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DYNAMIC PERFORMANCE EVALUATION OF BANKING INDUSTRY IN TAIWAN AFTER MERGERS

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Abstract

In order to become a member of WTO, Taiwan first passed the Financial Holding Company Act (FHCA) in 2001 to implement reform in the financial system and enhance the global competitiveness of domestic financial institutions. This study divided 33 banks into two groups based on whether they belong to financial or non-financial holding companies. Using a dynamic DEA model, we compared the operating efficiency of the two groups and then compared the operating efficiency of the 33 banks individually. The most significant difference between this study and existing literature is that this study encompasses an M&A boom and global economic crises during its fifteen-year-long study period. Furthermore, we screened carry-over as link variables using Cross Correlation periods Lag 1 and Lag 2, and our study model provides an optimal efficiency evaluation standard. The empirical results indicate that (1) The av-

erage operating efficiency of banks under financial holding companies paralleled rather than exceeded that of banks under non-financial holding companies in 2016. (2) The average capital of banks in Taiwan was already very close to the optimal projected capital; equity turnover was low due to underutilized capital. We also examined the low efficiency indicators of input and output in our study. (3) Cash capital increase presented the operating efficiency of small banks (under non-financial holding companies) more clearly than mergers. (4) Bank mergers in Taiwan did not induce restrictive competition; the mergers of smaller banks with poor efficiency under non- financial holding companies created inefficiency and should be controlled. The results of this study provide the competent authority of competition law with reference for law and regulation development.

Keywords: Finance, Banking, efficiency, dynamic DEA, carry-over, Competition law, Merger

(Editor's Note: section of this article are in single column format to facilitate easier reading of the complex formulas.)

Introduction

Following the international trend of financial liberalization, Taiwan has gradually relaxed its financial market regulation since the 1980's. After the 1997 Asian Financial Crisis, more comprehensive financial reforms were implemented and these financial reforms have significantly changed the domestic financial environment.[1] Due to the opening of the financial environment, people can hold foreign assets in foreign currency or other forms of assets through intermediary financial institutes. Taiwan first passed the Financial Holding Company Act (FHCA) in 2001 to implement reform in the financial system and enhance the global competitiveness of domestic financial institutions. The introduction of the FHCA instigated a whirlwind of financial institution mergers. Financial holding companies cover a wide range of industries including banking, insurance, and securities. Banks are the primary source of income for financial holding companies; the success of bank operations can determine the operational performance of controlling financial holding companies. After Taiwan began allowing new banks in 1991, a number of banks opened, and the financial market turned from an oligopoly to perfect competition. In 2016, there were 16 banks under financial holding companies and 17 banks under non-financial holding companies.[2]

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[1] Since 1978, Taiwan's foreign exchange market has changed from a fixed exchange rate system to a managed floating exchange rate system. In 1980, 1985, and 1986, the government of Taiwan gradually dissolved its control and regulation of bank interest rates for deposits and loans. In 1987, capital control was significantly relaxed, and the regulation of current accounts was discontinued. Additionally, to adapt to the trends of international financial development and improve the domestic financial environment, Taiwan formed the Financial Reform Task Force in 2002. The first financial reform measures were implemented in 2001 to 2003, followed by a second set in 2004 to 2008.

[2] After Taiwan adopted FHCA, 16 Financial Holding Companies (FHCs) were founded. Taiwan Government encourages the foundation of FHCs with the hope for FHCs to collect more capital and professional management personnel in order to make more profits that meets operation efficiency. There are 16 commercial banks under FHCs and there are also commercial banks under 17 non-financial holding companies which capital is smaller and only focuses on banking industry. The two groups comprise 33 commercial banks and the paper compares the efficiency value of the two groups.

Bank mergers increase capital scale and market share, which leads to restrictive competition.[3] If the definitions and conditions of the Fair Trade Act (FTA) are met, then approval must be obtained from the competent authority of the FTA before mergers are conducted. The competent authorities of competition law in many countries believe that this type of overall economic advantages is an advocacy of efficiency.[4] Previous studies have not performed a comprehensive review of policies in the 15 years and actually verified the mergers approved by the FTA. Thus, the contribution of this study lies in its empirical investigation of 33 banks in Taiwan across a period of 15 years from 2002 to 2016.

This study examined the operating efficiency of banks under financial and non-financial holding companies from 2002 to 2016 and investigated the correlation between operating efficiency and the merger partner. It is hoped that the empirical results regarding the operating efficiency of the 33 banks can provide the FTA with reference in formulating laws and regulations and handling merger cases.

This study examined 33 domestic banks under financial and non- financial holding companies from 2002 to 2016. The banking services provided by these banks included deposits and loans, bond trading, securities brokerage and dealing, and foreign exchange. When borrowers repay their loans, the bank's cash increases and is available for loans. When loans decrease, the bank must also adjust their deposit.

Bank profit converted to capital, loans may be Non-Performing Loan (NPL). Thus, an interdependent relationship exists between the input and output of banks. Furthermore, banking with multiple inputs and outputs that can be either desirable (good) or undesirable (bad). However, static DEA cannot be used to measure the relative efficiency of DMUs across several consecutive time periods.

Demand deposits accounted for 34.37% of deposit and remittances in the 33 banks, which means that as much as 34.37% during the year comprises non-uniformly distributed deposits and withdrawals. Furthermore, time deposits accounted for 44.29% of deposits and remittances which means 44.29% of similar stock properties. Deposits are also not always made at the beginning of the current period, repaid during the current period, or even repaid years later.[5] On average, 23.81% of short-term loans, which must be repaid within a fiscal year. Mid-term and long-term loans accounted for 72.78% on average, which means that these loans last several years. Both have a deferred effect that sets the banking industry apart from other industries. The fact that our sample period covers 15 years, traditional DEA is not applicable to our study.

Researchers that have applied DEA to banking include Rhoades (1993), Miller and Noulas (1996), Canhoto and Dermine (2003), Sufian and Majid (2007), Chortareas, Girardone, and Ventouri (2013), and Tsionas, Assaf, and Matousek (2015), while Sengupta (1994), Nemoto and

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[3] The competition law in Taiwan is called the Fair Trade Act (FTA).
[4] OECD Competition Committee, Competition Policy and Efficiency Claims in Horizontal Agreements (Dynamic Efficiencies in Merger Analysis, 2008).

[5] The discounts and loans of the 33 banks include discounts and overdrafts (0.6%), short-term loans (23.81%), mid-term and long-term loans (72.78%), and other (2.81%).

Goto (1999), Sengupta (1999), Nemoto and Goto (2003), Chen and van Dalen (2010), Kao (2013, 2014), and Lee, Peng, and Fu (2015) adopted dynamic DEA. Tone (2010) developed a dynamic DEA with weighted measurement and defined a carry-over activity called the slacks-based measurement (SBM) approach. The design of SBM models allows non-uniformly distributed inputs and outputs, which therefore makes it appropriate for this study. Prior studies have not taken consideration of non-radial, non-oriented and slacks related issues. The paper adopts Tone (2010) with consideration of non-radial, non-oriented and slacks to provide more precision to the merger cases reviewed by competent authority of competition law, which will offer more potential benefits to the evaluation of merger cases.

Regarding the development of DEA, Farrell first proposed the use of single inputs and outputs to measure technical efficiency. In 1978, Charnes, Cooper, and Rhodes presented the CCR model, which uses multiple inputs and outputs to measure technical efficiency. It was then that this method of estimation began to be referred to as data envelopment analysis (DEA). Farrell's model and the CCR model both assume constant returns to scale in all decision making units (DMUs). However, in reality, the returns to scale may be increasing, decreasing, or constant. Banker, Charnes, and Cooper thus developed the BCC model in 1984, which is a modification of the CCR model to address variable returns to scale. The models above estimate the technical efficiency of the current period. However, when DMUs change with time, static DEA is no longer applicable, thereby leading to the development of dynamic DEA. Miller and Noulas (1996) employed dynamic DEA to study 201 major commercial banks (total assets over US 1 billion) in the US from 1984 to 1990. They decomposed technical efficiency into pure technical efficiency and scale efficiency and found that (i) the 201 large banks presented lower average efficiency (including technical efficiency and scale efficiency) than that in previous research by roughly 5%, (ii) banks overly large in scale presented decreased returns, and (iii) large banks had lower profits and pure technical efficiency. Some researchers incorporated uncertainty factors and quasi-fixed inputs into the model. For instance, Sengupta (1999) , Nemoto and Goto (1999), Sueyoshi and Sekitani (2005) included variable inputs and quasi-fixed properties into the framework. In other words, dynamic DEA should be used when interdependent relationships exist between the inputs and outputs. Seiford and Zhu (2002)、Kao(2013) mentioned that an industry has desirable (good) and undesirable (bad) characteristics, and the dynamic properties of carry-overs are overlooked, then efficiency will be slightly overestimated. The studies above all indicate that ignoring dynamic properties and carry-over results in the overestimation of efficiency.

Due to the non-uniform distribution of inputs and outputs, carry-over properties, and the fifteen-year-long sample period, we referred to the dynamic DEA model developed by Tone (2010) and used three inputs, three outputs, and two carry-overs to calculate and compare the operating efficiency of banks under financial and non-financial holding companies and

the operating efficiency of 33 banks individually.

Model and Data

Model

The DEA methods used to gauge efficiency across periods include window analysis and Malmquist (1953). Window analysis was proposed by Klopp in 1985, while the Malmquist Index was developed by Färe, Grosskoft, Norris, and Zhang (1994). However, neither mention linking activities among consecutive periods. Later, Nemoto and Goto (1999, 2003), Sueyoshhi and Sekitani (2005), Chen (2009), Kao (2009),and Chang et al. (2009) developed dynamic DEA, and Tone (2010) incorporated SBM into dynamic DEA. The resulting model is non-oriented, and it can process inputs and outputs individually. This means that the model is suitable for non- uniformly distributed inputs and outputs, and different weights can be assigned to the inputs and outputs depending on their degree of importance. Tone divided carry-overs into four types for the analysis foundation of dynamic DEA models: (1) desirable (good), (2) undesirable (bad), (3) discretionary (free), and (4) nondiscretionary (fixed). DEA model variables can be divided into three categories: input, output, and non-oriented, and SBM can be used to identify the optimal solution.

This study utilized the model established based on the assumptions of Tone and Tsutsui (2010), which include T periods and n DMUs, each of which has different inputs, outputs, and carry-overs in period t and period t links to the next period, t+1.

The details of the model are as follows:
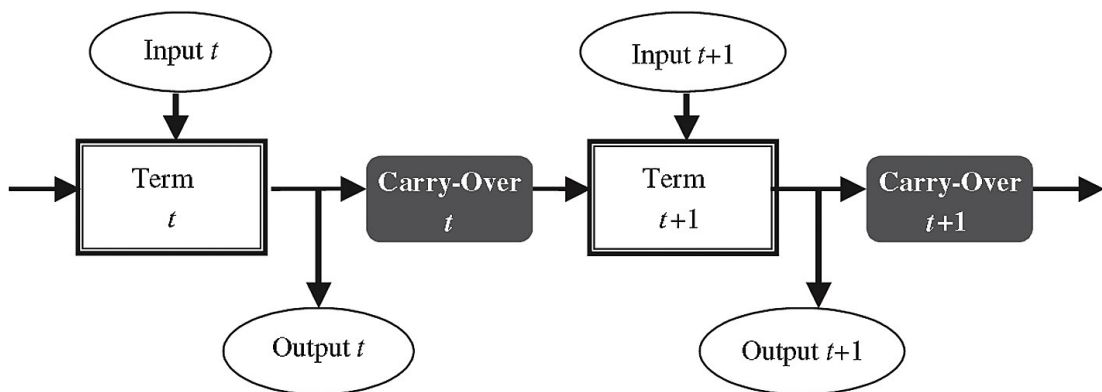
Let n DMUs (j = 1 ... ..n) over T terms (t = 1 .... T)

There are m inputs (i = 1, k, m) of the DMUs,

F: non-discretionary (fixed) inputs (i = 1, k, f)

S: output (i = 1, k, s)

P: non-discretionary (fixed) outputs (i = 1, k, p)

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z: link (carry over) has good, bad, free and fix four categories

w: weight

Following is the non-oriented model:

$$\Theta_0^* = \frac{\min\left(\frac{1}{T}\sum_{t=1}^{T} W^t \left[1 - \frac{1}{m+nbad}\left(\sum_{i=1}^{m}\frac{W_i^- s_{it}^-}{x_{iot}} + \sum_{i=1}^{nbad}\frac{s_{it}^{bad}}{z_{iot}^{bad}}\right)\right]\right)}{\frac{1}{T}\sum_{t=1}^{T} W^t\left[1 + \frac{1}{s+ngood}\left(\sum_{i=1}^{s}\frac{W_i^+ s_{it}^+}{y_{iot}} + \sum_{i=1}^{ngood}\frac{s_{it}^{good}}{z_{iot}^{good}}\right)\right]} \tag{1}$$

$$\sum_{j=1}^{n} z_{ijt}^\alpha \lambda_j^t = \sum_{j=1}^{n} z_{ijt}^\alpha \lambda_j^{t+1} \ (\forall i; t = 1, \dots, T-1) \tag{2}$$

shows the connection equation of t and t + 1

$$x_{iot} = \sum_{j=1}^{n} x_{ijt}\lambda_j^t + s_{it}^- (i = 1, \dots, m; t = 1, \dots, T)$$

$$x_{iot}^{fix} = \sum_{j=1}^{n} x_{iot}^{fix}\lambda_j^t (i = 1, \dots, f; t = 1, \dots, T)$$

$$y_{iot} = \sum_{j=1}^{n} y_{ijt}\lambda_j^t - s_{it}^+ (i = 1, \dots, s; t = 1, \dots, T) \tag{3}$$

$$y_{iot}^{fix} = \sum_{j=1}^{n} y_{iot}^{fix}\lambda_j^t (i = 1, \dots, p; t = 1, \dots, T)$$

$$z_{iot}^{good} = \sum_{j=1}^{n} z_{iot}^{good}\lambda_j^t - s_{it}^{good} (i = 1, \dots, ngood; t = 1, \dots, T)$$

$$z_{iot}^{bad} = \sum_{j=1}^{n} z_{ijt}^{bad}\lambda_j^t + s_{it}^{bad} (i = 1, \dots, nbad; t = 1, \dots, T)$$

$$z_{iot}^{free} = \sum_{j=1}^{n} z_{ijt}^{free}\lambda_j^t + s_{it}^{free} (i = 1, \dots, nfree; t = 1, \dots, T)$$

$$z_{iot}^{fix} = \sum_{j=1}^{n} z_{ijt}^{fix}\lambda_j^t (i = 1, \dots, nfix; t = 1, \dots, T)$$

$$\sum_{j=1}^{n} \lambda_j^t = 1 \qquad (t = 1, \ldots, T)$$

$$\lambda_j^t \geq 0, s_{it}^- \geq 0, s_{it}^+ \geq 0, s_{it}^{good} \geq 0, s_{it}^{bad} \geq 0 \text{ and } s_{it}^{free}:free(\forall i, t) \qquad (4)$$

Here is the solution with most efficient

$$\Theta_{0t} = \frac{1 - \frac{1}{m + nbad}\left(\sum_{i=1}^{m} \frac{w_i^- s_{iot}^{-*}}{x_{iot}} + \sum_{i=1}^{nbad} \frac{s_{iot}^{bad*}}{z_{iot}^{bad}}\right)}{1 + \frac{1}{s + ngood}\left(\sum_{i=1}^{s} \frac{w_i^+ s_{it}^{+*}}{y_{iot}} + \sum_{i=1}^{ngood} \frac{s_{iot}^{good*}}{z_{iot}^{good}}\right)} \qquad (i = 1, \ldots, T) (5).$$

Data source and description

This study examined 33 banks in Taiwan (Table 1) from 2002 to 2016.[6] As all of these banks are publicly traded, full adoption of the International Financial Reporting Standards (IFRS) for financial statements began in 2013, so their financial statements were later consistent in format. To fully and fairly represent the true financial conditions of the banks, we based on analyses on their consolidated financial statements, the reporting bodies of which are the banks themselves and the subsidiaries under them. Consolidated financial statements also eliminate the transactions, revenue, expense, income and losses among subsidiaries and thus give us a good look at their efficiency.

Table 1. Sample bank

Panel A. Banks under non-FHCs
Chang Hwa Bank [CHB][a], Standard Chartered Bank (Taiwan) Limited [SCBL],King's Town Bank [KTB], Taichung Commercial Bank [TB], Taiwan Business Bank [TBB],Bank of Kaohsiung [BOK], Union Bank of Taiwan [UBT], Far Eastern International Bank [FEIB], Entie Commercial Bank [ECB], Sunny Bank [SB], O-Bank [OB], Hwatai Bank [HB],COTA Bank [COTAB], Land Bank of Taiwan [LBOT], Bank of Panhsin [BOP],Taipei Star Bank [TSB], The Shanghai Commercial & Saving Bank [SCSB]

Panel B. Banks under FHCs
KGI Bank [KGIB], TC Bank [TCBK], Shin Kong Bank [SKB], Cathay United Bank [CUB],

Taipei Fuban Bank [TFB], Hua Nan Bank [HNB], CTBC Bank [CTBC],Mega International Commercial Bank [MICB], First Commercial Bank [FCB],E.Sun Commercial Bank [ESCB], Taishin International Bank [TIB], Bank Sino Pac [BSP],JihSun Bank [JSB], Yuanta Bank [YB], Taiwan Cooperative Bank [TCB], Bank of Taiwan [BOT]

Notes: [a] Abbreviation for bank name is in [.].
Data Resource: Banking Bureau, Market Observation Post System, Author's collection.

Furthermore, DEA may produce different or even completely opposite efficiency estimates depending on the variables chosen. For this reason, we used cross correlation to screen the carry-over variables of the current period and periods Lag 1 and Lag 2. We

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[6] As of 2016, there were 38 domestic banks in Taiwan. The properties of the Export-Import Bank of the Republic of China are different from those of most commercial banks, and Citibank Taiwan, HSBC Taiwan, DBS Taiwan, and ANZ Taiwan did not have public financial statements until 2007, 2010, 2012, and 2013, respectively, so these banks were eliminated from the samples of this study for the sake of consistency.

used capital, owner's equity, and net income, which have good carry-over properties, to screen the variables in this study. The coefficient of net income was the least, so it was not considered. Although the Lag 1[7] and Lag 2[8] coefficients of capital, was less than those of owner's equity,[9] owner's equity actually already includes capital, so owner's equity was not chosen. Furthermore, we used non-performing loans (NPLs), NPL ratio, and loss on uncollectible expenses, which have bad carry-over properties, for screening; NPL ratio was the only negative risk item. After screening the carry-over variables of the current period and periods Lag 1 and Lag 2 using cross correlation, we chose capital and NPL ratio as the carry-over variables of this study. Then, we chose number of employees, fixed assets, deposits and remittances, discounts and loans, investment, revenue of sale, as the inputs and outputs variables of this study. (Table 2)

Table 2. Input and output variables

Input	Output	Carry-over
Number of employees	Discount and Loan	Capital
		NPL Ratio
Fixed Assets	Investment	
Deposits and Remittances	Revenue of Sale	

Data Resource: Author's collection.

The variable data in this study (except NPL ratio) originated from the Taiwan Economic Journal (TEJ) database, consolidated balance sheets, and income statements. For the same of consistency[10], we adopted annual data to calculate NPLs and NPL ratios.

Thus, the inputs and outputs of the banking industry in Taiwan are interdependent, which is suitable for the SBM model for non-uniformly distributed inputs and outputs. We thus adopted the non-oriented SBM model for variable returns to scale. Table 2 presents the eight variables used to evaluate the efficiency of 33 banks in Taiwan with DEA-SOLVER, including three inputs, three outputs, and two carry-overs.

The descriptive statistics in Table 3 present 495 observed values. For non-financial holding companies, the mean number of employees, fixed assets, deposits and remittances, discounts and loans, investment, revenue of sale, capital, and NPL ratio were 2,478 people, NTD 7.95 billion, NTD 442.64 billion, NTD 354.20 billion, NTD 93.72 billion, NTD 15.24 billion, NTD 20.71 billion, and 1.71%, respectively. For financial holding companies, the mean number of employees, fixed assets, deposits and remittances, discounts and loans, investment, revenue of sale, capital, and NPL ratio were 5,460 people, NTD 20.36 billion, NTD 1,061.22 billion, NTD 804.95 billion, NTD 274.81 billion, NTD 39.71 billion, NTD 43.97 billion, and 1.34%, respectively. All eight means of the financial holding companies were greater than those of non-financial holding companies. If we divide the 15 years of the sample period into two phases, with Phase 1 starting from the introduction of the FHCA in Taiwan in 2002 to the end of the global financial crisis in 2009 and Phase 2 running from 2010 to 2016, we can see that both groups displayed a growing trend in scale in Phase 2; the NPL ratio of the

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[7] 0.7628, 0.7461, 0.5822, 0.748 0.6977, 0.7472.

[8] 0.6846, 0.662, 0.537, 0.6624, 0.6166, 0.6766.

[9] Lag 1: 0.7189, 0.8572, 0.7602, 0.8283, 0.7894, 0.815; Lag 2: 0.6504, 0.7801, 0.7154, 0.7507, 0.7138, 0.7438

[10] However, the NPL data that the various banks put in the TEJ database were handled in various ways; moreover, the years in which they divided NPLs into two items (NPLs and

loans under surveillance) were also different.

Table 3. Means of inputs, outputs, and carry-overs of banks in Taiwan

Sample period	Input			Output			Carry-over	
	Number of Employees	Fixed Assets	Deposits and Remittances	Discount and Loan	Investment	Revenue of Sale	Capital	NPL Ratio (%)
Panel A. Banks under non-FHCs								
2002-2016	2,478	7.95	442.64	354.20	93.72	15.24	20.71	1.71
2002-2009	2,386	8.05	370.82	302.58	63.46	15.42	17.35	2.81
2010-2016	2,583	7.83	524.72	413.21	128.30	15.03	24.56	0.47
Panel B. Banks under FHCs								
2002-2016	5,460	20.36	1061.22	804.95	274.81	39.71	43.97	1.34
2002-2009	4,995	19.06	821.17	634.98	183.18	39.03	34.31	2.14
2010-2016	5,992	21.85	1335.57	999.19	379.60	40.50	55.02	0.43

Notes: The unit of the number in this table is billion domestic currency (NTD) (beside number of employees).
Data Resource: Author's collection.

non-financial holding companies improved from 2.81% to 0.47%, while that of the financial holding companies progressed from 2.14% to 0.43%.

Results

The study employed dynamic SBM to evaluate the efficiency of 33 banks in Taiwan from 2002 to 2016. The analysis results were as follows:

Efficiency Comparison Of Banks Under Financial And Non-Financial Holding Companies And Impact Of Global Financial Crisis

As shown in Table 4, the total average efficiency of the 16 banks under financial holding companies from 2002 to 2016 was 0.89, which is greater than the 0.79 of the 17 banks under non- financial holding companies. Table 4 shows that banks under financial holding companies led those under non-financial holding companies all the way in average efficiency; however, the average operating efficiency of banks under financial holding companies paralleled rather than exceeded that of banks under non-financial holding companies in 2016.

Table 4 shows that the financial crisis of 2007-2008 exerted a major impact on the domestic banking industry and that the banks under non-financial holding companies actually suffered to a lesser degree and recovered more quickly than those under financial holding companies. In contrast, the European debt crisis of 2009-2010 clearly did not affect the banking industry in Taiwan.

Efficiency comparison of individual banks

Table 4 shows that 12 banks presented efficiency equaling 1 from 2002 to 2016, six banks under financial holding companies and six banks under non-financial holding companies.[11] The years with efficiency lower than the mean were 2002, 2003, 2004, 2006, 2007, 2008, and 2009, which means that the overall efficiency was poor in these seven years. None of the 33 banks in Taiwan remained in a poor state; each had their ups and downs. In the periods before 2007, from 2007 to 2012, and from 2013 to 2016, the banks with the poorest efficiency were KTB[12], SB[13], and BP [14]. All three of these banks belong to non-financial holding companies. The bank that displayed the largest sudden change in efficiency was KTB, whose efficiency dropped by -126.05% from 2002 to 2003.

Top four banks with poorest efficiency and most severe declines

The top four banks with the poorest efficiency (overall score) from 2002 to 2016 were TB (ranked 30), KTB (ranked 31), SKB (ranked 32), and SB (ranked 33). We analyze the reasons for the poor efficiency in these four banks using Table 4:

(1) TB: 30 in overall ranking; TB suffered an illegal loan scandal in 1998, has not merged with or acquired any credit unions or banks since 2002, and made a cash capital increase of NTD 5 billion in 2007. We have found that TB has shown increasing efficiency since the cash capital increase, and its efficiency

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[11] Banks under non-financial holding companies: BOK, OB, COTAB, TSB, SCSB. Banks under financial holding companies: KGIB, CUB, CTBC, MICB, BSP, BOT.
[12] predecessor: Tainan Business Bank.
[13] predecessor: Yang Ming Shan Credit Union.
[14] predecessor: Panchiao Credit Union.

improved to 1 from 2012 to 2014 and in 2016.

(2) KTB: The predecessor of KTB was the Tainan Business Bank; it has not merged with any credit unions, and it made a cash capital increase of NTD 3.6 billion in 2005. Thus, we have found that KTP has shown increasing efficiency since the cash capital increase, and its efficiency was 1 from 2011 to 2016.

(3) SKB: The predecessor of SKB was Macoto Bank[15]; it joined Shin Kong Financial Holdings in 2005 and merged with SKB[16], with Macoto Bank as the surviving bank and renamed SKB. After SKB joined Shin Kong Financial Holdings in 2005, its efficiency increased the following year, but this did not last. SKB presented minor increases from 2011 to 2016.

(4) SB: SB purchased the assets and assumed the liabilities of Yuanlin Credit Cooperative in Changhua County and Pingtung City Second Credit Cooperative in 2001 in addition to Tainan City Fifth Credit Cooperative in 2002. In 2005, they then merged with Kao-Shin Commercial Bank[17]. We observed that SB presented increased efficiency in the year following each merger with a credit union or bank, but each increase only lasted a year. There were two mergers during the period from 2002 to 2016.

(5) BOP: presented the most severe decline: BOP merged with the First Credit Cooperative of Chiayi City in 2005 and the Ninth Credit Cooperative of Taipei in 2014. While its efficiency increased in the year following each merger, it then began to drop the year after that and presented the most severe declines among all 33 banks.

We found that if banks with small capital and poor efficiency merge with banks of fairly the same capital scale, they cannot improve their operating efficiency. In contrast, making a cash capital increase is more conducive to enhancing efficiency.

Examples of banks with highest efficiency

(1) Under non-financial holding companies: Six banks including BOK[18] presented efficiency equaling 1 and did not merge with any banks or credit unions from 2002 to 2016.

(2) Under financial holding companies: Six banks including KGIB[19] presented efficiency equaling 1. (Below we explain with banks under financial holding companies as examples.)

1) The predecessor of KGIB was Cosmos Bank, which merged with the Hsinchu City Fifth Credit Cooperative in 2003 and accumulated NTD 7 billion in losses on uncollectible expense in 2007, their net losses of this year reaching NTD 9.4 billion. In

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[15] originally the Third Credit Cooperative of Taipei, which purchased the assets and assumed the liabilities of Chiayi Second Cooperative and the Credit Cooperative of Gang Shan in 2001.
[16] product of merger between Taichung City Sixth Credit Cooperative and Pingtung Sixth Credit Cooperative.
[17] which merged with the Cishan Credit Cooperative of Kaohsiung County in 1998.

[18] BOK, OB, COTAB, LBOT, TSB, SCSB
[19] KGIB, CUB, CTBC, MICB, BSP, BOT

2007, Cosmos Bank first reduce its capital by NTD 5.9 billion and then made cash capital increases of NTD 33 billion in common shares and NTD 16.5 billion in preferred shares Class A. As the capital reduction and cash capital increases were made in the same year, and we only used annual data in the variables of this study, it is unclear what the actual conditions were during 2007. It is therefore evident that the efficiency of KGIB was overestimated in 2007.

2) Cathay Commercial Bank and the United World Chinese Commercial Bank joined Cathay Financial Holdings in 2002. They further merged and were renamed CUB in 2003. In 2007, CUB merged with the Seventh Commercial Bank, which had merged with the Sixth Credit Cooperative of Hsinchu and Changhua City Second Credit Cooperative in 1997 and 1998, respectively. However, as CUB was already a major bank with capital amounting to NTD 78.6 billion, merging with any bank in Taiwan would hardly affect its operations.

3) CTBC merged with Grand Commercial Bank in 2003, acquired Fengshan Credit Cooperative in 2004, made a successful bid to purchase the Enterprise Bank of Hualien in 2007, merged with the Chinatrust Bills Finance Corporation in 2008, and merged with CTBC Insurance Brokers in 2015. With CTBC being a major bank with a capital of NTD 131.1 billion, merging with small

banks merely increased its business channels and did not affect its operating efficiency.

Among the top four banks with the poorest efficiency, one belongs to a financial holding company, and the other three belong to non-financial holding companies. The two that made large cash capital increases managed to make a rebound in efficiency, while the two that merged with multiple credit unions continued to have poor efficiency. We found that mergers had no influence on the efficiency of banks under financial holding companies (except SKB) and that cash capital increases improved the efficiency of banks under non-financial holding companies.

Efficiency Growth Comparison Of Banks Under Financial And Non-Financial Holding Companies

In 2006 before the global financial crisis of 2007-2008, the overall performance of the banks in Taiwan had already presented negative growth (-1.74%) (Table 5), so some signs of the financial crisis had already appeared in the year before its occurrence. The overall performance was worst in 2007 (-3.61%), but in 2008, the overall growth rate was positive (0.19%).Suffering a blow from the financial crisis of 2007-2008, the banking industry in Taiwan presented a steep decline, and it was two years before conditions improved.

(1) Table 5 shows that the efficiency growth rates of banks under financial and non-financial holding companies under the impact of the financial crisis were -2.26% and -1.21%, respectively, in 2006, -4.36% and -2.85%

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Table 4 Banks' efficiency scores under non-FHCs for 2002-2016

Bank	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Overall Score	Rank
Panel A. Banks under non-FHCs																	
CHB	0.99	1	1	1	1	0.99	0.99	0.99	0.99	0.99	1	1	1	1	1	0.99	13
SCBL	0.51	0.63	1	1	1	1	0.99	1	1	1	1	1	1	0.65	0.51	0.76	26
KTB	0.19	0.08	0.08	0.16	0.19	0.16	0.33	0.64	0.73	1	1	1	1	1	1	0.30	31
TB	0.18	0.19	0.16	0.17	0.24	0.23	0.38	0.34	0.41	0.50	1	1	1	0.48	1	0.34	30
TBB	0.99	0.99	1	1	1	0.72	0.81	1	1	1	1	0.99	0.99	0.99	1	0.95	20
BOK	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
UBT	0.78	1	1	1	1	0.64	0.52	0.46	0.45	0.45	0.61	0.55	0.67	0.99	0.99	0.71	27
FEIB	1	1	1	1	0.60	1	1	1	1	1	1	1	1	1	1	0.96	19
ECB	0.46	0.39	0.71	1	1	1	1	1	1	1	1	1	1	1	1	0.84	25
SB	0.20	0.21	0.23	0.25	0.36	0.24	0.13	0.08	0.08	0.05	0.13	0.21	0.57	0.59	0.53	0.16	33
OB	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
HB	0.90	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.99	15
COTAB	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
LBOT	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
BOP	0.50	0.64	1	1	1	1	1	1	1	1	0.37	0.18	0.30	0.23	0.13	0.50	28
TSB	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
SCSB	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Average	0.75	0.77	0.83	0.85	0.84	0.82	0.83	0.85	0.86	0.88	0.88	0.87	0.91	0.88	0.89	0.79	-
Average (excluding SB)	0.78	0.81	0.87	0.89	0.87	0.86	0.87	0.90	0.91	0.93	0.93	0.92	0.93	0.89	0.91	0.83	-

Table 4 *(Continued)*

Bank	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Overall Score	Rank
Panel B. Banks under FHCs																	
KGIB	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
TCBK	0.57	0.49	1	1	1	1	1	1	1	1	1	1	1	1	1	0.89	23
SKB	0.18	0.22	0.20	0.22	0.29	0.25	0.31	0.21	0.22	0.26	0.35	0.42	0.52	0.52	0.59	0.29	32
CUB	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
TFB	1	1	1	0.99	0.77	0.85	1	1	1	1	1	1	1	1	1	0.97	18
HNB	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.97	0.96	0.90	0.64	0.70	0.94	21
CTBC	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
MICB	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
FCB	1	1	1	1	1	1	1	1	1	1	0.99	0.99	0.99	0.85	0.99	0.98	16
ESCB	0.82	1	1	1	1	1	0.67	0.59	1	1	1	1	1	0.83	0.74	0.89	24
TIB	1	1	1	1	1	0.53	0.60	1	1	1	1	1	1	1	1	0.92	22
BSP	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
JSB	0.25	0.24	0.432	0.60	0.43	0.21	0.13	0.15	0.38	0.46	0.51	1	1	1	0.50	0.35	29
YB	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.76	0.98	17
TCB	1	1	1	1	1	1	1	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	14
BOT	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Average	0.86	0.87	0.91	0.92	0.90	0.86	0.85	0.87	0.91	0.92	0.92	0.96	0.96	0.92	0.89	0.89	-
The average of 33 banks	0.80	0.82	0.87	0.89	0.87	0.84	0.84	0.86	0.88	0.90	0.90	0.91	0.93	0.90	0.89	0.87	-

Data Resource: Author's collection.

Table 5 Average efficiency growth rates (%) of banks in Taiwan

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Banks under non-FHCs	3.12	7.24	2.64	-1.21	-2.85	1.37	2.42	0.95	2.24	0.67	-1.16	0.04	-0.04	0.01
Banks under non-FHCs (excluding SB)	3.07	7.23	2.56	-2.05	-2.05	2.15	2.80	0.96	2.39	0.21	-1.78	0.02	-0.04	0.02
Banks under FHCs	0.96	4.62	1.26	-2.26	-4.36	-1.02	1.74	4.40	0.81	0.79	3.53	0.00	-0.04	-0.04
Banks under non-FHCs and FHCs	2.01	5.91	1.94	-1.74	-3.61	0.19	2.08	2.67	1.53	0.73	1.22	0.02	-0.04	-0.01

Data Resource: Author's collection.

in 2007, and -1.02% and 1.37% in 2008. As can be seen, banks under financial holding companies were hit harder and longer than those under non-financial holding companies. This shows that even though banks under financial holding companies had substantial capital and even though financial holding companies had many business operations and more professional talent, they were still overwhelmed in the short term. Furthermore, the efficiency growth rates of all of the banks were also negative in 2015 and 2016[20]. The banks under non-financial holding companies rebounded in 2016, but the banks under financial holding companies still showed no positive growth. Whether this is the result of an economic recession or the sign of another financial crisis remains to be seen.

Inefficiency In Inputs, Outputs, And Carry-Overs

Inefficiency in banks under financial and non-financial holding companies (Table 6 show Inefficiency in inputs, outputs, and carry-overs, negative figures indicate excess, while positive figures indicate inadequacy).

Number of employees: The banks under financial holding companies (-89.42%) presented better conditions than those under non-financial holding companies (-92.75%); if we do not count SB in the banks under non-financial holding companies, then they (-66.23%) were in better condition than those under financial holding companies. These results show that all of the banks, regardless of whether they belonged to finan-

cial or non-financial holding companies, employed too many employees and presented inefficiency greater than 60%.

(2) Fixed Assets: The banks under financial holding companies (-64.52%) presented better conditions than those under non-financial holding companies (-101.83%). The results indicate that the banks utilized too much capital on purchasing fixed assets. If we do not count SB in the banks under non-financial holding companies, then they (-55.96%) were in better condition than those under financial holding companies.

(3) Deposit and Remittance: The banks under non-financial holding companies (-14.28%) presented better conditions than those under financial holding companies (-16.98%), which means that the deposits of the latter were excessive to a greater degree than those of the former. Both groups of banks had the issue of having too much in deposits, but on the whole, the situation was not severe.

(4) Discount and Loan: The banks under financial holding companies (4.8%) presented better conditions than those under non-financial holding companies (20.07%). The results indicate that both groups of banks accumulated too much in deposits and did not make enough discounts and loans. This resulted in too many interest expenses for the banks under non-financial holding companies and not enough interest revenue.

(5) Investment: The banks under financial holding companies (813.92%) presented better conditions than

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[20] Efficiency growth rates of banks under financial and non-financial holding companies were -0.01% and -0.04%, respectively, in 2015 and -0.04% and 0.01% in 2016.

those under non-financial holding companies (2243.25%). However, both groups of banks displayed extremely poor efficiency in this respect, which means that they did not make enough investments.

(6) Revenue of Sale: The banks under financial holding companies (44.36%) presented better conditions than those under non-financial holding companies (130.31%), which means that the latter made too little revenue of sale and were thus inefficient.

(7) Carry-over (good): Table 7 presents the inefficient carry-over (good) for 2002-2016.

The capital of the banks were slightly below the standard amount regardless of whether they belonged to financial or non-financial holding companies. To safeguard investors, depositors, and borrowers and reach standards for international competition, the competent authority in Taiwan initially stipulated a minimum capital threshold of NTD 10 billion. However, the average equity turnover was only 54.51%, which means that their capital is not far from the standard, but making money using the capital is not fast enough. Table 9 shows that the carry-over (good) capital of the banks, regardless of whether they belonged to financial or non-financial holding companies, improved by 1899.79% and 1225.42% in the periods 2002-2009 and 2010-2016, while the overall improvement was 3125.21%.

(8) Carry-over (bad): Table 8 presents the inefficient carry-over (bad) for 2002-2016.

The results in Table 8 show that the banks under financial and non-financial holding companies in Taiwan all had overly high NPL ratios. The mean NPL ratio of banks under non-financial holding companies (10.59%) was higher than that of banks under financial holding companies (7.01%). If we do not count SB, the mean NPL ratio of banks under non-financial holding companies (7.55%) was still higher than that of banks under financial holding companies (7.01%). Table 8 presents the conditions after the global financial crisis. The NPL ratios of the two groups improved by 817.72% and 535.01%, respectively, and the overall improvement was 1352.73%.

According to the results in Tables 7 and 8, the banks under financial and non-financial holding companies in Taiwan should reduce the number of employees, fixed assets, deposits and remittances, increase discount and Loan, investments, revenue of sale, increase carry-over(good)-capital by a little, and reduce carry-over(bad)-NPL ratio.

Requirements and regulations of Fair Trade Act with regard to mergers

If a bank merger case in Taiwan meets the specified requirements, a merger application must be filed with the Fair Trade Commission beforehand. The competent authorities of the FTA then reviews the case based on concerns of restrictive competition and overall economic advantages. In terms of restrictive competition, the Fair Trade Commission's written approvals generally include reasons such as the financial market in Taiwan being in a dispersed state; merging can increase the diversity

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Table 6 Compare inefficiency difference in input and output variables

Bank	Projection difference					
	Number of employees	Fixed Assets	Deposits and Remittances	Discount and Loan	Investment	Revenue of Sale
Panel A. Banks under non-FHCs						
CHB	-0.02	-0.06	0	0	0.24	0.19
SCBL	-117.76	-49.04	-2.5	97.27	378.91	22.67
KTB	-170.76	-147.86	-27.73	21.29	9998.74	465.12
TB	-156.79	-75.9	-42.98	22.13	8509.35	425.02
TBB	-34.87	-3	-15.45	0	76.34	76.09
BOK	0	0	0	0	0	0
UBT	-398.21	-316.86	-43.49	133	655.36	104.02
FEIB	-19.79	0	0	6.65	208.66	9.37
ECB	-43.54	0	-4.09	0	870.78	6.92
SB	-517.21	-835.88	-91.02	9.73	13855.18	809.84
OB	0	0	0	0	0	0
HB	-2.94	-30.38	0	0	4.36	0
COTAB	0	0	0	0	0	0
LBOT	0	0	0	0	0	0
BOP	-114.93	-272.21	-15.53	51.12	3577.28	296.07
TSB	0	0	0	0	0	0
SCSB	0	0	0	0	0	0
Average	-92.75	-101.83	-14.28	20.07	2243.25	130.31
Average(excluding SB)	-66.23	-55.96	-9.49	20.72	1517.50	87.84
Panel B. Banks under FHCs						
KGIB	0	0	0	0	0	0
TCBK	-46.12	0	0	0	606.18	5.9
SKB	-708.75	-484.47	-162.7	58.91	5408.83	260.96
CUB	0	0	0	0	0	0
TFB	-43.43	-12.16	-12.37	13.23	65.75	0.88
HNB	-42.44	-103.91	-0.38	2.04	0.07	60.12
CTBC	0	0	0	0	0	0
MICB	0	0	0	0	0	0
FCB	-14.13	-24.91	0	0	0	21.98
ESCB	-119.73	-119.37	-17.19	2.58	296.66	37.76
TIB	-78.07	-49.8	0	0	356.11	0
BSP	0	0	0	0	0	0
JSB	-371.03	-237.56	-68.15	0	6259.66	314.81
YB	-6.94	0	-10.83	0	28.57	7.3
TCB	-0.11	-0.07	0	0	0.96	0.09
BOT	0	0	0	0	0	0
Average	-89.42	-64.52	-16.98	4.80	813.92	44.36
The average of 33 banks	-91.14	-83.74	-15.59	12.67	1550.24	88.64

Data Resource: Author's collection.

Table 7 Compare the carry-over inefficiency for 2002-2016

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Avg.
Panel A. Good carry-over inefficiency																
Banks under non-FHCs	33.49	29.73	25.55	15.22	13.43	15.93	8.31	6.86	5.51	4.44	5.43	5.59	3.14	6.93	5.73	12.35
Banks under non-FHCs (excluding SB)	16.35	15.61	14.25	8.03	8.12	10.76	4.18	2.78	1.72	0.97	2.02	2.64	1.41	5.87	5.55	6.68
Banks under FHCs	21.99	20.92	20.92	6.32	6.02	7.03	4.60	5.92	4.54	3.80	2.95	1.89	1.45	1.70	0.79	7.39
Banks under non-FHCs and FHCs	27.91	25.46	23.30	10.91	9.84	11.61	6.51	6.40	5.04	4.13	4.23	3.80	2.32	4.39	3.33	9.95
Panel B. Bad carry-over inefficiency																
Banks under non-FHCs	-22.17	-18.69	-14.71	-11.69	-8.77	-8.69	-9.10	-9.67	-7.80	-4.72	-5.47	-9.01	-8.30	-6.10	-13.99	-10.59
Banks under non-FHCs (excluding SB)	-18.05	-15.94	-10.66	-7.46	-4.75	-5.35	-5.69	-6.03	-3.82	-1.07	-4.77	-7.41	-4.31	-6.48	-11.44	-7.55
Banks under FHCs	-8.87	-8.00	-9.68	-8.51	-10.53	-8.49	-8.12	-7.09	-7.57	-5.73	-0.34	-1.55	-1.29	-3.18	-16.19	-7.01
Banks under non-FHCs and FHCs	-15.72	-13.51	-12.27	-10.15	-9.62	-8.59	-8.62	-8.42	-7.69	-5.21	-2.99	-5.39	-4.90	-4.68	-15.06	-8.85

Data Resource: Author's collection.

Table 8 Compare the carry-over inefficiency ratio during 2002-2016 (Unit :%)

	2002-2009 (A)	2010-2016 (B)	Difference (B-A)
Panel A. Good carry-over inefficiency			
Banks under non-FHCs	2524.88	625.09	-1899.79
Banks under non-FHCs (excluding SB)	1281.13	322.82	-958.31
Banks under FHCs	1499.17	273.75	-1225.42
Banks under non-FHCs and FHCs	4024.05	898.84	-3125.21
Panel B. Bad carry-over inefficiency			
Banks under non-FHCs	-1759.28	-941.56	817.72
Banks under non-FHCs (excluding SB)	-1183.28	-628.71	554.57
Banks under FHCs	-1108.51	-573.5	535.01
Banks under non-FHCs and FHCs	-2867.79	-1515.06	1352.73

Data Resource: Author's collection.

of financial commodities, reduce operating costs, increase operating efficiency, and has little chance of inducing restrictive competition. In other words, the competent authorities of the FTA believe that at present, bank mergers in Taiwan do not significantly increase any market shares. Moreover, the government's policy is to maintain an open financial market, and in principle, they follow government policies. With regard to overall economic advantages, their reasons for approval indicate that merging can prompt banks toward enlargement and internationalization, increase overall resources for allocation and enhance the operating efficiency of financial institutions. Since there is no concern of restrictive competition in the banking industry in Taiwan, only the overall economic advantages need to be verified. The results of this study indicate that in the 15 years examined in this study, banks under financial holding companies did not present better efficiency than those under non-financial holding companies after mergers. Furthermore, when major banks (under financial holding companies) merge with small banks, it does not significantly increase or decrease their efficiency. In contrast, when banks under non- financial holding companies merge with credit unions or banks of fairly the same scale, then their efficiency declines instead. Thus, the banks whose efficiency was truly affected after mergers were the ones which made mergers that do not have to be approved under the regulations of the FTA. We therefore suggest that the application requirements be removed and that banks with poor efficiency be discouraged from merging with one another.

Mann-Whitney U test

As the DEA model does not contain residual terms, it may overestimate bank efficiency. We therefore conducted the Mann-Whitney U test to determine whether significant differences exist between the two independent populations. The result was $X^2 = 0.557^{***}$ (p-value=0.00), which indicates that the mean efficiency of the banks under financial holding companies (0.89) is indeed higher than that of the banks under non-financial holding companies (0.79).

Conclusion

The introduction of the Financial Institutions Merger Act in 2000 and the FHCA in 2001 induced an M&A boom in the financial industry in Taiwan. If cross-strait financial holdings restrictions are lifted, it may create another major M&A boom. The trends toward internationalization and large capital and scale seem to make mergers and acquisitions inevitable. In Taiwan, banks increase their scale by merging with or acquiring banks or credit unions, making cash capital increases, or joining financial holding companies. Some refrain from joining financial holding companies and only merge with local credit unions in Taiwan. The results of this study were as follows:

1. The efficiency gap between banks under financial holding companies and those under non-financial holding companies grew increasingly narrow over the years. At the end of 2016, the two groups became almost identical in efficiency. After 15 years, the efficiency of banks under financial holding companies was parallel to that of banks under non-financial holding companies.

2. Between 2002 and 2009, approximately half of the banks had insufficient capital, with banks under non-financial holding companies having less than those under financial holding companies. After the financial crises in the period from 2010 to 2016, the banking industry invested large amounts of capital, so only Sunny Bank, which belongs to a non-financial holding company, remained with severely insufficient capital. In terms of capital stock, the banks has clearly entered a suitable period. However, from a static perspective, the average equity turnover was only 54.51%[21], which means that their capital was close to the optimal state but underutilized.

3. Between 2002 and 2009, over half of the banks had overly high NPL ratios. The banks under non- financial holding companies were in a worse situation than those under financial holding companies. After writing off significant bad debts, the NPL ratios of the banks were much lower, but the banks under non-financial holding companies were still in a worse situation than those under financial holding companies.

4. With regard to the causes of overall inefficiency in the inputs and outputs, we found that all of the banks, regardless of whether they belonged to financial or non-financial holding companies, had too many employees, and the situation was worse in

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[21] OB lowest at 10.77% in 2002, and TCB highest at 131.55% in 2002.

the banks under non-financial holding companies than in those under financial holding companies. The banks also had too many fixed assets, which means that the banking industry is not investing its capital in banking business or purchasing equipment necessary for business. The situation was worse in the banks under non-financial holding companies than in those under financial holding companies. Furthermore, when making investments is difficult, and the overall economy is not good in Taiwan, causing banks to have too much capital in deposits, not enough loans, and not enough investments. This situation was worse in the banks under non-financial holding companies than in those under financial holding companies. Insufficiency in mid-term and long-term investments was extremely severe in the 33 banks, which demonstrates that Taiwan's restrictions on bank investments and tax system should be reviewed again.

5. During the sample period from 2002 to 2016 in this study, 17 banks merged with or acquired a bank or credit union, among which 9 banks merged with or acquired a credit union. We discovered that banks with large capital are not affected when they merge with or acquire credit unions but banks without a large capital or good performance, such as BP, SKB, and TIB, still presented poor efficiency. In contrast, KTB and TB displayed rising efficiency after they made cash capital increases (NTD 3.6 billion and NTD 5 billion) in 2005 and 2007, respectively. Thus, we conclude that mergers and acquisitions

between smaller banks does not change their operating efficiency and that cash capital increases can improve operating efficiency more than mergers.

6. Our analysis of the operating efficiency of the 33 banks in Taiwan across 15 years revealed that the overall operating efficiency of banks under financial holding companies paralleled that of banks under non-financial holding companies in 2016. Furthermore, when major banks (under financial holding companies) merge with small banks, it does not significantly increase or decrease their efficiency. In contrast, when banks under non-financial holding companies merge with credit unions or banks of fairly the same scale, then their efficiency declines instead. The FTA requires that when banks with a revenue over NTD 30 billion merge with banks with a revenue over NTD 2 billion, they must apply for approval. However, this study found that the efficiency of banks with high revenue does not decrease when they merge with banks with small revenue. What presents a cause for concern is when banks with small revenue merge with banks with small revenue. We therefore suggest that the application requirements be removed and that banks with poor efficiency be discouraged from merging with one another so as to truly enhance bank efficiency.

7. This study will provide more precision to the merger cases reviewed by competent authority of competition law, which will offer more potential benefits to the evaluation of

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merger cases.

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