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Abstract

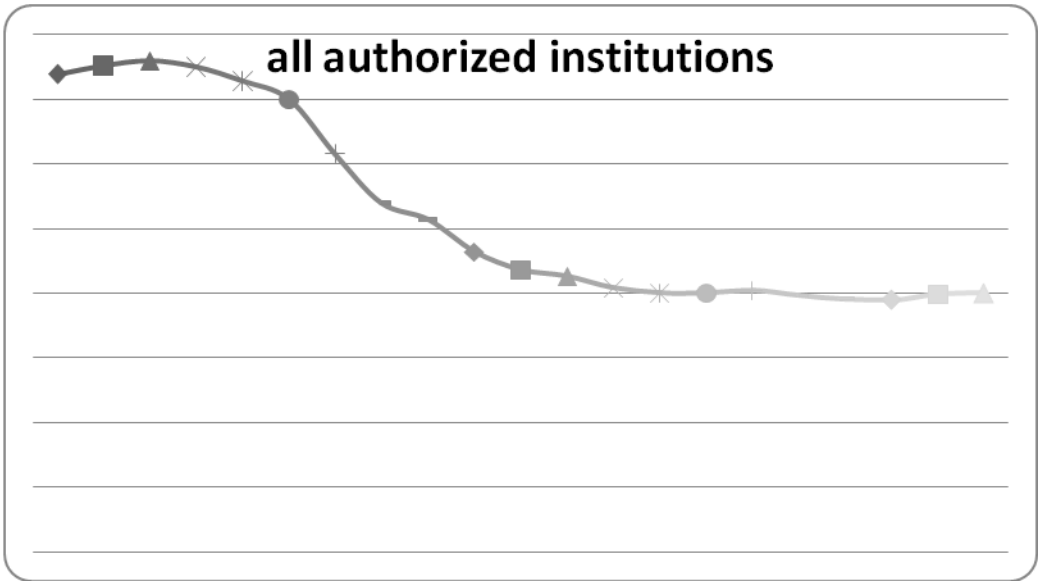
This paper tests the competition structure of Hong Kong's banking industry using the Panzar-Rosse approach and a panel dataset of the largest 20 banks in Hong Kong from 1998 to 2011. The estimation results showed that the competitive pressures were equal across time and across the different sizes of the banks in Hong Kong's banking industry. Competitive pressures may heighten in the near future as banks will seek to gain competitive edge and they can do so through mergers and acquisitions. Regulations are also slowly being relaxed after the financial crisis in order to boost the economy and more advances in technology are also anticipated.

Key words: Competition Banking Industry Panzar-Rosse Approach

1. Introduction

Hong Kong, as an international financial centre, has one of the most concentrated and competitive banking industries in the world. Prior to the year 2000, the number of all authorized institutions in Hong Kong's banking industry was more than three hundred (the highest number is 381 in 1995). But this number keeps decreasing gradually in the recent years. At the end of 2012, the number of authorized institutions in Hong Kong's banking industry was just two hundred. The following figure describes the average number of all authorized institutions in Hong Kong's banking sector each year.

Figure 1 Average number of all authorized institutions



So what are the implications of the deceasing number of banks for the remaining banks? Are they increasing their profit because of larger market shares?

In this paper, we use the Panzar-Rosse approach and a panel dataset of the largest 20 banks in Hong Kong from 1998 to 2011 to test whether competition has a positive effect on the profits of banks. In our analysis we use only 20 banks because out of the 37 ranked banks in Hong Kong, more than 10 were formed after the year 2000 and the data of some banks were not readily available.

Wong et al. (2006) analyse the evolution of competitive conditions of Hong Kong's banking industry for the period 1991 to 2005 by using the Panzar-Rosse assessment. This research claims that competitive pressure was higher among larger banks and lower among smaller banks. This is already an improvement on the study by Jiang et al (2004) who use the aggregate data of the banking sector to check the competitive conditions between 1992 -2002.

In our study, we extend the period from 2005 to 2011 to make a more accurate analysis of how competition affects profit. Of special importance is the year 2008 when there was the financial crisis in the US. At the time, Hong Kong's banking industry came under a great deal of strain and makes 2008 particularly important when analyzing whether competition has a positive or negative effect on banks' profits.

The paper is organized as follows: The literature review of how competition effect banking sector is discussed in part 2. Then we talk about Panzar-Rosse approach in part 3. Part 4 is the data description and part 5 is dedicated to the empirical model. The result and analysis are discussed in part 6. The final part is the conclusion.

2. Literature Review

In 1987, Panzar and Rosse created a method to measure the competitive conditions in the banking industry, which is the H-statistic. This measure is based on the estimated effect of changing input prices on revenue.

The first research applying Panzar-Rosse approach was conducted by Shaffer in 1982. The author analyzed the banking monopoly in New York and found that the value of H ranged from 0.32 to 0.36.

Jiang et al (2004) applied Panzar-Rosse approach to Hong Kong's banking sector and suggested that competitive pressures in the sector may have eased in the later years based on aggregate data of the banking industry.

Jim Wong et al followed up on the study by Jiang et al in 2006. They separated the sample banks into two groups and found that competitive pressure was higher among larger banks and lower among smaller banks.

Other researchers have also studied the effect of competitive conditions on profits of banks using other approaches. John Boyd & De Nicolo (2006) stated that less competitive banking systems are less fragile. While Franklin Allen & Douglas Gale (2003) argued competition leads to less fragility.

Uhde et al (2008) used data from 25 EU countries to prove that national banking market competition has a negative relationship with the revenues of European banks.

Berger et al (2009) also conducted a cross-country study and in this paper they make great suggestions as to how control variables can be chosen.

It is safe to say that across different regions and time, the relationship between competition and banks' profits may differ. We intend to focus on the Hong Kong banking industry and use the past 14 years data to draw conclusions.

3. Theoretical Model

The assumption of the model is that banks will adopt different pricing strategies according to different market structures of input costs. Through the analysis of a bank's profit and input costs, one can determine which market conditions a bank operates in. The Panzar - Rosse method was derived from a general financial market model, which model determines how single bank maximises profit given equilibrium output and equilibrium number of banks.

When marginal cost equals marginal revenue, bank i maximize profits:

$$R_i^{'}(x_i, n, z_i) - C_i^{'}(x_i, w_i, t_i) = 0$$

$R_i^{'}$ represent bank i's margin revenue; $C_i^{'}$ represents bank i's margin cost; x_i represents bank i's output; n is the number of banks; w_i is a vector of unit price; z_i is the bank's profit function of exogenous variables and t_i is the bank's profit function of exogenous variables.

Next, we solve for equilibrium at the market level:

$$R_i^{*}(x^{*}, n^{*}, z) - C_i^{*}(x^{*}, w, t) = 0$$

* *variables represent the equilibrium value*.

Panzar and Rosse use the H index to measure the market power, namely, market structure and competition. H index is measured by income elasticity of the input prices:

$$H = \sum_{k=1}^{m} \frac{\partial R_i^{*}}{\partial w_{ki}} \frac{w_{ki}}{R_i^{*}}$$

The H-statistic is calculated by summing the estimated elasticity of revenue to factor prices, with a value of one indicating perfect competition, a value of zero (or less) indicating monopoly, and intermediate values indicating the degree of monopolistic competition.

Table 1 Meaning of H value

Competitive structure	**Values of H**
Monopoly	H≤0
Monopolistic Competition	0<H<1
Perfect Competition	H=1

4. Data Description

In the Panzar-Rosse framework approach, the H-statistic is the sum of total coefficients of three major inputs which affect the bank's total income.

Table 2 Variables, description and data source

Variables	Description and calculation	Data source
Capital cost	Unit price of Capital - Other Operating expenses/Fixed Asset	Bankscope database
Labour cost	Unit price of Labour - Personnel expenses/Total Asset	Bankscope database
Funds cost	Unit price of Funds – Interest Expense/Deposit (from customers)	Bankscope database
Risk of Asset	(Equity / Total Assets+ROA) / Standard Deviation of ROA	Bankscope database
Asset size	Level of Assets for the banks	Bankscope database
GDP level	Level of GDP	IMF
Inflation rate (inflation)	Inflation rate	IMF

When it comes to the selection of the three major variables, we choose PF (unit price of funds), PL (unit price of labor) and PK (unit price of capital).

First, PF, also called the cost of funding rate, refers to the ratio of interest expense to total funding. If we assume that the main source of funding for banks is customer deposits, then the corresponding cost is interest payment. Therefore, PK should equal total interest expense divided by total deposit from customers.

Second, PL, which stands for cost of labor rate, is computed as the ratio of staff expense to total asset (Bikker and Groeneveld 1998), (Gelos and Roldos 2002). Note that other measures of unit price of labor as the ratio of staff expense to the number of employees are also frequently used.

Third, PK represents the cost of fixed asset. Generally speaking, the total expenses of a bank can be divided into two parts; one is total interest expenses and the other is total non-interest expenses. Total non-interest expenses less personnel expenses is the value of general cost of fixed assets of a bank. Therefore, we can use equation 'other operating expenses divided by fixed assets' to calculate the cost of fixed asset.

In order to study such problem more reasonably, we add another important factor, Z-score in our model. Z-score equals the sum of μ (the return on average assets before taxes, ROAA) and k (the equity capital as a percent of total assets) divided by σ (the standard deviation of

ROAA). Therefore, the Z-score is a combination factor that contains banks' profitability (μ), capital ratio (k) and return volatility (σ).

Generally speaking, these 3 indicators can comprehensively reflect the operating situation of a bank. To be precise, profitability (μ) is an indicator of the profitability of a bank's assets. It is also used to evaluate a bank's performance. Capital ratio (k) is a key financial ratio measuring the financial stability and capital adequacy of a bank. The higher the ratio, the more stable the bank. Compared to the low capital ratio banks, banks with high capital ratio are better able to protect themselves against operating losses. Return volatility (σ), on the other hand, shows the extent of fluctuations in ROAA.

It is clear that the Z-score will increase with μ (the banks' profitability) and k (capital ratio) and decrease with increasing σ (return volatility). From an economic viewpoint, the Z-score measures the probability of a bank going insolvent when the value of assets becomes lower than the value of debt. Hence, a higher (lower) Z-score implies a lower (higher) probability of insolvency risk (Uhde and Heimeshoff, 2008).

Macroeconomic control variables are also important in our model. We include the GDP growth rate and the annual inflation rate (provided by the International Monetary Fund) to capture macroeconomic developments that are likely to affect the quality of banks' assets.

First, GDP growth rate reflects the economic performance of the country and closely related to the banking industry. Hence, we expect a positive symbol of the coefficient that the banks' performances improve in periods of economic prosperity. In addition, borrowers' solvency should be higher under increasing economic performance which in sum raises banks' asset quality.

Second, the inflation rate is also important. Inflation is an increase in general price level and is typically expressed as an annual percentage rate of change. Higher inflation can decrease the real rate of return on assets and then discourage saving but encourage borrowing.

5. Empirical Model

For the purpose of analysis, the panel-data analysis technique is employed as it has the advantage of containing the information necessary to deal with both the intertemporal dynamics and the individuality of the entities being investigated (Aviral and Mihai 2011). There are basically three types of panel-data models, namely, a pooled Ordinary Least Square (OLS) regression, panel model with random effects and panel model with fixed effects.

Using the variables described above, the equation for the pooled OLS regression can be specified as follows:

$$Y_{it} = \alpha_0 + \sum_{k=1}^{k} \alpha_k \left(w_{it}^k\right) + x_{it}\beta + \varepsilon_{it}$$

Where i represents the bank, t represents time and ε represents the error term which is the white noise and varies across banks and time.

However, using the pooled OLS regression technique will not capture the countries' unobservable individual effects. According to Bevan and Danbolt (2004), the inherent differences across the different panels can influence measurements of the estimated parameters. Hence, we use a panel-data model with fixed or random effects to help account for individual peculiarities.

By taking into account countries' peculiarities and variables used, the panel-data model with fixed effects is to be estimated as follows:

$$Y_{it} = \alpha_0 + \alpha_1(PF_{it}) + \alpha_2(PK_{it}) + \alpha_3(PL_{it}) + \beta_1(Risk\ of\ Asset_{it}) + \beta_2(Asset\ Size_{it}) + \beta_3(GDP_{it}) + \beta_4(Inflation_{it}) + w_{it}$$

Where$w_{it} = \mu_i + \varepsilon_{it}$, with μ_i representing the banks' unobservable individual effects. The panel-data model with random effects is described in the same way whilst $w_{it} = \mu_i + \varepsilon_{it}$, where μ_i will have zero mean, independent of individual observation error term ε_{it}, has constant variances, and is independent of the explanatory variables. Y_{it} is the return on assets (Net Income/Asset Size).

6. Estimation Results

We begin by reporting the results of the pooled OLS model. OLS is in fact the most restrictive of all models because it does take into consideration differences in cross-sectional units as it assumes a common intercept for the whole panel. In order to assess whether the pooled OLS model is the correct model to be applied, we conducted the Wald test whose null hypothesis is that all individual effects are zero. The result we obtained rejects the null hypothesis and hence, the OLS estimator is biased and inconsistent. Therefore, we resort to using panel-data model with fixed and random effects (see table below for results).

Table 3 Regression results: what affects the coefficient on profitability of a bank

Variables	Pooled OLS	Fixed Effects	Random Effects
Capital cost (lnpk)	0.0021533***	.00161862***	0.0014547**
Labour cost (dlnpl)	0.0010065	0.00166391	0.0017107
Funds cost (dlnpf)	0.0016744**	.00101839**	0.0013554**

Risk of Asset (riskass)	0.0070527***	.00886992***	0.0083012***
Risk of Asset to the square (riskass*riskass)	-0.0005294***	-.00059603***	-0.0006037***
Asset size (lnasset)	-0.0018177***	-.00762774***	-0.002926***
GDP level (lngdp)	0.0118982*	.02155633***	0.0135348**
Inflation rate (inflation)	-0.0005977*	-.00041827*	-0.0005174*
Constant	-0.1251603^	-.18363149***	-0.1361322*
Hausman Test		Prob>chi2 = 0.0000	
Wald Test		Prob>f=0.0000	
R squared	0.6271	0.78460741	0.6529
Adjusted R squared	0.6161	0.76152963	0.6115
Countries	20 banks		
Observations	280		
Period	1998-2011		
legend: ^p<0.10; * p<0.05; ** p<0.01; *** p<0.001			
Note: The p-value for dlnpl is 0.116 for Fixed Effects			

Despite the fact that the OLS estimators are biased, the results are reported since it does indicate somehow the relationship (positive or negative) between the independent variables and dependent variable.

As for the fixed and random effects models, we need to evaluate which of the two models is the more appropriate to use since they are inherently different as they have different assumptions, as described above. The Hausman specification test is used to choose the better model to be used. According to the test performed, the null hypothesis that the individual effects are not correlated with the other explanatory variables in the model (Hausman 1979) is rejected. Hence, the fixed effect model is more appropriate one to employ, as shown above.

The above results show that capital costs, labour costs and funds costs have a positive relationship with the profitability of the banks. Capital costs and funds costs are significant at 0.1% and 1% level respectively. Labour costs are significant at a 15% level. The risk of asset exerts a positive effect on the profitability of a bank meaning that the more risks a bank takes, the more profits are expected. The above results also show that beyond a certain level of risk, the bank will begin to incur losses since the 'risk of the asset to the square' reports a negative figure and this is significant at a 0.1% level. The above results also show that as the level of asset rises, the profits will be reduced and this is statistically significant. The macro economic variables are also significant in determining the level of profits in the banks: the level of GDP

exerts a positive effect on profitability whereas inflation rate exerts a negative effect, as would be expected since higher level of GDP would indicate economic growth and hence banks should eventually experience higher profits whereas inflation erodes profits level.

We could further determine the level of competition in the banking industry by summing all the αs as mentioned above. The results are demonstrated as follows.

Table 4 Regression results: what affects the coefficient onprofitability of a bank

Variables	All	Small banks	Big banks	1998-2007	2008-2011
Capital cost (lnpk)	.00161862***	0.00038511	.00117835*	0.00115687	-0.00070759
Labour cost (dlnpl)	0.00166391	.003102*	0.00142708	0.00100473	0.00170185
Funds cost (dlnpf)	.00101839**	-0.00044234	.00138233**	.00100028*	.00279774*
Risk of Asset (riskass)	.00886992***	.0065143***	.00909858***	.00978623***	.0070418***
Risk of Asset to the square (riskass*riskass)	-.00059603***	-.00036207***	-.00066703***	-.00063492***	-.00047218***
Asset size (lnasset)	-.00762774***	0.00146217	-.01037001***	-.00623578***	-.01785844***
GDP level (lngdp)	.02155633***	-0.00154212	.02435452***	.01575143*	0.01625235
Inflation rate (inflation)	-.00041827*	-0.00008449	-0.00044785	-0.00044435	-0.00060467
Constant	-.18363149***	-0.00793739	-.19463196**	-0.13137658	0.00207378
R squared	0.78460741	0.89871616	0.80684599	0.80519938	0.94149888
Adjusted R squared	0.76152963	0.88163214	0.7828517	0.77462021	0.9111233
Countries	20 banks	7 banks	13 banks	20	20
Observations	280	98	182	200	80
Period	1998-2011	1998-2011	1998-2011	1998-2007	2008-2011
H statistic	*0.00430092*	*0.00304477*	*0.00398776*	*0.00316188*	*0.003792*
legend: ^p<0.10; * p<0.05; ** p<0.01; *** p<0.001					

We used the Fixed Effect model since the OLS and the Random effects model have been ruled out. We have further tried to determine the level of competition across the sizes of banks and across time. We have categorized the following banks (highlighted in **bold**) as big as they were classified among the 20 largest banks.

Table 5 List of banks

No.	Name of bank	No.	Name of bank
1	**HSBC**	11	Dah Sing Bank
2	**Bank of China**	12	China Construction Bank (Asia)
3	**Hang Seng Bank**	13	Shanghai Commercial Bank
4	**Bank of East Asia**	14	Chong Hing Bank

5	**ICBC (Asia)**	15	Fubon Bank (Hong Kong)
6	**DBS Bank**	16	Chiyu Banking Corporation
7	Nanyang Commercial Bank	17	Public Bank HK
8	**Wing Hang Bank**	18	Orix Asia Limited
9	China CITIC Bank International	19	Allied Banking Corporation
10	Wing Lung Bank	20	Mevas Bank

Source: http://www.asianbanks.net/HTML/Countries/HK/HKrankings.htm

We also tried to analyse the effect of competition across time by splitting the time periods into 2 parts: 1998-2007 and 2008-2011 to see the effects before and after the Financial Tsunami of 2007-2008. The above table summarises the findings. We found that the H-stat ranged between 0.003 and 0.004 across both the big and small banks, and across the different time spans. This indicates that the level of competition in the banking sector is of a monopolistic competition or a partially contestable equilibrium, whereby total revenue rises less than proportionally to the changes in input prices. This does show that the banking sector in Hong Kong is neither a monopoly nor a perfect competition situation as revealed by the statistics. As such, we can deduce that the market is somehow very competitive while it is dominated by a large amount of banks at the same time.

7. Conclusion

This paper determines the main factors that affect the level of profitability in a bank. We have used the Panzar- Rosse approach in order to achieve this. The banking sector in Hong Kong is under a monopolistic situation over the period under review. The estimation results showed that the competitive pressures were equal across time and across the different sizes of the banks. This may suggest that currently banks are equally exposed to the same kind of challenges in maintaining their profitability. Competitive pressures may heighten in the near future as banks seeks to gain competitive edge and they can do so through mergers and acquisitions. Regulations are also slowly being relaxed after the Financial Tsunami in order to boost the economy and more advances in technology are also anticipated. Hence, the competitive pressures need to be closely monitored in the future to avoid any surprises.

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