Are Bigger Banks More Profitable
than Smaller Banks?

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Abstract

In this study, we apply Panel Threshold Model (Hansen, 1999) to examine whether there is optimal asset scale for interest spread to affect banks' profits. The empirical results demonstrate the existence of three thresholds, which divide banks into four groups into four groups according to asset scale. When asset scales of banks are in the 3rd capital group, banks profit by the widening in loan-deposit interest spread. For the other three groups, however, the relationship between profit and loan-deposit spread is negative. Banks' return on equity (ROE) is positively correlated with net commission income, net invest income, net non-operating income, and net interest income.

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1   Introduction

In the 1970s, developed countries in the western world started for financial deregulation, and most countries follow the trend of financial liberalization. Facing the rapid changes in financial environment, Taiwan also deregulated her restrictions on financial institutions and markets. In 2005, there are 44 commercial banks in Taiwan. Under the competitive environment, banks tend to narrow down the loan-deposit spread to widen their market shares, and it further makes banks less profitable and increasing in the non-performing loan ratio.

Taiwan is one of the most overbanking and fragmented country in Asia. Although the leading commercial banks control 2/3 of Taiwan's banking assets, some of the smaller banks are likely to be absorbed by stronger players or forced out of the industry because of fierce competition, eroding pricing power and profit margins, and many of the banks' best corporate customers are decamping to mainland China. As Taiwanese banks have been forbidden to follow their customers, the authorities in Taipei are pressing for banking reform. Domestic bank consolidation in Taiwan began in 2001 when the Financial Holding Company Act was enacted. This law encourages consolidation in the industry by allowing the formation of financial holding companies. In 2002, the government announced a renewed push to consolidate its banking sector, encouraging combinations between financial holding companies as well as acquisition of smaller banks. The goal of the reform is to reduce the existing 14 financial holding companies in Taiwan to seven by the end of 2006. Domestic consolidation in Taiwan is likely to occur either through merger among the big state-owned banks, or by private-sector acquisition of state-owned banks. The state-sector restructuring will be driven by the government which has announced the goal to reduce the number of state-run banks from 12 to six by end of 2005 with the establishment of an M&A task force for the banking industry. Market forces will drive private-sector acquisitions of state-owned banks, and takeover action will happen only when further regulatory reform becomes affirmative. Few

private-sector banks would be willing to risk an acquisition without a government guarantee that the state would absorb future losses from emerging non-performing loans.

In this paper, we explore whether the impact of loan-deposit spread on banks' profitability is different for banks with different sizes. Hameetemam et al. (2000) find negative relationship between bank size and net profit before income tax. Similarly, Allen and Rai (1996) show that small banks have advantages for economy of scale. On the contrary, Hunter and Timme (1986) indicate positive relationship for size of bank assets and non-traditional banking profit. Haslem et al. (1983) also show that the better a bank performs, the higher the more stable net interest margin.

Generally speaking, literatures distinguish banks' business into traditional deposit and loan, and non-traditional business. Diamond (1984) and Gorton and Rosen (1995) point out that a bank's role is an intermediate to transfer money from depositors to borrowers. Relatively, Rogers and Sinkey (1999) define non-traditional activities of banks as generating income from activities, including stock underwriting, cash management and wealth management. Rogers (1998) measure banks' revenue, profit, and cost efficiency, and shows that banks' profit efficiency and cost efficiency are increased and revenue efficiency is reduced if non-traditional banking income is included in the model. It implies that banks engaging in non-traditional banking increase profit efficiency and cost efficiency but reduce revenue efficiency. Rogers and Sinkey (1999) apply regression analysis to investigate 8,931 commercial banks in the U.S. from 1989 through 1993. They show that the degree banks involved in non-traditional is positive to their scales. In all traditional indicators of profitability, return on equity (ROE) is generally considered as the most important and representative indicators. Venkartraman and Ramanujam (1986) divide performance into three types: financial, business, and organizational. Financial performance, which commonly includes return on total assets (ROA), ROE and earnings per share (EPS), is the measurement to achieve

business financial objectives. Brewer (1990) concludes the negative relationship between risk and investment in non-banking subsidiary of banks. Although Demirguc-Kunt and Huizinga (1999) point out that return-adjusted return on capital (RAROC) is a better measurement that ROA because most banks in developing are protected by government and thus make their capital low and result in banks' ROE over-stated. However, the Taiwanese government does not involve in banks' capital management after the financial reform and the opening up of financial services industry. Therefore, we apply ROE as the proxy for profitability of banks.

Olson and Sollenberger (1978) decompose revenue changes of a bank into operating income and non-interest income. Furthermore, Ho and Sauders (1981) point out that the bank interest margin (i.e., spreads) depends on market structure, competition, the average amount per transaction, and assets and liabilities nominal interest rates. Haslem et al. (1983) conclude that better performed banks have higher net interest margin and stable growth rate. In addition, better performed banks reduce their operating costs by controlling their non-interest expense. Flannery (1981) indicates that most commercial banks in the U.S. tend to borrow in long-term and loan in short-term, and short-term and long-term interest rate fluctuations do not significantly influence banks' profits. Samuelson (1945) show banks profit more in interest rates rising than in interest rates descending, and commercial banks are more profitable than savings banks. Similarly, Hancock (1985) demonstrates that raise in interest rates will increase the profits of banks, namely, to lending rate elasticity is higher than deposit rate elasticity. However, Silverberg (1973) holds the opposite view that interest rates will reduce bank profits and increase the risk. Hamweck and Kilcollin (1984) show that small banks have short-term advantage when interest rates rise. Moreover, descending in interest rates may result in slow loan growth and loan losses. For large banks, net interest income is less sensitive to the change of interest rates. For smaller banks, however, the net interest income decreasing may result in reducing loan growth

and loan losses during the period of decline in interest rates. Thus small banks are difficult to maintain profitability during market interest rates decline than raise.

2   Data

Other than traditional studies that decompose banks' profits into traditional and non-traditional profits, we break banks' profits down into net interest income, net fee income, net investment income, net operating income. In addition, we add ratio of overdue loans, rediscount rate, asset size, and loan-deposit interest spread as control variables. The dependent variable is ROE, which is banks' profitability proxy concerned by investors. We then explore if there is a threshold of asset size, and further a threshold of interest margin to influence banks' profitability.

We obtain the data from Taiwan Economic Journal (TEJ), and the study period is from the 1st of 2000 through the 4th quarter 2009. We focus on the commercial banks, thus the industrial banks are excluded. Therefore, this study sample includes 34 banks with a total of 40 quarters. The data are cross-sectional and longitudinal time series, namely balance panel data.

3   Methodology: Threshold Autoregression (TAR)

In this paper, spreads on bank deposits and loans interest rates may differently affect banks' profitability for different asset sizes. In general, the larger size of a bank's assets, the greater economy of scale and profitability of the bank. The deposit and loan interest rate spreads have a positive impact on bank profitability if other conditions remain unchanged. However, a bank can hardly deposit and loan if its asset scale is not large enough when the spread of the bank deposits and loans interest rate is wide. Furthermore, as a bank increases its asset size, the bank loan to low-credited and thus increasing in asset may result in

diminishing marginal utility-scale. We expect there is a threshold (γ_1) of the size of bank assets. The relationship between spreads of banks deposits and loans interest rates and profitability is negative below the threshold (γ_1), while the relationship is positive between the threshold (γ_1) and the threshold (γ_2). Due to over-increased asset size, the relationship is negative for the asset size beyond the threshold (γ_2).

According to Hansen (1999), we set the empirical threshold model as follows:

$$v_{it} = \begin{cases} \mu_i + \theta' h_{it} + \alpha_1 s_{it} + \varepsilon_{it} & \text{if} \quad s_{it} \le \gamma_1 \\ \mu_i + \theta' h_{it} + \alpha_2 s_{it} + \varepsilon_{it} & \text{if} \quad s_{it} < \gamma_2 \end{cases} \tag{1}$$

$$\theta = (\theta_1, \theta_2)', \quad h_{it} = (SP_{it}, NC_{it}, NII_{it}, NIR_{it}, NOI_{it}, NNOR_{it}, NPL_{it}, RR_{it})'$$

where v_{it} is ROE, s_{it} is asset scale and the measure of threshold, γ is the threshold value. h_{it} is the control variable vector, which includes:

(1) SP_{it}: spread on bank deposits and loans interest rate;

(2) NC_{it}: net fee income;

(3) NII_{it}: net interest income;

(4) NIR_{it}: net investment income;

(5) NOI_{it}: other net revenue income;

(6) $NNOR_{it}$: net non-revenue income;

(7) NPL_{it}: over-due loan ratio;

(8) RR_{it}: market interest rate. In addition, μ_i is the fixed effect to capture the heteroskedastivity of banks under different management, ε_{it} is the error term, and the expected value is 0, and σ^2 is the variance and $\varepsilon_{it} \sim iid(0, \sigma^2)$.

(1) is identical to:

$$p_{it} = \mu_i + \theta' h_{it} + \alpha_1 s_{it} I(s_{it} \le \gamma_1) + \alpha_2 s_{it} I(s_{it} > \gamma_2) + \varepsilon_{it} \tag{2}$$

where I(.) is an indicator function.

That is, $p_{it} = \mu_i + \theta' h_{it} + \alpha' s_{it}(\gamma) + \varepsilon_{it}$, or

$$v_{it} = \mu_i + \beta' x_{it}(\gamma) + \varepsilon_{it} \qquad (3)$$

where

$$s_{it}(\gamma) = \begin{bmatrix} s_{it} I(s_{it} \le \gamma_1) \\ s_{it} I(s_{it} > \gamma_2) \end{bmatrix} \text{ and } \alpha = (\alpha_1, \alpha_2)', \ \beta = (\theta', \alpha')', \text{ and } x_{it} = (h'_{it}, s'_{it}(\gamma))'.$$

Since there may exists three threshold, (1) may be modified to:

$$v_{it} = \begin{cases} \mu_i + \theta' h_{it} + \alpha_1 d_{it} + \varepsilon_{it} & \text{if } d_{it} \le \gamma_1 \\ \mu_i + \theta' h_{it} + \alpha_2 d_{it} + \varepsilon_{it} & \text{if } \gamma_1 < d_{it} \le \gamma_2 \\ \mu_i + \theta' h_{it} + \alpha_3 d_{it} + \varepsilon_{it} & \text{if } \gamma_2 < d_{it} \le \gamma_3 \\ \mu_i + \theta' h_{it} + \alpha_4 d_{it} + \varepsilon_{it} & \text{if } d_{it} > \gamma_3 \end{cases} \qquad (4)$$

where $\gamma_1 < \gamma_2 < \gamma_3$. Furthermore, we may extend the model to mutli-threshold:

$(\gamma_1, \gamma_2, \gamma_3, \gamma_4 \cdots \gamma_n)$.

4   Empirical Results

4.1 Single threshold model

As Table 1 shows, the asset size threshold (γ) is 16.9998. The threshold divide the observations into two blocks: when the asset size (r_{it}) is less than 16.9998, the t-statistic of β_1' in homogeneous and heterogeneous standard deviation is -5.9925 and -3.7998 respectively, and they are significant at 1% level. It shows highly significant and negatively correlated. Similarly, when the asset size (r_{it}) is greater than 16.9998, the t-statistic of β_2' in homogeneous and heterogeneous standard deviation is -3.3255 and -3.1122 respectively, and they are also significant at 1% level. Since β_1' and β_2' are both significantly negative at 1% level, it demonstrates that the relationship for the impact of deposit and loan

interest rate spread on a bank's profit is negative, no matter its asset size is below or beyond the threshold.

Table 1: Single Threshold Model

Threshold Estimate				16.9998	
	Value	Homogeneous S.D.	Hetergeneous S.D.	t-statistic 1	t-statistic 2
$\hat{\beta}_1^{'}$	-899.0625	139.3568	218.5521	-5.9925***	-3.7998***
$\hat{\beta}_2^{'}$	-217.0232	59.2159	62.1423	-3.3255***	-3.1122***

Note: ***, **, * respectively indicates significance at 1, 5, 10 percent.
    The parameter $\hat{\beta}_1^{'}$ and $\hat{\beta}_2^{'}$ denote for the regressor coefficient below and beyond the threshold respectively.

4.2 Multiple threshold model

We estimate the thresholds by (4). As Table 2 shows the three thresholds which are 16.9998 and 23.8886, which divide the observations into four blocks: the first is the case as asset size is less than 16.9998, the second is the case as asset size is between 16.9987, 23.8977, and 25.0025. In the first, the second, and the third case, we find that $\hat{\beta}_1^{'}$, $\hat{\beta}_2^{'}$, and $\hat{\beta}_4$ are all significantly negative at 5% level ($\hat{\beta}_1^{'}$ and $\hat{\beta}_2^{'}$ at 1% level) for both homogeneous and heterogeneous standard deviation estimation. However, we find that $\hat{\beta}_3$ is significantly negative at 1% level for both homogeneous and heterogeneous standard deviation estimation.
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Table 2: Multiple Threshold Model

	Value	Homogeneous S.D.	Hetergeneous S.D.	t-statistic 1	t-statistic 2
Fixed Tresholds			23.8977		25.0025
Threshold Estimate			16.9987		
Thresholds			16.9987	23.8977	25.0025
$\hat{\beta}_1^{'}$	-798.6796	139.2215	218.2765	-6.0012***	-3.1776***
$\hat{\beta}_2^{'}$	-151.2017	59.6627	66.2557	-2.3252**	-2.2787**
$\hat{\beta}_3$	1395.1728	177.7085	359.1155	7.9921***	3.8927***
$\hat{\beta}_4$	-198.8035	80.7881	73.2379	-2.9925***	-2.8053***

Note: ***, **, * respectively indicates significance at 1, 5, 10 percent.

The parameter $\hat{\beta}_1^{'}$, $\hat{\beta}_2^{'}$, $\hat{\beta}_3$ and $\hat{\beta}_4$ denote for the regressor coefficient for the four thresholds respectively.

Therefore, the empirical results show that when the asset size is less than 16.9987, the deposit and loan interest rates spread for bank profitability has a negative correlation between the asset. On the other hand, if the asset size is greater than 23.8977 and less than 25.0025, the relationship is positive. Furthermore, the relationship becomes negative again when the asset size is greater than 25.0025.

4.3 Robustness

Table 3 demonstrates the comparison for single, double, and triple-threshold models, and we apply the 100 times bootstrap. As Table 3 shows, the hypothesis of no double-threshold is not rejected at 10% significance level. The hypotheses of single and triple-threshold, however, are rejected at 10% significance level. Furthermore, we find that the F-Statistic of the triple-threshold model is largest among the three models, and it implies that we may reject the null hypothesis of no threshold effects for triple thresholds at a higher significance level.

Table 3: Robustness Test of Thresholds

Single Threshold			Double Thresholds			Triple Thresholds		
16.9998			17.0027 and 25.1753			16.9987, 23.8977, and 25.0025		
F-Statistic 45.3328			F-Statistic 12.1287			F-Statistic 55.6735		
p-value		0.00	p-value		0.17	p-value		0.00
Critical value	10%	15.1841	Critical value	10%	15.4675	Critical value	10%	23.8793
	5%	19.0608		5%	17.2022		5%	44.0976
	1%	27.4374		1%	23.0286		1%	52.8572

Note: ***, **, * respectively indicates significance at 1, 5, 10 percent.
     F-Statistics and p-values are obtained from bootstrapping 100 times.

As Table 4 shows, we find that net fee income, net interest income, net investment income, other net revenue income, and net non-revenue income have positive impacts on banks ROE at 5% significance level. In addition, over-due loan ratio has negative impact on ROE. These findings are straight forward and it shows consistency for the triple-threshold model.

Table 4: Tests for Control Variables: Triple Thresholds

	Value	Homogeneous S.D.	Hetergeneous S.D.	t-statistic 1	t-statistic 2
$\hat{\theta}_1$	2.6969	1.1355	1.6952	1.5875	1.4965
$\hat{\theta}_2$	82.5677***	23.0025	27.8521	3.6365	2.8954
$\hat{\theta}_3$	59.8757***	12.1158	13.0251	5.3814	3.9558
$\hat{\theta}_4$	129.3355***	22.9965	27.0011	5.8756	4.7824
$\hat{\theta}_5$	44.8844***	9.6023	13.0799	4.8815	3.6597
$\hat{\theta}_6$	47.0988**	9.8875	20.2277	5.0127	2.2051
$\hat{\theta}_7$	-2.9521**	1.0023	1.6521	-2.3597	-1.8998
$\hat{\theta}_8$	-0.2358	0.3567	0.3552	-0.8475	-0.6992

***, **, * respectively indicates significance at 1, 5, 10 percent

5   Conclusion

This study aims to analyze the profitability of banks by Hansen (1999) through asset size as threshold to empirically examine the existence of asymmetric non-linear relationship.

We take ROE as a proxy for bank profitability, bank assets as the threshold variable. The empirical results show that there are triple thresholds, the threshold values are 16.9987, 23.8977, and 25.0025, the size of the asset banks is below the threshold 16.9987 or greater than 25.0025, the relationship between bank's deposit and loan interest spreads and bank's profitability is negative. However, if it is between 23.8977 and 25.0025, the relationship is positive. Thus, it demonstrates the optimum size of banks.

In addition to deposit and loan interest spreads, fee income, net investment income, net non-operating income, other net operating income, net interest income also influence bank profits, and overdue loans reduce banks' profitability.

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