the relative difference in the sectoral composition between the bank's loan portfolio and the benchmark portfolio (i.e. the aggregate banking sector portfolio). By construction, a positive value of $\Delta hq_{i,t}$ indicates that the bank tends to overweigh (relative to the benchmark portfolio) its loan allocation towards sectors with higher risks and vice versa.

Based on these variables, our baseline specification for examining the effect of loan concentration on a bank's risk is detailed as follows: `

$$q_{i,t} = \beta_0 + \beta_1 Q_{t-1} + \beta_2 \Delta hq_{i,t-1} + \beta_3 M_{i,t-1} + \sum_a \beta_a X_{a,i,t-1} + \gamma_i + \varepsilon_{i,t} \qquad (7)$$

where $q_{i,t}$ is the overall specific loan loss provision ratio of bank *i* at time *t*. $M_{i,t-1}$ is the concentration measure of the loan portfolio of bank i. As mentioned previously, $\Delta hq_{i,t-1}$ is included to control for a bank's composition factor. In addition, the average overall loan loss provision ratio of the banking sector (Q_{t-1}) is included in the model to account for the common credit risk factor in Hong Kong. Meanwhile, the model includes a vector of bank control variables ($X_{a,i,t-1}$), such as the natural logarithm of the bank's total assets, deposits to asset ratio and loans to asset ratio. All of the explanatory variables are lagged by one quarter to alleviate the potential problem of endogeneity.[3] The bank fixed effect (γ_i) is also included to capture unobservable time-invariant characteristics of banks in Hong Kong.

The coefficient of key interest is β_3, which captures the effect of loan concentration on bank's risk after controlling for common risk and loan composition factors. A negative statistically significant β_3 indicates that a more concentrated loan portfolio is, on average, associated with a lower risk. This suggests that the specialisation gains arising from improved selection and monitoring abilities would more than offset the associated rise in concentration risks.

We also consider a modified model to study whether there is a non-linear relationship between $q_{i,t}$ and $M_{i,t-1}$. We conjecture that the marginal gains from

[3] One typical endogeneity problem is reverse causality, where the dependent variable also affects the independent variables contemporaneously. While the problem of reverse causality is difficult to be fully eliminated in any empirical analysis, one common practice in the literature to partly reduce this issue is to include the lagged independent variables (see Buch *et al*. 2013, Tabak *et al*. 2011). This is because the lagged independent variables are arguably less likely to be influenced by the contemporaneous dependent variable.

improved selection and monitoring abilities tend to diminish as a bank's credit portfolio becomes more concentrated. To test this, we add a squared term of $M_{i,t-1}$ into Eq. (7) to allow for a non-linear relationship as shown in Eq. (8). Specifically, a negative β_3 and a positive β_4 are expected if our conjecture holds true.

$$q_{i,t} = \beta_0 + \beta_1 Q_{t-1} + \beta_2 \Delta hq_{i,t-1} + \beta_3 M_{i,t-1} + \beta_4 M_{i,t-1}^2 + \sum_a \beta_a X_{a,i,t-1} + \gamma_i + \varepsilon_{i,t} \quad (8)$$

Turning to the model for bank's performance, we essentially replace the dependent variable of Eq. (8) with bank's return on assets:

$$roa_{i,t} = \delta_0 + \delta_1 Q_{t-1} + \delta_2 \Delta hq_{i,t-1} + \delta_3 M_{i,t-1} + \delta_4 M_{i,t-1}^2 + \sum_a \delta_a X_{a,i,t-1} + \upsilon_i + \eta_{i,t} \quad (9)$$

Similar to the empirical model for bank's risk, bank's return on assets ($roa_{i,t}$) is regressed on $M_{i,t-1}$ and $M_{i,t-1}^2$ to account for the possible non-linear relationship between bank's performance and loan concentration. The same sets of bank control variables, bank fixed effects, common credit risk factor (Q_{t-1}) and the loan composition factor $\Delta hq_{i,t-1}$ are added in the model. As a robustness check, time-fixed effect (θ_t) is replaced with Q_{t-1} to account for more broader changes in economic conditions (including economic growth and interest rate environment) that could commonly affect banks in Hong Kong.

The regression models are estimated using a quarterly panel dataset of the largest 100 licensed banks by assets size[4] in Hong Kong spanning from 2000Q1 to 2017Q3.[5] The bank-level data are constructed using confidential regulatory data filed by banks in Hong Kong to the Hong Kong Monetary Authority. In particular, the data of banks' specific loans loss provisions are obtained from the HKMA's *quarterly analysis of loans and advance and provisions*. Banks' return on assets and their bank control variables are constructed from data obtained from the HKMA's *return of current year's profit and loss account* and *return of assets and liabilities* respectively. Table 2 presents the summary statistics for the variables used.

3. ESTIMATION RESULTS AND IMPLICATIONS

[4] Based on the banks' total assets at the end of 2016.
[5] The sampled banks account for 98% of total loans of all AIs at the end of Sep 2017.

3.1 Estimation results

We first focus on the estimation results regarding the impact of a higher loan concentration on a bank's loan loss provision ratio (Table 3). Columns 1-3 present the results for the baseline model (Eq. 7) for the three concentration indexes respectively. Columns 4-6 present the results for allowing a non-linear effect of loan concentration on a bank's risk (Eq. 8).

Overall, our estimation results indicate that a bank with a more concentrated loan portfolio tends to have a lower loan loss provision ratio after controlling for the differences in banks' loan composition and the common risk factor.[6] This can be shown by the negative statistically significant coefficient for $M_{i,t-1}$ (i.e. β_3) across the three loan concentration measures (as shown in columns 1-6 of Table 3). The estimated coefficient for $M_{i,t-1}^2$ (i.e. β_4) is found to be positively significant (see columns 4-6), suggesting that the extent of the marginal impact on bank's loan loss provision ratio is dependent on the bank's initial level of $M_{i,t-1}$.[7] Specifically, the estimated marginal impact of a higher loan concentration on a bank's loan loss provision ratio tends to be smaller if the bank has already held a concentrated loan portfolio *ex ante*, possibly reflecting a diminishing marginal benefit from improved selection and monitoring abilities. In terms of its economic significance, a one-standard-deviation increase in $hhi_{i,t}$ from its mean value (i.e. an increase by 0.25), while holding other things constant, is estimated to reduce the bank's overall loan loss provision ratio by 24 bps, which is significant given the sample mean of a bank's loan loss provision ratios is 0.85% (see Table 2).

Other explanatory variables are also found to have the expected signs. In particular, a bank that overweighs its loan portfolio towards riskier sectors relative to the benchmark portfolio (i.e. a positive value of $\Delta hq_{i,t-1}$) would have a higher loan loss ratio given other factors being held constant. The estimation results also suggest the existence of a significant positive relationship between the common risk factor (Q_{t-1}) and the loan loss provision ratio, suggesting the overall credit risk environment also plays a key role in affecting the credit risk of an individual banks' loan portfolios.

For the impact on a bank's return on assets (Eq. 9), the estimation results are presented in Table 4. In line with our expectations, a higher loan concentration is

[6] Estimation results remain robust if Q_{t-1} is replaced with time fixed effects for controlling common risk factors. Results are available on request.

[7] The marginal impact of higher loan concentration can be calculated by taking the first partial derivative of the dependent variable with respect to $M_{i,t-1}$, which is equal to $\beta_3 + 2\beta_4 M_{i,t-1}$.

found to help boost a bank's return and the results are robust, even controlling for other common macroeconomic factors (which are captured by the time dummies). Also, possibly reflecting the diminishing marginal return of specialisation gains, the marginal increase in the bank's return from a higher loan concentration is also found to be smaller if the bank's loan portfolio is already concentrated.

3.2 Net impact of rising loan concentration on banks' loan loss provision ratios after the crisis

Although a higher loan concentration *per se* is found to be negatively related to a bank's risk, the net impact on that risk is also dependent on how far the bank allocates its loan portfolio in riskier sectors (proxied by the composition factor, $\Delta hq_{i,t}$). Chart 2 presents the development of the median value of $hhi_{i,t}$ and $\Delta hq_{i,t}$ for the sampled banks over time. As can be seen in the chart, the median $hhi_{i,t}$ increased from 0.23 at the end of March 2010 to 0.30 at the end of September 2017, while the median $\Delta hq_{i,t}$ rose slightly from 0.30 to 0.38 during the same period. Together, these suggest that banks in Hong Kong have, on average, increased the focus of their loan business slightly towards riskier sectors after the global financial crisis.

Based on our estimation result of column 4 in Table 2, the rise in loan concentration is estimated to decrease $q_{i,t}$ by 13 basis points, which would more than offset the estimated increase in $q_{i,t}$ of five basis points arising from the increase in $\Delta hq_{i,t}$. Overall, the net effect is estimated to decrease $q_{i,t}$ by about eight basis points. Taken together, our empirical estimate suggests that the post-crisis increase in banks' loan concentration has, on average, helped improve their asset quality, partially due to their improved screening and monitoring abilities.

3.3 Robustness analysis

As shown in Table 1, loans for use outside Hong Kong account for a notable share of total loans, which may raise concerns about the robustness of our estimation results. To check the robustness of the results, two additional analyses are conducted: (1) excluding loans for use outside Hong Kong in the estimation; and (2) approximating the geographical breakdown of the loans for use outside Hong Kong based on other data sources. For the first robustness analysis, we repeat the estimations by using loans that are for use in Hong Kong only. Table 5 provides the estimation results for Eq. (7) and (8) using only loans for use in Hong Kong, while the results for Eq. (9) are presented in Table 6.

For the second robustness analysis, since the exact geographical breakdown of

loans for use outside Hong Kong is not available, we try to divide the loans for use outside Hong Kong into two sub-groups: (a) loans for use in Mainland China and (b) other loans for use outside Hong Kong and Mainland China. For the former, we approximate the amount of loans for use in Mainland China by using banks' external loans to non-bank sectors in Mainland China obtained from the HKMA's *return of external positions* (for 2000 to 2014) and the *return of international banking statistics* (since 2015 onwards). Loans that are not for use in Hong Kong or Mainland China are grouped as "other loans for use outside Hong Kong and Mainland China". Tables 7 and 8 show the estimation results for Eq. (7) and (8) and Eq. (9) respectively. Overall, the estimation results from both robustness analyses are found to be quantitatively the same as the baseline analysis, suggesting that our results are robust and are not driven by the notable share of loans for use outside Hong Kong.

4. CONCLUSION

Our empirical results suggest that there are potential gains of improved screening and monitoring abilities for banks, which buffer the associated concentration risk, by focusing lending to certain loan sectors. In particular, a bank with a more concentrated loan portfolio is estimated to have a lower loan loss provision ratio and higher return on assets after controlling for loan composition and common risk factors. A key implication is that the potential specialisation gains from higher loan concentration should be taken into consideration for a more balanced assessment on banks' risks and return.

While this finding may alleviate some concerns about the rising sectoral concentration in the loan portfolios of banks after the crisis, it is important to note that the net impact on their loan loss provision ratio depends on how far the bank allocates its loan portfolio towards riskier sectors. In addition, the common credit risk factor, which is exogenous, is found to be a key driver in affecting the credit risk of banks' loans. In view of this, it is essential for banks to maintain prudent credit risk management and stringent underwriting standards of their credit businesses.

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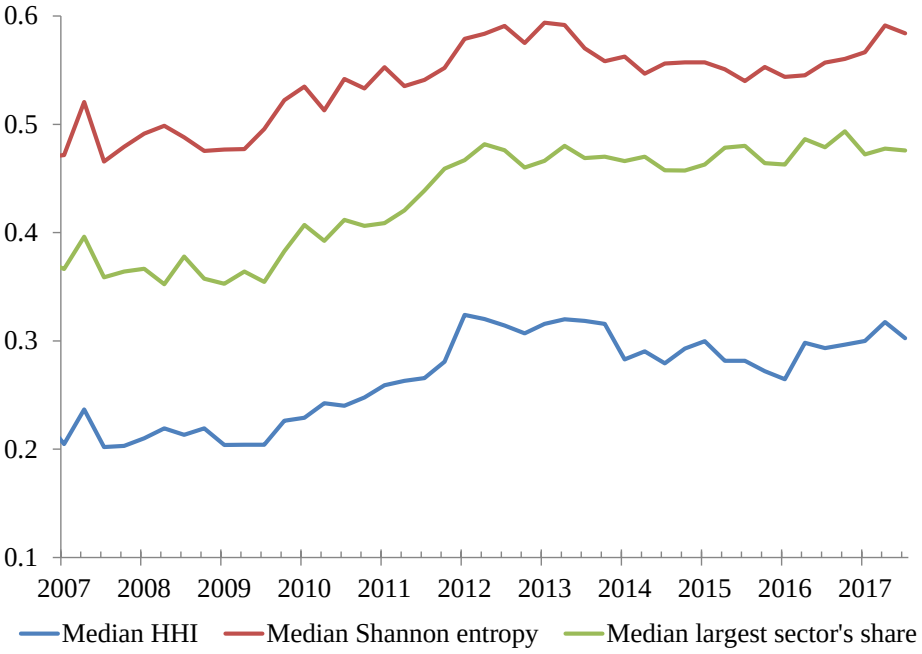
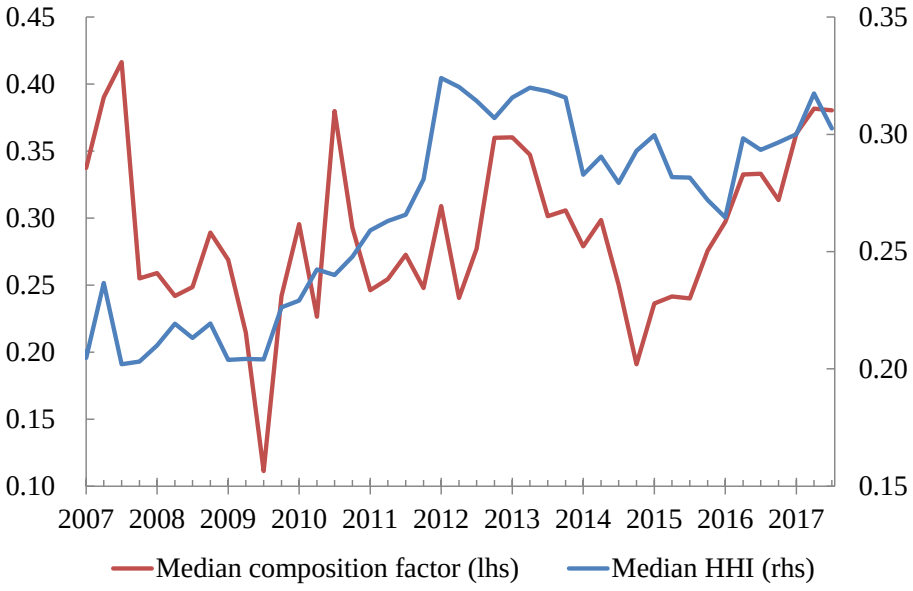
Chart 1: Median value of various loan concentration measures of the sampled banks



Source: Authors' calculation based on data from the HKMA.

Chart 2: Median value of HHI and composition factor of the sampled banks



Source: Authors' calculation based on data from the HKMA.

Table 1: List of economic sectors

No.	Sectors	09/2017
	Loans for use in Hong Kong	
1	Textile	0.2%
2	Footwear and wearing apparel	0.3%
3	Metal products and engineering	0.3%
4	Rubber, plastic and chemicals	0.6%
5	Electrical and electronic	0.7%
6	Food	0.1%
7	Beverages and tobacco	0.1%
8	Printing and publishing	0.1%
9	Other manufacturing miscellaneous	0.9%
10	Property development	7.5%
11	Property investment	8.0%
12	Civil engineering works	0.4%
13	Electricity and gas	1.3%
14	Recreational activities	0.1%
15	Telecommunications	0.6%
16	Other information technology	0.7%
17	Wholesale and retail trade	4.6%
18	Shipping	1.2%
19	Air transport	0.7%
20	Taxis	0.6%
21	Public light buses	0.1%
22	Other transport and transport equipment	1.1%
23	Hotels, boarding houses and catering	1.0%
24	Financial concerns	8.0%
25	Stockbrokers	0.8%
26	Non-stockbroking companies and individuals for the purchases of shares	0.9%
	Professional and private individuals:-	
27	for the purchase of flats covered by the guarantee issued by the Housing Authority under Home Ownership Scheme, Private Sector Participation Scheme and Tenants Purchase Scheme	0.6%
28	for the purchase of other residential properties	13.1%
29	for credit card advances	1.2%
30	for other business purposes	0.1%
31	for other private purposes	5.0%
32	Other miscellaneous	3.7%
33	Trade financing	5.6%
34	Other loans for use outside Hong Kong	30.0%

Source: HKMA.

Table 2: Summary statistics of variables for the estimation sample

	Mean	Median	Standard deviation	25th Percentile	75th Percentile
Credit risk and profitability					
$q_{i,t}$ (% pt.)	0.8530	0.1650	1.8625	0.0000	0.8017
Q_t (% pt.)	0.5909	0.3352	0.5505	0.2236	0.6458
$roa_{i,t}$ (% pt.)	0.6720	0.6947	1.6579	0.1848	1.3354
Composition and concentration measures					
$\Delta hq_{i,t}$	0.3542	0.2744	0.6453	-0.0686	0.6571
$hhi_{i,t}$	0.3433	0.2555	0.2528	0.1378	0.4893
$\hat{s}_{i,t}$	0.5602	0.5247	0.2082	0.3775	0.7284
$mw_{i,t}$	0.5316	0.4941	0.2508	0.3096	0.7332
Bank characteristics					
Log assets $_{i,t}$	17.4156	17.5174	1.7420	16.4349	18.5759
Deposits/Assets $_{i,t}$ (% pt.)	45.3364	44.9953	27.8590	19.6199	72.3050
Loans /Assets $_{i,t}$ (% pt.)	33.3232	46.0539	17.9328	20.2341	46.0539

Table 3: Estimation results for Eq. (7) and (8) which investigates the effect of loan concentration on banks' loan loss provision ratio

Dependent variable: $q_{i,t}$	(1) $M = hhi$	(2) $M = \hat{s}$	(3) $M = mw$	(4) $M = hhi$	(5) $M = \hat{s}$	(6) $M = mw$
Q_{t-1}	1.241***	1.254***	1.255***	1.283***	1.289***	1.280***
	(0.057)	(0.058)	(0.058)	(0.059)	(0.059)	(0.059)
$\Delta hq_{i,t-1}$	0.610***	0.614***	0.600***	0.595***	0.611***	0.595***
	(0.088)	(0.087)	(0.088)	(0.088)	(0.088)	(0.088)
$M_{i,t-1}$	-0.815***	-1.313***	-0.905***	-3.078***	-3.587***	-2.614***
	(0.180)	(0.251)	(0.159)	(0.495)	(0.933)	(0.549)
$M^2_{i,t-1}$				2.277***	2.086***	1.159***
				(0.518)	(0.808)	(0.530)
Constant	-2.372***	-1.950***	-2.413***	-2.603***	-1.607**	-2.415***
	(0.518)	(0.525)	(0.519)	(0.511)	(0.544)	(0.516)
Bank characteristics:						
Log assets $_{i,t-1}$	0.175***	0.173***	0.182***	0.199***	0.187***	0.194***
	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)
Deposits/Assets $_{i,t-1}$	0.005**	0.005**	0.005**	0.005**	0.005**	0.005**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Loans/Assets $_{i,t-1}$	-0.010***	-0.010***	-0.010***	-0.010***	-0.010***	-0.010***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Observations	5,832	5,832	5832	5,832	5,832	5832
R-squared	0.401	0.401	0.402	0.403	0.402	0.402
Cluster	Bank	Bank	Bank	Bank	Bank	Bank
Time fixed effect	N	N	N	N	N	N
Bank fixed effect	Y	Y	Y	Y	Y	Y

Note: ***, ** and * denote statistical significance at 1%, 5% and 10% respectively. Standard errors are in parenthesis.

Table 4: Estimation results for Eq. (9) which investigates the effect of loan concentration on banks' return on assets

Dependent variable:$roa_{i,t}$	(1) $M = hhi$	(2) $M = \hat{s}$	(3) $M = mw$	(4) $M = hhi$	(5) $M = \hat{s}$	(6) $M = mw$
Q_{t-1}	0.116***	0.098**	0.117***			
	(0.038)	(0.039)	(0.039)			
$\Delta hq_{i,t-1}$	0.100*	0.086	0.092	0.075	0.059	0.066
	(0.057)	(0.057)	(0.057)	(0.056)	(0.055)	(0.055)
$M_{i,t-1}$	3.315***	7.389***	4.069***	3.098***	7.137***	3.563***
	(0.481)	(0.984)	(0.562)	(0.473)	(0.957)	(0.555)
$M_{i,t-1}^2$	-3.935***	-6.340***	-4.007***	-3.558***	-5.904***	-3.463***
	(0.517)	(0.839)	(0.545)	(0.507)	(0.811)	(0.534)
Constant	-2.854***	-4.438***	-3.413***	-5.696***	-7.423***	-6.227***
	(0.812)	(0.916)	(0.855)	(1.016)	(1.113)	(1.060)
Bank characteristics:						
Log assets $_{i,t-1}$	0.173***	0.180***	0.181***	0.333***	0.346***	0.344***
	(0.043)	(0.044)	(0.044)	(0.057)	(0.058)	(0.058)
Deposits/Assets $_{i,t-1}$	0.001	0.002	0.002	0.003	0.004*	0.003*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Loans/Assets $_{i,t-1}$	0.009***	0.008***	0.009***	0.013***	0.013***	0.013***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Observations	5,788	5,788	5,788	5,788	5,788	5,788
R-squared	0.430	0.427	0.427	0.459	0.458	0.457
Cluster	Bank	Bank	Bank	Bank	Bank	Bank
Time fixed effect	N	N	N	Y	Y	Y
Bank fixed effect	Y	Y	Y	Y	Y	Y

Note: ***, ** and * denote statistical significance at 1%, 5% and 10% respectively. Standard errors are in parenthesis.

Table 5: Estimation results for Eq. (7) and (8) using only loans for use in Hong Kong

Dependent variable: $q_{i,t}$	(1) $M = hhi$	(2) $M = \hat{s}$	(3) $M = mw$	(4) $M = hhi$	(5) $M = \hat{s}$	(6) $M = mw$
Q_{t-1}	1.394***	1.421***	1.419***	1.368***	1.348***	1.350***
	(0.109)	(0.109)	(0.109)	(0.109)	(0.111)	(0.109)
$\Delta hq_{i,t-1}$	0.426***	0.439***	0.431***	0.422***	0.426***	0.418***
	(0.083)	(0.084)	(0.083)	(0.083)	(0.083)	(0.082)
$M_{i,t-1}$	-1.444***	-1.611***	-1.346***	0.108	3.851**	2.513**
	(0.350)	(0.387)	(0.356)	(1.035)	(1.782)	(1.153)
$M_{i,t-1}^2$				-1.461	-4.348***	-3.460***
				(1.079)	(1.523)	(1.171)
Constant	-5.974***	-5.731***	-5.994***	-6.184***	-7.033***	-6.635***
	(1.220)	(1.285)	(1.215)	(1.274)	(1.434)	(1.286)
Bank characteristics:						
Log assets $_{i,t-1}$	0.420***	0.426***	0.427***	0.423***	0.423***	0.424***
	(0.067)	(0.069)	(0.067)	(0.068)	(0.069)	(0.067)
Deposits/Assets $_{i,t-1}$	-0.017***	-0.016***	-0.016***	-0.017***	-0.017***	-0.016***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Loans/Assets $_{i,t-1}$	-0.004	-0.003	-0.003	-0.004	-0.004	-0.004
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Observations	5,797	5,797	5,797	5,797	5,797	5,797
R-squared	0.299	0.299	0.298	0.298	0.299	0.300
Cluster	Bank	Bank	Bank	Bank	Bank	Bank
Time fixed effect	N	N	N	N	N	N
Bank fixed effect	Y	Y	Y	Y	Y	Y

Note: ***, ** and * denote statistical significance at 1%, 5% and 10% respectively. Standard errors are in parenthesis.

Table 6: Estimation results for Eq. (9) using only loans for use in Hong Kong

Dependent variable: $roa_{i,t}$	(1) $M = hhi$	(2) $M = \hat{s}$	(3) $M = mw$	(4) $M = hhi$	(5) $M = \hat{s}$	(6) $M = mw$
Q_{t-1}	0.154***	0.138***	0.148***			
	(0.046)	(0.047)	(0.047)			
$\Delta hq_{i,t-1}$	-0.014	-0.014	-0.013	-0.018	-0.020	-0.018
	(0.030)	(0.030)	(0.030)	(0.029)	(0.030)	(0.030)
$M_{i,t-1}$	2.658***	5.268***	3.265***	2.551***	5.233***	2.871***
	(0.448)	(0.907)	(0.520)	(0.436)	(0.875)	(0.504)
$M^2_{i,t-1}$	-2.783***	-4.183***	-2.972***	-2.595***	-4.002***	-2.590***
	(0.435)	(0.712)	(0.468)	(0.421)	(0.685)	(0.452)
Constant	-3.090***	-4.232***	-3.458***	-5.589***	-6.914***	-5.845***
	(0.904)	(1.009)	(0.932)	(1.095)	(1.186)	(1.116)
Bank characteristics:						
Log assets $_{i,t-1}$	0.192***	0.196***	0.193***	0.333***	0.343***	0.331***
	(0.048)	(0.049)	(0.048)	(0.061)	(0.062)	(0.062)
Deposits/Assets $_{i,t-1}$	0.002	0.003	0.003	0.004**	0.004**	0.004**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Loans/Assets $_{i,t-1}$	0.006***	0.006***	0.007***	0.010***	0.011***	0.011***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Observations	5,771	5,771	5,771	5,771	5,771	5,771
R-squared	0.421	0.418	0.420	0.451	0.450	0.449
Cluster	Bank	Bank	Bank	Bank	Bank	Bank
Time fixed effect	N	N	N	Y	Y	Y
Bank fixed effect	Y	Y	Y	Y	Y	Y

Note: ***, ** and * denote statistical significance at 1%, 5% and 10% respectively. Standard errors are in parenthesis.

Table 7: Estimation results for Eq. (7) and (8) with the approximated geographical breakdown in loans for use outside Hong Kong

Dependent variable: $q_{i,t}$	(1) $M = hhi$	(2) $M = \hat{s}$	(3) $M = mw$	(4) $M = hhi$	(5) $M = \hat{s}$	(6) $M = mw$
Q_{t-1}	1.258***	1.275***	1.273***	1.296***	1.305***	1.285***
	(0.058)	(0.059)	(0.059)	(0.060)	(0.061)	(0.060)
$\Delta hq_{i,t-1}$	0.658***	0.663***	0.654***	0.650***	0.663***	0.652***
	(0.085)	(0.085)	(0.086)	(0.086)	(0.086)	(0.086)
$M_{i,t-1}$	-0.761***	-1.230***	-0.784***	-2.573***	-3.160***	-1.383**
	(0.189)	(0.262)	(0.165)	(0.519)	(0.949)	(0.539)
$M_{i,t-1}^2$				1.833***	1.595***	0.559
				(0.547)	(0.825)	(0.527)
Constant	-2.132***	-1.701***	-2.160***	-2.208***	-1.436***	-2.145***
	(0.521)	(0.538)	(0.521)	(0.518)	(0.554)	(0.521)
Bank characteristics:						
Log assets $_{i,t-1}$	0.159***	0.155***	0.164***	0.172***	0.165***	0.168***
	(0.026)	(0.027)	(0.026)	(0.026)	(0.027)	(0.026)
Deposits/Assets $_{i,t-1}$	0.006***	0.005**	0.006***	0.005***	0.005**	0.006***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Loans/Assets $_{i,t-1}$	-0.011***	-0.011***	-0.011***	-0.011***	-0.011***	-0.011***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Observations	5,832	5,832	5,832	5,832	5,832	5,832
R-squared	0.403	0.404	0.404	0.405	0.405	0.404
Cluster	Bank	Bank	Bank	Bank	Bank	Bank
Time fixed effect	N	N	N	N	N	N
Bank fixed effect	Y	Y	Y	Y	Y	Y

Note: ***, ** and * denote statistical significance at 1%, 5% and 10% respectively. Standard errors are in parenthesis.

Table 8: Estimation results for Eq. (9) with the approximated geographical breakdown in loans for use outside Hong Kong

Dependent variable: $roa_{i,t}$	(1) $M = hhi$	(2) $M = \hat{s}$	(3) $M = mw$	(4) $M = hhi$	(5) $M = \hat{s}$	(6) $M = mw$
Q_{t-1}	0.116***	0.086**	0.124***			
	(0.038)	(0.039)	(0.039)			
$\Delta hq_{i,t-1}$	0.067	0.048	0.055	0.039	0.021	0.029
	(0.054)	(0.054)	(0.054)	(0.054)	(0.054)	(0.054)
$M_{i,t-1}$	2.949***	7.331***	3.471***	2.520***	6.630***	2.785***
	(0.508)	(1.001)	(0.550)	(0.496)	(0.960)	(0.536)
$M^2_{i,t-1}$	-3.680***	-6.452***	-3.576***	-3.142***	-5.749***	-2.915***
	(0.549)	(0.861)	(0.542)	(0.532)	(0.825)	(0.524)
Constant	-2.833***	-4.249***	-3.328***	-5.621***	-7.040***	-6.094***
	(0.805)	(0.913)	(0.850)	(1.009)	(1.100)	(1.054)
Bank characteristics:						
Log assets $_{i,t-1}$	0.176***	0.176***	0.188***	0.335***	0.337***	0.350***
	(0.042)	(0.043)	(0.044)	(0.056)	(0.057)	(0.058)
Deposits/Assets $_{i,t-1}$	0.002	0.002	0.002	0.003	0.003*	0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Loans/Assets $_{i,t-1}$	0.009***	0.008***	0.009***	0.013***	0.012***	0.013***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Observations	5,788	5,788	5,788	5,788	5,788	5,788
R-squared	0.428	0.428	0.425	0.457	0.457	0.455
Cluster	Bank	Bank	Bank	Bank	Bank	Bank
Time fixed effect	N	N	N	Y	Y	Y
Bank fixed effect	Y	Y	Y	Y	Y	Y

Note: ***, ** and * denote statistical significance at 1%, 5% and 10% respectively. Standard errors are in parenthesis.