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The influence of mergers & acquisitions on the management performance of financial institutions in the Taiwan region

Abstract

In order to increase global competition, the merger among domestic financial industry has appeared (merged) since Taiwan joining WTO in 2002. The main purpose of this study is to examine the operating performance and the embedded risk factors for these organizations after affiliation. In this study, Data Envelopment Analysis (DEA) model was applied for performance measurement. Input and output were used to collect relevant information (secondary data) to conduct empirical research. The results showed that risk factors have positive impact on efficiency, especially the overall efficiency and technical efficiency. Although the beginning efficacy and end efficacy were not obvious, the overall efficacy was no significantly influenced. However, the means was decreasing because not every short period of consolidation is absolutely efficient, arising out of, two banks before acquisition, each with their different corporate cultures, and some non-financial factors. But the long-term synergies, the acquisition of commercial banks in Taiwan is to help the growth of both its banking financial or non-financial aspects of the surface, for both long-term helpful extraordinary.

Keywords: acquisition, performance, Data Envelopment Analysis.
JEL Classification: G01, G17, G21, G32.

Introduction

Taiwan's entrance to the World Trade Organization (WTO) has led to the opening of financial markets because the WTO requires its members to grant most favored nation (MFN) status to all other members. Consequently, domestic banks in Taiwan face pressure to compete with highly sophisticated European and American financial institutions. With nations all over the world implementing the three-in-one model in which a financial institution offers banking, securities, and insurance, Taiwanese banks must increase the scope of their business projects and provide a variety of customer services to become competitive with the financial institutions of other developed nations. Currently, domestic banks are overly small and numerous, but competition from large international banks will force adjustments to occur. Mergers and acquisitions (M&A) represent one promising direction that could be pursued to adapt to the changing economic conditions. In particular, Taiwanese banks are facing the harsh pressures of business diversification and internationalization while simultaneously seeking to expand their operating territory and maintain control of their economic niches; thus, for domestic financial institutions, M&A represent a means of upgrading themselves to meet the challenges presented by the large-scale invasion of foreign investment institutions into the marketplace. Financial institutions are becoming increasingly more competitive every day, and the M&A trend has already begun in developed nations, including European countries, the United States, and Japan. Financial institutions are conducting M&A in rapid succession, and in general, the operation of financial institutions is gradually developing towards a "large group" model. In Taiwan, M&A among domestic banks, firms offering domestic securities, and other financial industry firms will likely change the financial landscape over time to approach this comprehensive group model.

In recent years, the Taiwanese government's active encouragement of bank mergers strongly indicates that financial institutions face intense competition and that the government is eager and determined to strengthen the operational structure of financial institutions. However, the actual benefit of bank M&A is a topic worthy of discussion. Despite an abundance of domestic and foreign literature on the topic of the performance of financial industry M&A, all published works failed to account for the impact of risk factors on performance. If risk factors are neglected during performance evaluations, important internal management mechanisms may be ignored, and the risks involved in M&A may be underestimated or overestimated. Therefore, performance and risk assessments are necessary and important aspects of the M&A process.

To date, there have been two types of bank M&A in Taiwan. One type involved financial institutions in operational crisis that were taken over by government-designated banks or new commercial banks eager to expand the scope of their businesses. The other type of bank M&A occurred during Taiwan's domestic economic downturn in late 1995. During this time, the ratio of nonperforming loans to total loans (NPL ratio) of financial institutions rose steadily, leading the Taiwanese Ministry of Finance to vigorously advocate for and actively contribute to bank mergers.

Originally, between the end of 2000 and early 2001, several mergers were actively promoted. In

particular, three major merger plans were created, including mergers between the following firms: Cooperative Bank and Qingfeng; First Bank, Dahan, and Pan Asia; and Bank of Taiwan, Land Bank of Taiwan, and the Central Trust Corporation. However, all three of these plans were temporarily suspended, as all of these mergers await court approval. Court decisions regarding whether the merger plans adhere to budget laws and other related bills are not expected for another three years or more. However, M&A have been prevalent internationally for many years, and foreign experiences have shown that M&A is a feasible approach to the development of the financial industry. Based on the current domestic situation, bank M&A are imperative. Nevertheless, given the inadequate experience of domestic banking and regulatory agencies with M&A, careful selection of the objects of the M&A and successful execution of the lengthy and complex M&A process are the most critical issues to resolve prior to the adoption of M&A as a common means to evolve the Taiwanese financial industry. This study investigates these issues; its purpose is primarily to examine the operational performance of financial institutions after mergers as well as the impact of risk indicators on the efficiency of financial institutions.

1. Literature review

In their research, Copeland (Jennifer Francis, Per Olsson and Dennis R. Oswald, 2000) indicate that success rates are higher for M&A-related companies and that smaller-scale mergers have higher success rates than larger-scale mergers.

By induction, related businesses suffer a smaller impact from a merger due to the similarity in the natures of the merging organizations; moreover, smaller-scaled enterprises have generally not yet formed any established corporate culture and can easily adapt to the organizational nature of the combined company, resulting in minimal chaos and easy integration of company cultures following a merger.

Legally, there are two common ways to merge and acquire a target company.

1.1. Asset acquisition. A buy-out strategy in which key assets of the target firm are purchased, rather than its shares. This is particularly popular in the case of bankrupt firms, who might otherwise have valuable assets which could be of use to other firms, but whose financing situation makes the firm unattractive for purchasers (an asset acquisition strategy may be pursued in almost any case where the potential target firm has an unattractive financing structure). Further, the asset acquisition strategy

might be pursued if the acquirer is interested in certain specific assets, and not all the possible target assets (Vivek Sah, 2011).

Asset acquisition is the buying and selling of the target company's assets. In this process, only the property rights of the traded resources are involved; because the acquired company's stock shares are not being purchased, the merger does not result in the inheritance of the acquired company's debts. If the acquired company sells all of its assets, it may declare bankruptcy due to an inability to continue operations. As an external growth strategy, this type of M&A is often used to expand production scale by allowing a firm to acquire inventory, machinery, and equipment from other companies (Copeland, Tom, Koller, Tim & Murrin, Jack, 1994).

1.2. Stock acquisition. Stock acquisition is an investment method that utilizes the purchase of equity (or stock shares) of a target company. After the buyer (acquirers) directly or indirectly purchases part or all of the shares of the target company, the buyer becomes a shareholder of the target company (Berger, Hancock, and Humphrey, 1997).

The acquisition of a considerable percentage of the shares of the target company to acquire operational control is known as a takeover, and acquisition to obtain control of a share purchase is called investment. The following three methods exist for acquiring: transactions via transfer of private equity, public stock offers (tender offers) in the open stock market, and public solicitation of proxies (proxy solicitation). With a public tender offer, unless the transaction is made with the target firm's consent or presented in a benign manner to the existing shareholders of the target company, the acquisition can easily be regarded as a hostile takeover and therefore met with resistance. As external growth strategies, takeovers and investments are often used to form strategic alliances (Jane N. O'Sullivan, 2012).

1.3. Acquisition of risk. Cooke (1986) conducted systematic research on the motivations underlying M&A cases among 16 countries in the 1980s and identified four main rationales, namely, (1) improvements in market share, (2) creation of a synergy effect, (3) financial motivations, and (4) political concerns. Jauch and Glueck (1989) suggested that from the perspective of the target companies, there are seven reasons to consent to a merger:

1. The merged company increases the shareholder value.
2. The merger leads to the procurement of additional resources from the parent company and therefore enhances the growth rate of the targeted company.

3. The merger stabilizes company operations and thereby increases the target company's efficiency in resource acquisition and use.

4. Taxation benefits, as privately-owned target companies can resolve potential inheritance tax issues through M&A.

5. Diversification of management and the types of equity that management can own.

6. Prospective future benefits, as the merged company may participate in the management of the new company and share in all future profits.

7. The resolution of issues among senior management, such as in cases in which no clear successor to a family-owned business exists or when conflicts are present among senior executives of the targeted firms.

Healy and Ascher (1992) attempted to further understand the relationship between annual and current stock compensation after M&A and to confirm and explain the extent of performance improvements from M&A. They used the amount of operating cash flow and the return rate as indicators to evaluate enterprise performance in real terms. Based on their study of the 50 largest M&A cases in the U.S. between 1979 and 1984, they discovered that performance improvement was much better among companies that participated in an M&A compared with their peers. These researchers acquired results supporting their hypothesis that a value creation effect motivated companies to participate in M&A. One important finding in this study is related to the abnormal stock returns calculated by the researchers, as they discovered a strong positive correlation between abnormal returns on stocks and post-M&A operational performance (De Young, R., J.P. Hughes and Choon-Geol Moon, 2001).

Agrawal, Jaffe and Mandelker (1992) also conducted a study of performance post-M&A. They used a considerably larger quantity of sample data, including 937 acquisitions and 227 motions for share purchases. The sizes of the sample companies they used are smaller than the sizes of those used in the research by Healy and Ascher (1992), which focused on 50 major M&A cases. After adjusting for the scale effect and measuring the beta (β) market return, they found that shareholders of the acquired company suffer approximately 10% in asset losses in the five-year period post-M&A. This finding is significant for two reasons.

First, it represents an abnormality because it is generally believed that there should be a positive return on additional investment opportunities after M&A; if the new company does not display adequate operational performance after the merger, investors can opt for long-term shorting of the new company's stock after the date of the merger announcement. Of course, in the long term, this anomaly should disappear.

The second significant finding is that Healy and Ascher (1992) found a positive return post-M&A after adjusting for industry factors, but Scholar found a negative return after adjusting for industry and market systems. On the whole, however, these studies demonstrated that M&A tend to happen in industries with worse performance than the overall market.

Park and Switzer (1995) followed the research methods of Healy and Ascher (1992) to extend and expand on that earlier study. The two primary limitations of the earlier study were that only large-scale M&A cases were used and that the research was conducted during a period of merger mania in the U.S. To address these concerns, Switzer considered 324 M&A cases in the U.S. between 1967 and 1987 in his research. This study demonstrated that the empirical results of are consistently upheld irrespective of the size of the merging companies and during different time periods.

Stillman (1983) primarily discussed whether a horizontal merger has the capacity to monopolize the market and therefore raise the price on commodities and produce inefficiencies in the allocation of social resources. Stillman collected corporate and competitor information for horizontal mergers between 1946 and 1972. His empirical results demonstrate that horizontal mergers do not have the capacity to produce monopolies. Leslie Berger and J. Efrim Boritz (2012) analyzed the effect of M&A on financial performance, based on financial reports of companies for the three years before and after a merger or acquisition, and found that of the 19 categories examined, the merged companies demonstrate extremely exceptional performance in 8 categories and exceptional performance in 2 categories.

Value-at-risk (VaR) is a vital market risk measurement and is critical for risk management. The purpose of risk management is to estimate the maximum possible loss that could result from a situation, based on past occurrences, and to control this possible loss, keeping it within a tolerable range for the company and its investors. Because risk management places a heavy emphasis on the extent of risk exposure, quantitative analysis of the impact of risk on assets and liabilities is used whenever possible; thus, VaR is currently a very common evaluation metric employed by diverse entrepreneurs, financial institutions, and governmental departments (Victor S. Maas, Marcel van Rinsum and Kristy L. Towry, 2012).

Morgan (1996) defined VaR as the maximum possible loss for an investment portfolio within a pre-defined period given an established confidence level, an established probability of price fluctuation, and an established holding period of the portfolio. In accordance with this reasoning, Linsmeier and Pearson (1996) agree that VaR is a measurement to statistically evaluate the possible loss of an investment portfolio over a particular period, within a given confidence level.

Therefore, in general, VaR is an assessment of various potential risks that an enterprise faces. VaR not only provides an enterprise with risk management information that may be used in establishing quotas but it also facilitates resource allocation planning and operating performance measurement for businesses.

Fei Du, Guliang Tang and S. Mark Young (2012) once again assessed banks' efficiency after risk management. The cost model used in this study is different from that of the previous study listed in several aspects:

1. It clearly noted that the quality of bank assets and the bank's bankruptcy probability may affect bank costs in various ways. For example, issuing a large number of high-risk loans may be more efficient and profitable than ensuring banking quality through consumption resource loans, but the tradeoff is acquiring substantial risk.
2. It considered financial capital to be an input factor in the production process. Financial capital, also known as equity capital, allows banks to cope with loan loss but can also serve as lending funds, to replace the deposits or other funds borrowed. A risk-adverse bank may prefer using financial capital as a source of funding for loans (which is less risky), which is a course of action not typically assumed by other banks because the cost of financial capital is often more expensive than deposits. This situation may cause risk-averse banks to be incorrectly identified with allocative inefficiency (inappropriate input factor combinations), when in fact allocation differ-rences are simply the result of a difference in risk preferences. To control for these differences in risk preferences, the cost function in this more recent study included the financial capital level. K.E. (Skip) Hughes II and Gwen R. Pate (2013).
3. It provided a confidence interval for banking inefficiency, resulting in better indicators of that banking inefficiency. In other ways, Mester's work in 1996 was similar to the earlier.

Regarding M&A-specific research, many studies in international finance have investigated the perfor-

mance and operational changes in enterprises after a merger. This research, according to Ondrich and Ruggiero (2001), generally consists of three main emphases:

1. The relationship of stock prices before and after M&A.
2. The change in company characteristics and structure before and after M&A.
3. The change in operational performance before and after M&A.

Overall, research related to the effect of M&A on performance typically starts from the synergy perspective, discussing the impact of M&A on operational, market, and financial synergy. Although the precise indicators used vary widely, generally the impact of synergy is most evident in the financial aspects of companies after M&A.

Additionally, the empirical results demonstrate that if a study does not consider risk factors, then it has a tendency to overestimate economies of scale and optimal bank sizes; i.e., in a performance evaluation, ignoring risk factors may cause underestimation or overestimation of the actual risk present as well as neglect of internal management mechanisms. Therefore, assessment of both performance and risk together is necessary and important for evaluation accuracy. For instance, Hughes, Mester and Moon (1996) studied large-scale banks and found that, after they controlled for risk, the banking industry demonstrated economies of scale as capital scales increased. In contrast, Hughes and Mester (1993) studied large-scale banks with increasing return to scale and re-evaluated efficiency after considering quality of assets, financing costs, and risks, thus producing results that only indicated constant returns to scale. Mester (1996) also suggest that unless asset quality and risk are controlled, bank inefficiency can be very easily miscalculated.

The present study asserts that consideration of risk is an essential element in investigating the economic efficiency of banks. Currently, however, no universally acknowledged standard for calculating risk value exists. Using the cues generated by the relevant literature, this study will attempt to determine a representative quantitative measurement for risk value. Mester (1996) emphasized that equity funding for financial institutions, in addition to being used to cope with loan losses, can also be used as lending funds to replace deposits or other funds borrowed. In this study, total shareholders' equity will be used as one of the indicators of risk value. Altunbas, Liu, Molyneux and Seth (2000) concluded that important asset quality will affect the economies of scale and the estimates of optimal banking scale.

Therefore, this study suggested that current assets/total assets should be considered to be a risk measure. According to the study by DeYoung and Hasan (1998), financial costs that arise from risk control will begin to decrease with greater risk management efficiency driven by increasing loan market competition.

As the main source of the capital cost for financial institutions derives from deposit interest payments, in general, the available storage index may be used as a measurement for risk estimates.

1.4. Data Envelopment Analysis. DEA is a non-parametric technique used to measure the efficiency of DMUs and was first proposed. It considers that each DMU is engaged in a transformation process, where by using some inputs (resources) it is trying to produce some outputs (goods or services). DEA uses all the data available to construct a best practice empirical frontier, to which each inefficient DMU is compared (Charnes, Cooper and Rhodes, 1978).

One of the interesting features of DEA is that it allows each unit to identify a benchmarking group; that is, a group of units that are following the same objectives and priorities, but performing better. In this regard DEA aims to respect the priorities of each DMU by allowing each one of them to choose the weight structure for inputs and outputs that most benefits its evaluation. As a result, it aims to classify each unit in the best possible light in comparison to the other units. Another advantage of DEA is that it does not require specification of a cost or production function, allowing for richer models (Charnes, Cooper and Rhodes, 1981).

2. Research methods

As the object of study, we used M&A cases among Business Bank in Taiwan in the 2000s and analyzed these situations from the perspective of the acquiring bank, with a focus on operational performance before and after the merger. However, there were difficulties in collecting the financial information from different financial institutions involved in merger cases in the 2000s. Certain data were incomplete due to the long period of time that had past, whereas other data were classified and remain undisclosed to the public; therefore, the obtained data may not be complete, thus rendering performance assessment in such cases rather difficult. The sample cases that had incomplete data due to one or more of these concerns are not included in the objects studied here.

The period of information collection is between January 2003 and December 2010.

This study uses the economic efficiency measure method as validation. This method is developed from fundamental economic theory and assesses economic efficiency by measuring the technical efficiency and allocative efficiency of every bank, relative to the goals of maximum output and minimum cost. The actual analysis of economic efficiency involves the use of border efficiency analysis, a technique primarily derived from Farrell's (1957) concept of efficiency, in which he assumed that under constant returns to scale of a manufacturer, the unit isoquant provides a method of determining technical efficiency via observation of empirical data points and the relationships between production curves as well as a method of determining allocative efficiency via input factor and pricing relations. Using various inputs and outputs of banks and comparing the banks' operational efficiencies, Data Envelopment Analysis (DEA) was combined with Slack Variable Analysis to identify inefficient inputs and outputs and therefore provided a reference for operators to improve banking efficiency. Refined DEA variants, commonly known as the BCC and CCR models (which were named using the initials of the variant creators), were used to further understand the appropriateness of the operational scale for each bank.

This study intends to use the DEA model as the mode of measuring bank performance and will conduct empirical research on the various inputs and output information (secondary data) garnered from that model to determine the sorting order of the banks' technical and allocative efficiencies, their banking inefficiencies, the sources of these inefficiencies, and potential improvements in inputs and outputs for inefficient banks. DEA does not require complicated assumptions and pre-defined settings and can be used to evaluate the operational performance of both for-profit and non-profit organizations; thus, it is widely used in various industries as a measure of industry performance. However, despite the fact that the DEA method is widely used, in research there are a variety of different input and output variables for the DEA model. The following will explain the selection and measurement of different variables. In DEA research, the most important step is the selection of input factors; as outcome varies given different input and output values, selecting the proper input and output variables is a crucial step of performance assessments. Because banks play the roles of intermediary agents, if only operational costs are considered, the production method would be a good means of assessing banks' cost efficiency, and the agency rule would be more suitable for analyzing the bank's operating efficiency. Regarding the ease with which data can be obtained, most domestic banks express their own financial information in quantitative fashion, and therefore data are easy to collect. However, data related to the number of trades and number of transactions that firms engage in are

comparatively harder to collect; in fact, there are very few statistical records in this area. Therefore, this study will use agency law to identify the inputs and outputs of the banks and continue to use the variables selected with the addition of risk value. The selection of value at risk will be based on ten assessment indicators of the Taiwan credit risk indicators (the TCRI); variable analysis is conducted first to eliminate excess variables, and three indicators are extracted from the data: current assets / total assets, deposit to loan ratio, and total shareholders' equity. These three indicators were selected as the value at risk variables. Additionally, total operating income was selected as an output variable; among the input variables, total net assets is considered to be investment capital, and operating expenses and bad debts are used for input costs. Financial costs, fees, expenses, and interest are calculated in total, whereas labor input is accounted for primarily by the number of employees. Given these selected input and output factors, this study will conduct analysis using the BCC & CCR variants of the DEA model.

In efficiency analysis, there are three categories of efficiency: technical efficiency (TE), allocative efficiency (AE), and combined efficiency (CE). These categories are related, as AE is the value of CE divided by TE. Technical efficiency, also known as the producer equilibrium, is the state of maximum output and minimum cost. Technical efficiency can be reached by minimizing cost for a given output or by maximizing the output for a given cost. Maximal technical efficiency can be decomposed into two components of minimizing waste from input factors and the proportional decrease in the use of input factors provided by allocative efficiency. Therefore, technical efficiency is the ratio of the gap between actual output and the potential maximum output that is caused by vendors' failure to produce at the level of production efficiency.

The combined efficiency is the gap ratio between the actual cost and the minimum cost, and allocative efficiency refers to production with the lowest cost, i.e., using the proper combination of the input factors to proportionally reduce cost.

If the actual technological substitution ratio between the input factors is not equal to the market price ratio, then allocative inefficiency exists. Therefore, allocative inefficiency occurs when a manufacturer fails to use the proper combination to minimize the resource input required to produce the necessary goods and services. In other words, combined efficiency refers to the gap ratio between actual cost and minimal cost, allocative efficiency occurs when a manufacturer minimizes the input required to create a

given output, and technical efficiency is the gap between actual output and the potential maximum output. CCR versions (Charnes et al., 1978).

In order to construct a virtual unit, Farell focused on units' set of weights to measure efficiency for units relatively. He suggested the below relationship as a means of measuring technical efficiency:

Efficiency = (*Weighted sum of outputs*) / (*Weighted sum of inputs*)

Regarding efficiency for n units enjoying m inputs and s outputs, the efficiency for unit j ($j = 1,2,\ldots n$) can be computed as below:

$$Unit\ efficiency = \frac{\sum_{r=1}^{s} U_r y_{rj}}{\sum_{t-1}^{m} v_t x_{tj}},$$

where x_{ij} is the amount of input i for unit j ($i = 1,2,\ldots m$), y_{rj} is the amount of output r for unit j ($r = 1,2,\ldots s$); v_i is the weight of input i, u_r is weight of output.

Refereeing to this definition, Charnes et al. (1978) developed CCR model with the BCC version (Banker et al., 1984).

The formulation of CCR version assumes that the relationship between inputs and outputs follows the constant returns to scales assumption. For instance, if inputs get twice as much, outputs get twice as much too. If inputs increase more than or less than twice as much, the returns are assumed increasing and decreasing, respectively. In many organizations, constant returns to scale assumption are not acceptable. This assumption is appropriate when every institution acts in optimal level. However, various problems, such as competitive effects, constraints, managements' week operations, and so on, cause institutions not to act in optimal scales. Therefore, Banker et al. extended BCC version in 1984 so that varying returns to scale (VRS) are considered. This version was known as BCC, taken by their names' first letters. The mathematical version is as follow:

$$Max\ Z_0 = \frac{\sum_{r-1}^{s} u_r y_{r0} + w}{\sum_{t=1}^{m} v_t x_{t0}}$$

$$s.t.\ \frac{\sum_{r=1}^{s} u_r y_{rj} + w}{\sum_{i=t}^{m} v_i x_{ij}} \le 1,$$

$j = 1,2,\ldots, n$

$u_r v_r \ge 0$, w : free in sign.

Equaling the denominator of the objective function to 1, the non-linear version can be converted to a linear one. As you see, the w free variable is the difference between CCR and BCC versions. The w variable in BCC can determine returns to scale for every unit. If $w < 0$, kind of return to scale is decreasing, if $w = 0$, return to scale is constant. If $w > 0$, return to scale is increasing.

3. Data envelopment analysis of the empirical result

To determine whether risk value creates an impact on efficiency, we first calculated combined effi-ciency, technical efficiency, and allocative effi-ciency with and without incorporating risk values, based on sample bank financial reports and selected variables (Table 1). We then assessed whether significant differences exist between the two sets of calculations. Samples with efficiency value equal to 100 are efficient; samples with effi-ciency value less than 100 contain ineffi-ciency, indicating that room for improvement exists in either cost reduction or output maximization. The test results demonstrate that risk value does have an impact on the three efficiency values, as shown in Table 2.

Table 1. Sample bank efficiency

No.	Incorporating risk value			Not incorporating risk value		
	Combined efficiency	Technical efficiency	Allocative efficiency	Combined efficiency	Technical efficiency	Allocative efficiency
1	99.79	100.00	99.79	98.63	98.85	99.78
2	98.87	100.00	98.87	99.79	100.00	99.79
3	99.40	100.00	99.40	98.87	98.97	99.90
4	98.63	100.00	98.63	99.40	100.00	99.40
5	98.01	100.00	98.01	96.93	97.31	99.61
6	100.00	100.00	100.00	98.01	98.06	99.95
7	98.99	99.14	99.85	100.00	100.00	100.00
8	97.59	99.01	98.57	98.99	99.00	99.99
9	100.00	100.00	100.00	99.11	100.00	99.11
10	99.50	99.63	99.87	100.00	100.00	100.00
11	100.00	100.00	100.00	98.47	99.63	98.84
12	100.00	100.00	100.00	98.63	100.00	98.63
13	100.00	100.00	100.00	93.80	97.63	96.08
14	99.02	99.79	99.23	98.85	100.00	98.85
15	100.00	100.00	100.00	98.05	98.79	99.25
16	98.06	98.84	99.21	100.00	100.00	100.00
17	98.59	99.76	98.83	91.49	96.12	95.18
18	100.00	100.00	100.00	93.77	97.87	95.81
19	95.52	96.04	99.46	95.11	99.67	95.42
20	96.84	98.16	98.66	91.36	95.42	95.75
21	100.00	100.00	100.00	86.82	90.75	95.67
22	99.89	100.00	99.89	94.91	100.00	94.91
23	97.35	99.44	97.90	90.72	95.61	94.89
24	96.47	99.73	96.73	87.30	91.52	95.39
25	100.00	100.00	100.00	81.98	85.42	95.97
26	98.89	99.68	99.21	91.29	96.00	95.09
27	96.21	100.00	96.21	89.10	93.48	95.31
28	95.75	100.00	95.75	84.34	88.12	95.71
29	100.00	100.00	100.00	80.05	84.16	95.12
30	96.09	97.32	98.74	71.32	74.37	95.90
31	100.00	100.00	100.00	74.95	78.51	95.47
32	100.00	100.00	100.00	96.37	100.00	96.37

Table 2. An assessment of the impact of risk value on sampled banks

Efficiency category	t-value	p-value
Combined efficiency	4.483	.000*
Technical efficiency	3.565	.001*
Allocative efficiency	4.571	.000*

Note: * Indicates that $p < 0.05$.

To demonstrate that data incorporating risk values may better reveal actual efficiency conditions, we assessed each of the three efficiency values before and after accounting for risk values. The results indicate that after considering the risk factor, combined efficiency, technical efficiency, and allocative efficiency are all significantly higher. We can conclude from this result that, in the competitive banking industry, banks are committed to reducing cost and increasing output to maintain operation. However, risk issues are not subsequently over-looked; instead, proper risk management is still practiced.

The subject of this study is the change in bank efficiencies before and after a merger; thus, we also assessed the efficiency values of the banks before and after the merger occurs. The results indicate that the merger of banks does not appear to have a significant impact on the overall efficiency of the banks in question, as no significant differences exist between the overall efficiency of banks before and after a merger. However, we can observe from Table 3 that even though there is no significant difference in efficiency before and after the mergers, the efficiency after the mergers has greater fluctuation, which implies that, in the banking industry, competition intensifies after the mergers. Furthermore, the average number of each of the efficiency values is smaller after the mergers than before the mergers. In other words, even though there is no significant difference before and after the mergers, there appears to be a declining trend in the average efficiency values for the sample data examined in this study.

Table 3. Sample bank t-values before and after mergers

Efficiency category		Average	Standard difference	t-value	p-value
Combined efficiency	Before mergers	99.232	0.826	1.771	0.088
	After mergers	98.225	1.827		
Technical efficiency	Before mergers	99.815	0.363	1.225	0.231
	After mergers	99.383	1.175		
Allocative efficiency	Before mergers	99.415	0.701	1.393	0.177
	After mergers	98.836	1.450		

Note: * Indicates that $p < 0.05$.

This study found, from the DEA measurement of bank efficiency change after mergers that inefficiency primarily arises from failures in allocative efficiency rather than technical inefficiency. The reason for this phenomenon may be that these five banks are all newly established banks and thus have not yet reached economies of scale in this early stage of their establishment. Their efficiency values were already demonstrating certain issues, which may have encouraged the banks in question to start merging to promote rapid expansion. After a series of mergers, however, the banks' efficiency values remain in a fluctuating state; technical efficiency and allocative efficiency effects are variable, but in general, the main impact on overall efficiency derives from allocative inefficiency. This phenomenon likely resulted from the negative impact of a credit crisis abroad and the resultant immense investment losses and increases in overdue loans, all of which hinder the growth of the financial sector as a whole.

However, domestic lower-level financial institutions repeatedly encounter challenges caused by extremely high NPL ratios. In addition, the recent domestic real estate slump also caused bank loan interest rates to decrease, lowering financial institutions' profits and hindering allocative efficiency. Thus, the low score for overall average efficiency may be largely caused by the government actively attempting to resolve bad debt concerns, the creation of executive mutual funds during the same fiscal year, and the practice of an accept-all borrowers policy at lower-level institutions with bad operational systems and high NPL ratios. Therefore, average efficiency was affected as banks were forced to adjust for bad accounts. As a result of the recent financial stresses, the Government began to adopt more regulations and policies that addressed the worsening issues of bad debts and bad accounts.

Overall, regarding the empirical analysis of efficiency for the merging banks, 20 out of 32 data samples demonstrate combined inefficiency, which indicates that the banks' average efficiency performance is unsatisfactory. The main cause of inefficiency in merged banks is inefficiency in scale, not technical inefficiency, although these inefficiencies may simply be due to the fact that the selected sample banks in this study were all emerging new banks. With increased operating locations and reduced human resources, banks were unable to raise allocative efficiency via mergers, through distribution of credit cards or by offering personal financial services. It should be noted, however, that banks in the early stage of a merger often find it harder to allocate capital input due to weaker liability management, improper risk diversification of assets, and inadequacy in raising capital sources. Furthermore, the government also placed restrictions on new banks during their early stages of establishment, such as commercial bank regulations from the Ministry of Finance that force

banks to apply for an attached savings department but do not allow investment in company stock, certificates of entitlement for new shares, bonds, and convertible certificate of entitlement for three years. Even after this three-year period, banks must follow designated application processes for these investments. Regarding sales of bad debt by financial institutions to asset management companies, losses from the sales will be recorded within the subsequent five-year period. These controls likely reduced the allocative efficiency of the merged bank, thus resulting in poor profitability.

In addition, M&A banks are largely low-level economic institutions with incomplete systems, unsatisfactory operations, and repeated losses. Therefore, even though mergers can exempt M&A banks from bankruptcy crisis, other issues often still exist. After absorbing all assets, liabilities, and operational structures of the problematic target financial institutions, the new bank may incur losses, such as increased debt, elevated NPL ratio, and reduced profitability, thereby reducing its efficiency.

Conclusions and recommendations

Conclusion. The increase in the number of banks and the international economic downturn caused intensified competition within the banking industry and prompted banks to continue their pursuit of more efficient operations. However, these occurrences also prompted banks to engage in more risky behaviors.

Very little of the previous research literature on Taiwan's banking sector efficiency considered risk factors when measuring that efficiency. Therefore, this study considered those risk factors when measuring bank efficiency. A DEA model was adopted to measure and compare the combined efficiency, technical efficiency, and allocative efficiency values.

The results indicate that risk factors indeed impact efficiency values and that these impacts were generally positive, especially with regards to combined efficiency and technical efficiency. In other words, when banks engage in mergers, risk factor evaluations do play a role in considerations of the overall inputs and outputs; moreover, risk management also affects the managerial aspect of technical efficiency. This result is consistent with the conclusion of Pastor (1999).

Overall, no significant effect on efficiency appears to be generated by mergers within the banking industry (see Table 4), as no significant efficiency differences were observed when comparing performance before and after mergers. However, the average efficiency values in each category are smaller after the merger than before the merger. In other words, even though no significant difference was shown to result from the merger itself, there exists a declining overall trend in the average efficiency values determined in this study. The reason for this trend could be that the overall competitive environment after the merger still does not possess an economy of scale. However, based on the differences in efficiency values after M&A, fluctuation clearly increases after the merger. Standard deviation in combined efficiency increased from 0.826 pre-merger to 1.827 post-merger, standard deviation in technical efficiency increased from 0.363 pre-merger to 1.175 post-merger, and standard deviation in allocative efficiency increased from 0.701 pre-merger to 1.450 post-merger. As shown, there are increased fluctuations post-merger in each of the efficiency categories, which imply intensified competition after the mergers that leads to an inability to achieve stable operational efficiency after a merger has occurred.

Table 4. Risk factor impact assessment

	Combined efficiency	Technical efficiency	Allocative efficiency
Overall sample	4.483*	3.565*	4.571*

Note: * Indicates that $p < 0.05$.

Suggestions for future studies. In this study, although we strove for perfection, there was still room for improvement. In sample collection, we were unable to garner all of the banks' financial information for empirical sampling due to limitations in the data collection channels; thus, we were unable to effectively investigate the efficiency conditions of all the banks in Taiwan. Furthermore, during the sample period selected, the global financial crisis of 2008 significantly impacted the domestic financial industry, and the effects from this crisis should be incorporated into future studies. In the process of measuring efficiency, secondary factors such as

markets that interfered with the banks' operational efficiency could be eliminated from the model, to reflect a more objective efficiency value for the bank itself. In addition, because this study only focused on banks, the findings here may differ from results for other firm types and would need to be further confirmed. Although this study attempted to address the change in bank efficiency before and after M&A and assess the impact of risk factors on merger efficiency using DEA, this study only used seven financial indicators; thus, the conclusions generated here are merely exploratory and need to be followed up with further verification.

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