Bank Competition in Hong Kong, Has the Crisis Made a Difference?

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Abstract: This paper describes an empirical assessment of the bank competition status in Hong Kong during the period of 2005 to 2012. In addition, it examines whether the 2008 financial crisis has changed the competition status in Hong Kong. The Panzar-Rosse approach is applied during estimating the panel dataset of 19 banks in Hong Kong. It divides the whole period of 2005 to 2012 into two separate periods, which are 2005 to 2007 and 2008 to 2012, in order to test for the structural change in 2008. The empirical results of this paper based on Panzar-Rosse indicates that the overall bank competition in Hong Kong during the period from 2005 to 2012 is monopolistic competition which can also be classified as a monopoly or conjectural variation short-run monopoly. The Wald test for the 2008 financial crisis shows that there are statistically changes in the competition condition of the banking sector in Hong Kong. However, both the competition situation of the two periods can be classified as monopolistic competition or monopoly, but the competition condition after 2008 seems higher than that before 2008 from the H-statistic.

1. Background

Good competitive conditions of the banking sector could have a positive effect on the economy. For example improve the economy efficiency and reduce the costs of the financial intermediation as well. While over-competition, on the other hand, could make a negative impact. It will lower the profitability of each bank in the market, and influence the market capacity as well. In addition, when the economy is going downturn and some unfavorable developments are brought to banks, banks ability to withstand situations like this will be weakened. Therefore, competition status among banks is very important for policy makers, as well as for depositors and investors. What is more, it is important for them to know how the competition status developed over time, especially during and after crisis [1].

Hong Kong is one of the largest international financial centres. It provides investors and customers from different countries with a comprehensive network of markets and financial products. Learning from the lessons of the previous financial crisis, the financial market of Hong Kong nowadays is operated under transparent and effective regulations, as well as a good risk control.

Financial crisis can exposed the weakness of the banking system. Meanwhile, it enhances the ability that the system can withstand the crisis as well. Through the historical financial crisis happened in Hong Kong, it has established a rigorous and comprehensive credit policy and regulatory system. This includes a discreet mortgage policy, credit risk control, and liquidity regulation. The subprime crisis began in 2008 has made great influences towards the world's major financial markets, including Hong Kong. It led to the world liquidity shortage, overall collapse of large financial institutions, the aid of banks by governments all over the world, and the world's stock markets' bust. Such a crisis like this would have some impact on the banking sector in Hong Kong, and the policy makers as well as investors would like to see the influence of it [2].

2. Methodology and literature review

2.1. Methodology

Panzar-Rosse model was an unstructured analytical method which brought forward by Rosse and Panzar [3]. It is also known as H Statistical method. The assumption of the model is that banks develop different pricing strategies according to the input costs determined by various kinds of

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market structures. Therefore, through the analysis of the change of elastic towards the total revenue and input prices, the type of the market structure in which the bank in can be determined. So firstly, in order to satisfy the maximization of the banks profit:

$$R'_i(x_i, n, z_i) - C'_i(x_i, w_i, t_i) = 0 \tag{1}$$

Where R stands for the marginal revenue of bank i; C is the marginal cost of bank i; x is the input prices; w is a series of vector of variable x; n is the number of banks and t is the exogenous variables of costs of bank i.

Secondly, it has to be in equilibrium from the market level, which means it should meets the constraints of zero profits:

$$R^*_i(x^*, n^*, z) - C^*_i(x^*, w, t) = 0 \tag{2}$$

Where the star (*) stands for the equilibrium value of the variables. H can be calculated as:

$$H = \sum_{k=1}^{m} \frac{\partial R^*_i}{\partial w_{ki}} \frac{w_{ki}}{R^*_i} \tag{3}$$

Also, through another way, H-statistic can also be calculated from a reduced form of revenue equations and it is used to measure the sum of a firm's revenue with respect to input prices [4]. The reduced form of the log-linear revenue equation is shown as follows:

$$\ln R_{it} = \alpha_0 + \sum_{j=1}^{J} \alpha_j \ln w_{jit} + \sum_{k=1}^{K} \beta_k \ln X_{kit} + \sum_{n=1}^{N} \gamma_n \ln Z_{nt} + \varepsilon_{it} \tag{4}$$

Where R is the total revenue of bank i at time t; W are the input prices; X are for different bank-specific variables that may affect the revenue and cost functions of the banks; Z stands for macro variables which may influence the banking market; and the last item is a stochastic disturbance term. In this equation, $H = \sum_{j=1}^{J} \alpha_j$.

As the H statistic is a decreasing function of demand elasticity, it will increase when the degree of competition among the market increases. Panzar and Rosse conclude that when H is negative (H<0), the market structure is monopolistic, which includes oligopoly with collusion and a conjectural variations short-run oligopoly. Under these conditions, marginal costs will increase and equilibrium output and total revenue will decrease when there is an increase in input prices. When H is between 0 and 1 (0<H<1), the market is monopolistic competition. When H statistic is equal to 1 (H=1), then the market belongs to perfect competition. Under this situation, both marginal and average costs increases then the increase in input prices, and the selling price and total revenue rise by the same amount as the costs because of the adjustment of demand in the long run.

A critical feature and limitation for the H statistic is that tests must be undertaken on data from observations which indicates that markets are in long-run equilibrium [5]. The equilibrium test is based on a regression which replaced the revenue on the left-hand-side of the previous equation with pretax profits to total assets (ROA), which is shown as follows:

$$\ln \pi_{it} = \alpha'_0 + \sum_{j=1}^{J} \alpha'_j \ln w_{jit} + \sum_{k=1}^{K} \beta'_k \ln X_{kit} + \sum_{n=1}^{N} \gamma'_n \ln Z_{nt} + u_{it} \tag{5}$$

So when $E = \sum_{j=1}^{J} \alpha'_j = 0$, the market is in long run equilibrium; when E<0, the market is in disequilibrium. The following table 1 summarizes the interpreting of the H statistic.

Table 1 Interpreting the Panzar-Rosse H Statistic

Competitive Environment Test	
H<=0	Monopoly or conjectural variation short-run monopoly

0<H<1	Monopolistic Competition
H=1	Perfect competition or natural monopoly in a perfectly contestable market, or sales maximizing firm subject to a break even constraint
Equilibrium Competition Test	
E<0	Disequilibrium
E=0	Equilibrium

2.2. Applications of Panzar-Rosse method

Currently, many researchers have made use of Panzar Rosse model to measure degree of market competition towards the same country or cross-border of the banking sector. Shaffer (1982) made one of the first adoptions using the Panzar-Rosse method to banking sector. He applied a series of cross-sectional researches [3]. And he examined the competitive status towards a sample of banks in New York banking market.

Nathan and Neave (1989) assessed the status of competition among Canadian financial services industry. They examined the competition of different sectors, like banks, trust companies and mortgage companies. And they used the cross-sectional data for three years of 1982, 1983 and 1984. In their findings, they found that H equals to 1.058 for commercial banks in Canadian in 1982, H equals to 0.680 in 1983 and H equals to 0.729 in 1984. So they concluded with that the competition among banks in Canadian was not monopoly (except in 1982) and not perfect competition.

Lloyd-Williams, Molyneux and Thornton (1994), who first estimates the competition condition of the European market using the Panzar Rosse approach. They carried the estimation on units of banks in French, German, Italian, Spanish and UK during the period of 1986 to 1989. Among their conclusion, they just point out that the competition of banks in Spain is medium monopolistic competition.

Bikker and Haaf (2002) did the research among banks of 23 OECD countries from the year 1988 to the year 1998. What is worth to mention is that they divided banks to large banks, medium-sized banks and small banks depending on their sizes and compared the competition status among the three types. Specifically, they pointed out that large banks were supposed to operate in international environment, medium-sized banks were then just operated national and small banks are just for regional purpose.

Claessens and Laeven (2004) conducted one of the broadest samples to research the bank competition among 50 developing countries during the period between the year 1994 to 2001. They computed the H-statistic for fifty developed and developing countries altogether. They found monopolistic competition could be the best description of the markets in their conclusion. Then, they also pay attention to the presence of foreign banks, activity restrictions, entry regime, market structure, and competition from the non-bank sector, general macroeconomic conditions and overall development of the country.

Buchs and Mathisen (2005), conduct an estimation using the data set from the annual individual bank balance sheets and income statements from 20 banks in operation among 8 African countries during the period between 1998 and 2003. From the estimation, they found that the average H-statistic of all specifications of all banks in Ghana is 0.555. And the H statistic for un-scaled specifications and scaled specifications were 0.627 and 0.482, respectively. In conclusion, they found that in addition Ivorian is a monopoly, the rest of the country are in a state of monopolistic competition.

Manthos D, Delis (2008) did research in the competitive conditions for banks of CEE countries between 1999 and 2006 using the Panzar Rosse approach. They concluded that these banks showed competitive and other non-competitive features of competition. They also considered that bank's income was largely affected by structural and macroeconomic conditions.

Goddard and Wilson (2009) empirically used the fix effect model (FE), and Gaussian mixture model (GMM) to examine the H statistics of banks from Canada and other six countries during the period between 1998 and 2004. They showed that the revenue and price equations lead to different results of the H statistic. They thought that the measurement of H statistic of Panzar-Rosse model

should use dynamic revenue equation, rather than static. However, both the two methods measuring the H statistic is close to zero.

3. Data and estimation methods

3.1. Data resources and explanations

The dataset used in the estimation is a panel dataset of 19 licensed banks incorporated in Hong Kong covering the period from 2005 to 2012. According to Hong Kong Monetary Authority, licensed banks in Hong Kong are one of the three types of authorized institutions in Hong Kong licensed under the Banking Ordinance. They are the only institutions permitted to carry on banking business in Hong Kong. Licensed banks may operate current and savings accounts, and accept deposits of any size and maturity from the public and pay or collect cheques drawn by or paid in by customers. The banking data are collected and calculated from the financial reports, which obtained from the bankscope, and collected from Monthly Statistical Bulletin and Economic & Financial Data for Hong Kong from the Hong Kong Monetary Authority.

In this paper, the following equation is estimated to derive the H statistic from a panel dataset of banks in Hong Kong:

$$\ln R_{it} = \alpha_0 + \sum_{j=1}^{J} \alpha_j \ln w_{jit} + \sum_{j=1}^{J} \delta_{jit} D_{jit} \ln w_{jit} + \sum_{k=1}^{K} \beta_k \ln X_{kit} + \sum_{n=1}^{N} \gamma_n \ln Z_{nt} + \varepsilon_{it} \quad (6)$$

All the variables are in natural logarithms. The dependent variable R is the revenue of bank i at time t; w is the input prices; D is the dummy variable, in order to examine the difference between the years before and after the 2008 financial crisis, here set D=1 for the years between 2008 and 2012 (including the year 2008), and set D=0 for the years before 2008; X is the bank-specific variables that affect the bank's revenue and cost functions; Z is the macro variables that affect the banking market as a whole; and the last term is a stochastic disturbance term.

In addition to the first equation, an equation to test if the market is in long run equilibrium will also be estimated by:

$$\ln \pi_{it} = \alpha'_0 + \sum_{j=1}^{J} \alpha'_j \ln w_{jit} + \sum_{1}^{J} \delta'_{jit} D'_{jit} \ln w_{jit} + \sum_{k=1}^{K} \beta'_k \ln X_{kit} + \sum_{n=1}^{N} \gamma'_n \ln Z_{nt} + u_{it} \quad (7)$$

Revenue is measured as gross revenue which includes both interest and non-interest incomes. This is consistent with other studies such as Shaffer (1982), Nathan and Neave (1989), Hempell (2002) and Jim Wong (2004).

In this paper, there are three factor inputs of banks, which are labor, funds, and capital. The unit price of labor is computed as the ratio of personnel cost to total assets which is in accordance with Molyneux et al. (1994) and Jim Wong (2004). And it reflects the overall intermediation activities undertaken by banks. The unit price of funds is calculated by the ratio of total interest expense to total deposits from the customers. Also, the unit price of capital is derived as the ratio of expense other than personnel and interest expenses to fixed assets [6].

Bank-specific factors are factors that reflect differences in risk and funding structures. They are included into the model because that they can control for other heterogeneities in the samples. These bank-specific variables which have been used previously by researchers include total assets, the ratio of provisions to total assets [7], bank's deposit mix, which is the ratio of deposits from customers to bank's total funding, and capital adequacy ratio. Here, in this paper, capital adequacy ratio (CAR) and total assets (ASSET) are used as bank specific factors. The reason chooses these two variables are that total assets are being a proxy for bank size and capital adequacy ratio can be a proxy for bank risk. For the CAR, the coefficient estimate is expected to be negative. That is because that as a lower level of bank risk, for example, a higher value in CAR, there would be lower bank revenue.

In addition to the bank characteristics, there are also macro variables which affect the banking market as a whole. Here, the real GDP growth rates in Hong Kong are considered in both equations above in order to control for the influence of economic cycles. Generally, banks should generate larger revenue with the same quantities of inputs under good economic conditions.

3.2. Analysis of the data

The standard tools of competition economists and competition authorities to measure market concentration are the Herfindahl index (HHI) and the concentration ratios [8]. Concentration ratio is a measure of the total output produced in an industry by a given number of firms in the industry. It is usually used to show the extent of market control of the largest firms in the industry and to illustrate the degree to which an industry is oligopolistic [9]. Herfindahl index (HHI) is a measure of the size of firms in relation to the industry and an indicator of the amount of competition among them. According to Jim Wong, Eric Wong, Tom Fong and K. F. Choi (2006), the Herfindahl index (HHI) is the sum of the squared market shares of assets of all retail banks. So it would range from zero to one. Both the HHI index and the concentration ratio are the common indicators of market structure. They suppose a positive relationship between market concentration and market power — fewer and larger firms (higher concentration) are more likely to engage in anti-competitive behaviour [10]. Below (Table 2) is a description of the concentration ratios and HHI index based on the market share of assets upon Hong Kong from 2005 to 2012. Figure 1 shows the asset market shares of the largest 2, 5 and 10 banks. Figure 2 shows the trend of the Herfindal index.

Table 2 CRs and HHI for the biggest two and biggest five banks (assets-based)

Year/ Measure	CR2	CR5	CR10	HHI
2005	0.5987	0.7968	0.8988	2532.5102
2006	0.5388	0.7994	0.9151	2600.6498
2007	0.5496	0.7979	0.9163	2716.8050
2008	0.5545	0.8085	0.9197	2770.4000
2009	0.5431	0.8041	0.9190	2655.7358
2010	0.5435	0.8102	0.9238	2614.9894
2011	0.5390	0.7967	0.9231	2584.2549
2012	0.5378	0.7957	0.9218	2582.7972

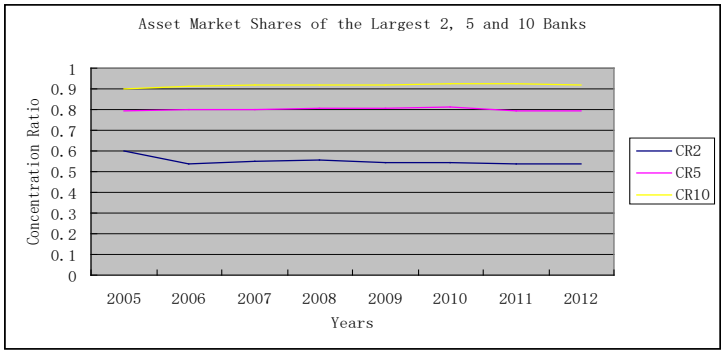

Figure 1 Asset market shares of the largest 2, 5 and 10 banks

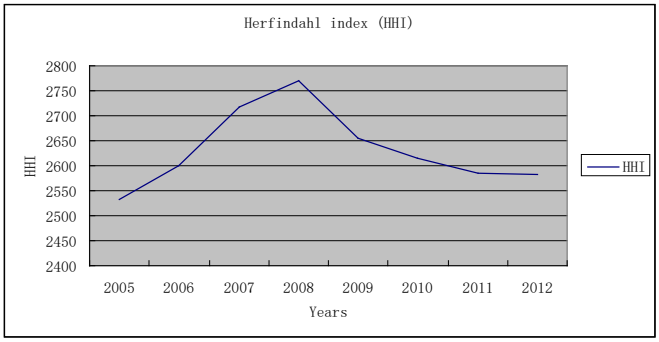

Figure 2 Herfindal index

From Table 2, the largest two banks which are Hong Kong and Shanghai Banking Corporation Limited and Bank of China (Hong Kong) Limited account for 59.87% market shares of total assets. Concentration ratios of the largest 2 and largest 5 banks in Figure 1 are almost between the range of 50% to 80%, while the concentration ratios of the largest 5 banks of the year 2008, 2009 and 2010 are a little bit higher than 80%. This range of ratio presents a medium concentration and an industry in this range is likely an oligopoly.

Also, the HHI index proved this. From 2005 to 2012, the entire HHI indexes are over 2500, which indicate high concentration in the market and an industry of high oligopoly.

Overall, there do not show much change in the concentration ratios based on the market shares of asset of the largest 2, 5 and 10 banks in Hong Kong during the period of 2005 and 2008 from Figure 1. But from the table (Table 2), slight changes can be found that from the year 2008, concentration ratios declined a little compared to the years before 2008. This change is much more obvious upon the change of the HHI index. As is shown in Figure 2, we can clearly see that before the year 2008, HHI index of HK banks are increasing, which from 2532.5102 in the year 2005 to 2770.4000 in the year 2008. However, from the year 2008, there is a steady decline of the HHI, which drop to 2582.7972 in 2012. So from these two ratios, it seems that the crisis happened in 2008 produce some influences upon the market concentration Hong Kong banking.

However, the concentration ratio and the HHI index may not accurately predict the condition of the market. Because these standard measures of market concentration can only be used as raw indicators of competitive conditions in the banking sector. For example, bank concentration ratios (CR) only take the market shares of a small number of large banks into account. The Herfindahl index (HHI) emphasizes the importance of larger banks by giving them a higher weight than smaller banks [11]. There is mixed empirical evidence towards the positive relationship between market concentration and the exercise of market power. For a contestable market with no barriers to entry, banks may not be able to exploit market power even in a highly concentrated market due to the threat of potential competition [12].

To analysis the data collected for the estimation, the following Figure 3, 4 and 5 shows the change of average profit before tax of the top five and bottom five banks in Hong Kong during the sample period. Here, the orders of the banks are set by the value of their total assets. There is a significant drop both among the top five and the bottom five banks in Hong Kong in the year 2008. Among the top five banks, the average profit before tax is 26610.6 million HK dollars in 2007, but fell to 19688.2 million HK dollars in 2008. Similarly, the average profit before tax of the five bottom banks in Hong Kong are declined by 410.44 million dollars in the year 2008 as well. However, after the decline in 2008, it shows a sudden steady grow in the next few years. And in the year 2008, it increase to 34601.6 million HK dollars among the top five banks, which is even higher before the crisis happened in 2008. The profit before tax also increased to 883.22 million HK dollars among the bottom five banks by 2012 but still no more than the value of 2007.

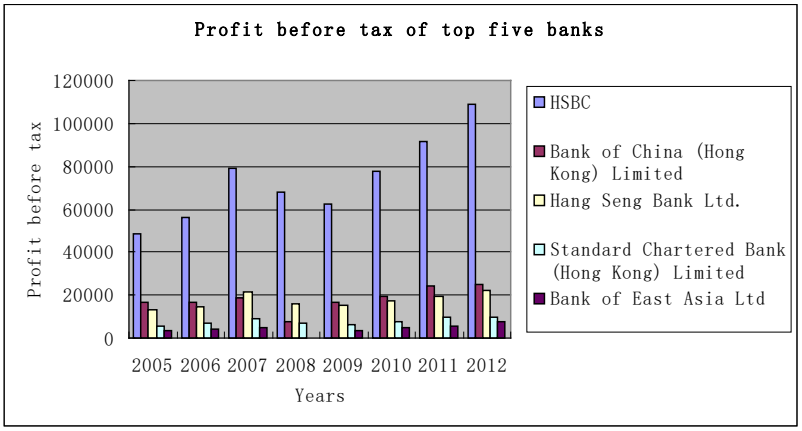

Figure 3 Profit before tax of top five banks

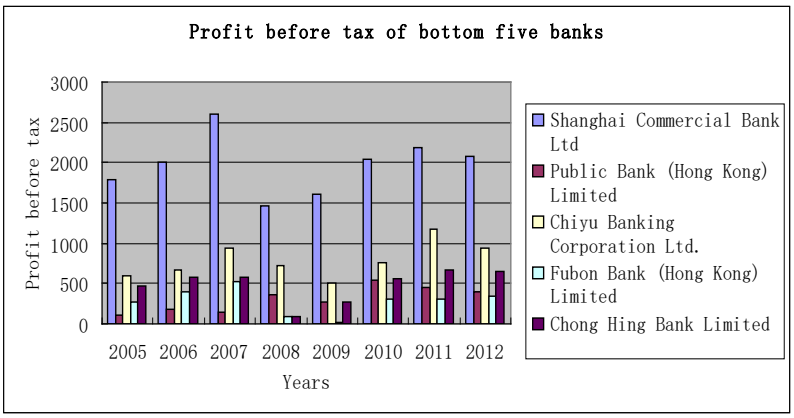

Figure 4 Profit before tax of bottom five banks

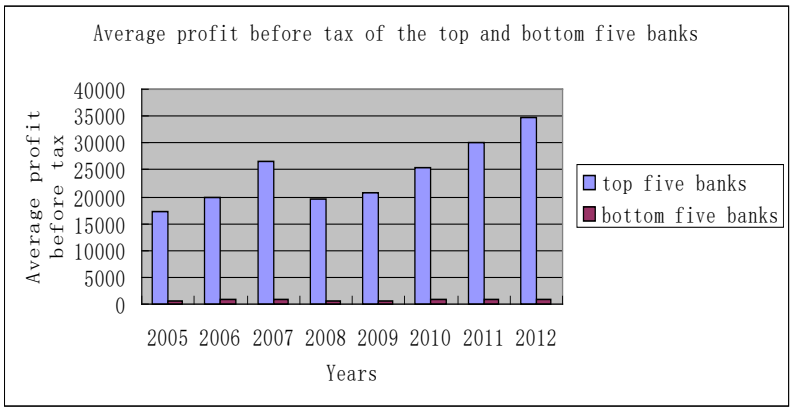

Figure 5 Average profit before tax of the top and bottom five banks

Figure 6 shows the change of average ROA of the top five and bottom five banks. Like the profit before tax, return on assets indicates the same but more obvious trend. The ROA of the top five banks in Hong Kong shows a plunge between 2007 and 2008. In 2007, the ROA is 1.7954, which is still in a steady growth according to the previous years, but in 2008, it sharply fell to 0.985. This also happened among the bottom five banks, which drop 0.4694 during the year 2008. However, the top five banks undertook a smooth increase after the decline in 2008. In the year 2012, the average ROA of the top five banks grows to 1.3038 from 2008, which is still less than the value of the year 2007. The average ROA of the bottom five banks in Hong Kong, on the other hand, undertake a slight fluctuation, and reach 1.0028 by 2012.

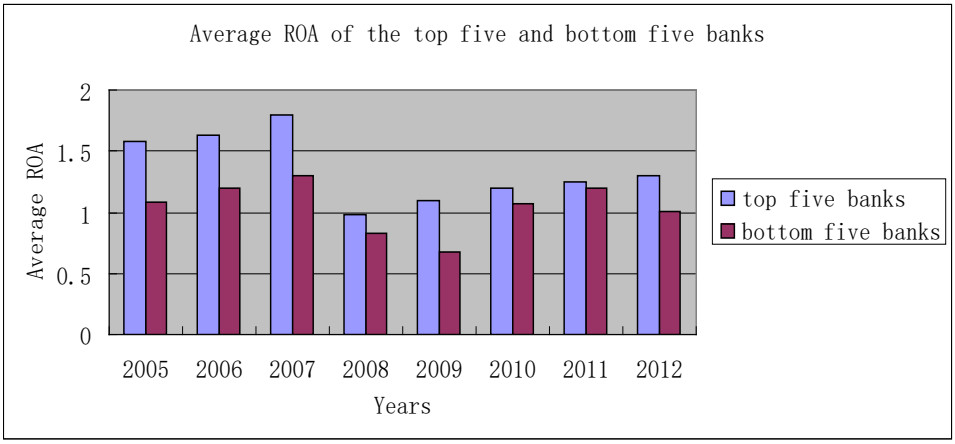

Figure 6 Average ROA of the top five and bottom five banks

4. Estimation results and analysis

There are four models in total for estimation. The first two of them is to test that whether the banking market of Hong Kong is in long-run equilibrium. One of them is the equilibrium test on the estimation of the overall competition situation in Hong Kong. The other one of them is the equilibrium test on the estimation with a dummy variable towards the 2008 financial crisis. The subsequent two models are H-statistic test which test the competition status in banking sector of Hong Kong. One of them is to test the overall competition situation of banks in Hong Kong during the whole period from 2005 to 2012. The other one of them is to test the impact of the 2008 financial crisis, with a dummy variable, D, which equals to 0 when at the years before 2008 and equals to 1 when at the years after 2008 (including the year 2008).

All the above four models are estimated by the panel dataset and in the first difference form, except for the capital adequacy ratio (CAR) and the GDP growth rate. Taking the first difference form can help reduce the individual effects and numbers of parameters to be estimated. This also avoids the chance that they may be correlated to the explanatory variables.

During estimating the equation, the method of the ordinary least square (OLS) is used. And during the OLS procedure, in order to avoid the heteroskedasticity, a cross-section fixed effect with a cross-section weighs is applied. Eviews 7.0 is used to do the related estimation of the model.

Empirical results of the four models are shown in table 3 and table 4, respectively.

Table 3 H-statistic Test of the Overall Competition Status and its Equilibrium Test

	H-statistic Test	Equilibrium Test
Independent Variables	Regression Results Sample Period: 2005 to 2012 Dependent Variables Revenue	Regression Results Sample Period: 2005 to 2012 Dependent Variables Return on Assets
Constant	-4.760466* (1.487406)	-1.974735 (1.479770)
Unit price of labor	0.086872 (0.198514)	-0.128288 (0.208211)
Unit price of fund	0.141267* (0.033247)	0.157377* (0.032654)
Unit price of capital	0.059947 (0.038789)	0.087236** (0.041033)
Total Assets (TA)	1.037832* (0.088388)	0.099866 (0.087461)
CAR	6.892910* (1.420114)	6.265346* (1.413357)
GDP	3.175207* (0.605742)	3.244831* (0.601681)
H-statistic	0.288086	0.116325
Test for H=0	CANNOT REJECT	CANNOT REJECT
F-test	(P=0.1257)	(P=0.5550)
Test for H=1	REJECT	---
F-test	(P=0.0002)	---
Number of banks	19	19
F-statistic	265.1148	12.65795
Adjusted R-squared	0.977184	0.654037
DW statistics	2.215703	2.343895
Number of observations	149	149

Notes: 1. *, **, and ***means statistical significance at 1%, 5%, and 10%, respectively; 2. Numbers in brackets are standard errors unless specified.

The above table 3 shows the empirical results of the overall Hong Kong banking competition status. It contains both the H-statistic test and its equilibrium test. The first column shows the different kinds of independent variables. The second column is the empirical results of the H-statistic test with the dependent variable of revenue from 2005 to 2012. The last column describes the empirical results of the equilibrium test with the dependent variable of return on assets from 2005 to 2012. There are 149 observations in total among 19 banks.

Firstly, from the equilibrium test, the adjusted R squared statistic, which measures the goodness of fit, is 0.654037. This could be considered as satisfactory for the models are given in the first

difference form. F-statistic is significant under the 99% confidence level within estimation; however, several independent variables do not pass the test 10% significance level, which means there is multicollinearity. After all, the equilibrium test shows that it cannot reject the null hypothesis of H0=0, which indicates the long run equilibrium. Based on this, the estimation of the H-statistic test is taken.

Secondly, from the empirical results of the regression on revenue, the adjusted R squared statistic is 0.977184, which shows a high level of goodness of fit. The F-statistic is also significant under the 99% confidence level. The unit price of labor and unit price of capital do not pass the 10% significance test. All the other independent variables are significant at the 1% level, except the GDP growth rate, which are significant at the 10% level, which suggests that the overall regression is reliable. The coefficients of all three input prices are positive, which in line with other findings of the developed banks systems. The unit price of fund which is significant, contributes more to the elasticity of input prices. The coefficients of the two bank specific variables, which are capital adequacy ratio and the total assets, are all positive. The positive coefficient of the total assets indicates that banks with larger total assets can produce higher revenue. The coefficient of GDP growth rate also shows a positive relationship with revenue.

The test shows that the market can be described as monopolistic competition and near to a monopoly, for the H statistics is 0.288086, which is between 0 and 1. The hypothesis of H=1 under the Wald test is rejected at the 1% level (P=0.0002), which means the market cannot be described as a perfect competition; however, it cannot be rejected that H=0 under the Wald test at the 1% level (P=0.1257), which suggests that the market can be classified as a monopoly. Therefore, even though the H statistic is equal to 0.288086, it can be described as monopoly, for the degree of competition situation is relatively low.

Table 4 H-statistic Test including the Dummy Variable and its Equilibrium Test

	H-statistic Test	Equilibrium Test
Independent Variables	Regression Results Sample Period: 2005 to 2012 Dependent Variables Revenue	Regression Results Sample Period: 2005 to 2012 Dependent Variables Return on Assets
Constant	-8.886583* (1.471804)	-5.490598* (1.425632)
Unit price of labor	0.148692 (0.211581)	-0.038084 (0.205569)
Unit price of fund	-0.102893 (0.097347)	-0.039951 (0.089854)
Unit price of capital	-0.037857 (0.051185)	0.002529 (0.050892)
DUM*Unit price of labor	0.064978 (0.068038)	0.120327*** (0.064150)
DUM*Unit price of fund	0.045086 (0.098650)	-0.025568 (0.091745)
DUM*Unit price of capital	0.060596 (0.044775)	0.042479 (0.044221)
Total Assets (TA)	1.349828* (0.101149)	0.397074* (0.098230)
CAR	7.205396* (1.536176)	5.505179* (1.459853)
GDP	1.253016*** (0.680220)	1.355821** (0.628892)
H-statistic before 2008 (H1)	0.007942	-0.075506
H-statistic after 2008 (H2)	0.178602	0.061732
Test for H1=0	CANNOT REJECT (P=0.9670)	---
Test for H1=1	REJECT (P=0.0000)	---
Test for H1=0	CANNOT REJECT (P=0.3358)	---
Test for H1=1	REJECT (P=0.0000)	---
Test for change H0: H1=H2	REJECT	---
F-test	P=0.0009	---
Test for H=0	---	CANNOT REJECT
F-test	---	P=0.6888 for H1 P=0.7355 for H2
Number of banks	19	19
F-statistic	190.5853	15.13290

Adjusted R-squared	0.971899	0.720538
DW statistics	2.235151	1.959057
Number of observations	149	149

Notes: 1. *, **, and ***means statistical significance at 1%, 5%, and 10%, respectively; 2. Numbers in brackets are standard errors unless specified.

The above table 4 shows the empirical results of the H-statistic test for the difference of the competition before and after the 2008 financial crisis for the sample period of 2008 to 2012 and its equilibrium test as well. As the same with table 3, the first column shows the different kinds of independent variables. Then the second column is the empirical results of the H-statistic test with the dependent variable of revenue from 2005 to 2012. And the last column describes the empirical results of the equilibrium test with the dependent variable of return on assets from 2005 to 2012. There are 149 observations in total among 19 banks as well for the two models.

Firstly, from the equilibrium test, the adjusted R-squared statistic, which measures the model's goodness of fit, equals to 0.720538. This indicates a relative high goodness of fit. The F-statistic is 15.13290, which is significant at the 1% significance level. As the existence of the dummy variable, there are two H-statistic to be tested. They are the H1 which related to the competition situation of banks in Hong Kong before 2008, and H2 which related to the bank competition in Hong Kong after 2008. Under the Wald test, which test the long-run equilibrium of the competition status, the null hypothesis of H1=0 cannot be rejected (P=0.6888), and the null hypothesis of H2=0 cannot be rejected as well (P=0.7355). This refers to the model is in long run equilibrium. And the H-statistic test can then be taken based on this.

Secondly, from the empirical results of the regression on revenue, the adjusted R squared statistic is 0.971899, which shows a fair level of goodness of fit and can be considered as satisfactory. The F-statistic is also significant under the 99% confidence level, which is equals to 190.5853. As what has been described above, there are two H statistics to be tested because of the existence of the dummy variable. As with the coefficients of the independent variables, several of them do not pass the test 10% significance level, which means there is multicollinearity. The coefficient of the unit price of labor is positive as well; however, the coefficients of the unit price of fund and unit price of capital are negative. The relationship between the dummy times input prices and revenue are all positive. Other bank specific variables like CAR and total assets are both positive and significant at 1% level. The GDP growth rate is significant at 10% level and has a positive relationship with revenue.

The test shows that both the competition conditions before and after 2008 financial crisis can be described as monopolistic competition, which much near to a monopoly. The H-statistic before 2008 is 0.007942, which is between 0 and 1. But the hypothesis of H1=0 under Wald test cannot be rejected (P=0.9670). The hypothesis of H1=1 can be rejected at 1%. Similarly, the H statistic after 2008 is 0.178602, which is also between 0 and 1. However, the hypothesis of H2=0 cannot be rejected while rejecting the hypothesis of H2=1 at 1% significance level as well. The competition status after 2008 seems higher than that before 2008 (H1<H2).

From the H-statistic, it shows that the bank competition in Hong Kong after 2008 is slightly higher than that before 2008. To estimate the statistical significance of the change in H statistic over the two periods, the hypothesis of H1 = H2 is tested under Wald test. From table 4 we can see that the hypothesis is rejected at 1% level (P=0.0009). This suggests that the competition condition is statistically different between the two periods.

5. Conclusion

This paper re-visits the competition situation of banks in Hong Kong. Compared to the previous studies, this paper updates the data with a panel dataset of annual data from 2005 to 2012, and examines if the 2008 financial crisis has made a difference to the bank competition in Hong Kong. It divides the whole period of 2005 to 2012 into two separate periods, which are 2005 to 2007 and 2008 to 2012. The empirical results of this paper based on Panzar-Rosse approach concludes that the H-statistic is between 0 and 1, and cannot reject the hypothesis that H=0. This indicates that the

overall bank competition in Hong Kong during the period from 2005 to 2012 is monopolistic competition which can also be classified as a monopoly or conjectural variation short-run monopoly. The Wald test for the 2008 financial crisis shows that there are statistically changes in the competition condition of the banking sector in Hong Kong. However, the competition conditions before and after 2008 are still the same. The H-statistics are between 0 and 1, and neither can be rejected by the hypothesis of H=0. So both the competition situation of the two periods can be classified as monopolistic competition or monopoly, but the competition condition after 2008 seems higher than that before 2008 from the H-statistic.

Because of various kinds of reasons, there are some limitations in this paper and the results got in this paper are not that consistent with the previous studies, which indicate that the bank competition in Hong Kong is more like monopolistic competition with a relative higher H-statistic.

The reasons of this may include: Firstly, there is a relative short sample period in this paper. As most of the statistics are obtained from the bankscope and the HKMA, there are limited years of statistics can be used, which are just from 2005 to 2012. But the Panzar-Rosse estimation usually needs a large panel dataset with a wide range of years, so the results may be influenced.

Secondly, the estimation is to examine the competition status during a relative special period, which includes the 2008 financial crisis. As is known to all, this crisis brings a recession to the economy and lasts for a long period. So the statistics within the sample period may be abnormal than other periods and give out different outcomes.

After all, banks in Hong Kong has withstood many threatens of financial and economic crisis. They are developing with a moderate speed in order to create a much better competition environment. Banks in Hong Kong have already set up a rigorous and comprehensive credit policy and regulatory system. However, in order to face more opportunities and threatens in the future, they need to learn from the lessons and improve themselves as well.

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