

# Financial Performance Evaluation of Top Universities Following the Mergers

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**Abstract**—This study adopted FRA to examine the impacts of merger on financial performance of two post-merger top universities in Taiwan from 2012 to 2021. This study shows that Taiwan's top universities are not outstanding in terms of financial management capabilities, including the ability to control costs well, utilize assets efficiently, and maintain good financial stability. Moreover, the merger of top universities may not improve the financial management capabilities of the post-merger university, and may even worsen its financial stability. Ignoring the financial management capabilities of universities, the policy of concentrating resources on developing top universities and even encouraging the merger of top universities to quickly enhance their competitiveness may not bring the expected results, but may lead to the deterioration of the financial soundness of universities and even the country. In view of this, this paper calls on higher education policy makers and university managers to pay more attention to the financial management capabilities and financial performance of universities, especially cost control, resource utilization efficiency, and financial stability, while pursuing innovative development and high competitiveness. Only in this way can it be possible to ensure the competitiveness improvement and the long-term sustainable development of the top universities and the country.

**Keywords**—top university, merger, financial performance, Financial Ratio Analysis (FRA)

## I. INTRODUCTION

With the financial pressure brought about by the declining birth rate and tight budget, Higher Education Institutions (HEIs) in many countries are actively expanding the international higher education market, aiming to attract more international students, and at the same time avoid the drain of domestic talents, so as to alleviate the financial pressure. This makes governments and HEIs of these countries begin to pay attention to their own international competitiveness [1–5].

What the more important is, meanwhile, with the rapid development of high technology, many governments are aware that they must concentrate national resources to develop so-called “world-class” or “elite” or “top” universities in order to improve the scientific research capacity of HEIs and the efficiency of professional knowledge transfer. They perceive that only in this way

can a country benefit from the cultivation of high-level talents, avoid brain drain, accumulate human capital, and enhance technological innovation capabilities, thereby enhancing the country's political and economic competitiveness in the world [4–10].

With this awareness, the international development needs of higher education and the trend of resource concentration have been further accelerated worldwide. Many countries have proposed initiatives to develop world-class universities. For example, Taiwan has launched the “Aim for the Top University Project” since 2003 [11] and “Sustained Progress and Rise of Universities in Taiwan (SPROUT) Project” since 2017 [4, 9, 12, 13]. China has launched the “Project 211” since 1995 [14], the “Project 985” since 1998 [15, 16], and the “Double First-class Initiative” since 2015 [10, 17–20]. South Korea launched the “Brain Korea 21” Project” since 1999 and “World Class University (WCU) Project” since 2008 [21, 22]. Singapore has launched the “World Class University Program” since 1997 [5, 23]. Japan has launched the “21st Century Center of Excellence (COE) Project” since 2002 [24, 25] and “Global Center of Excellence (COE) program” since 2007 [26, 27]. Germany has launched the “Excellence Initiatives” since 2006 [28–31]. France has launched the “Initiative D’EXcellence (IDEX)” since 2010 [32–35]. Finland has implemented the “New Universities Act” in 2010 and established the Aalto University [8, 36, 37].

Moreover, in view of the financial pressure and the need to enhance international competitiveness, governments and HEIs in many countries, such as China, France, Denmark, Finland, the United Kingdom, and the United States *et al.*, have regarded the mergers of HEIs, and even the mergers of top universities, as a way to rapidly and effectively strength the international competitiveness of HEIs [37–47]. This has given rise to a handful of mergers of top universities in many countries, by means of this way, these countries hope to establish so-called “world-class” or “flagship” universities to attract international talent (including faculty and students) and further enhance their countries' international competitiveness [7, 37, 42, 48]. Such as the merger of Beijing University and Beijing Medical University in China in 2000; the merger of École centrale Paris and Supélec to form the Centrale-Supélec in France in 2015; the merger of Helsinki University of Technology, Helsinki School of Economics and the University of Arts and Design Helsinki to establish the

Aalto University in Finland in 2010; the merger of the Victoria University of Manchester and the University of Manchester Institute of Science and Technology in 2004. As a result, Taiwan also saw its first merger of top universities in 2016, namely, National Tsinghua University (NTHU), a top university in Taiwan, and National Hsinchu University of Education (NHCUE) merged into NTHU on November 1, 2016. Then, there was the unprecedented first case of merger between top universities. That is, National Chiao Tung University (NCTU) and National Yang Ming University (NYMU), both top universities, have merged on February 1, 2021 to form a new university called National Yang Ming Chiao Tung University (NYCU).

This study argued that a country's prestigious universities are easy to gather various resources from the public and private sectors of a country, including talents, funds, and other resources. When the government attempts to develop "world-class universities", it will further accelerate the concentration of social resources to the so-called "top universities", and will affect the resource allocation of HEIs, thus deeply affecting a country's long-term development and international competitiveness [4, 7, 10, 49]. If the merger of top universities can really play the expected benefits, it will naturally be favorable to a country's long-term development and international competitiveness. However, it is definitely not desirable if a merger does not deliver the expected benefits, or if it does, it yet leads to financial instability. In addition, when a society's resources are excessively tilted and allocated unevenly, the macro and micro negative externalities it brings will also greatly reduce national competitiveness. In particular, the allocation of higher education resources is critical to the development of a country's professional talent cultivation, technological innovation and upgrading, and the widespread transfer of professional knowledge. Relevant policies should be carefully evaluated in advance to avoid to mislead resources allocation and to ensure that the country moves in the most favorable direction of development [43–45].

Although there have been a few studies in recent years that have explored the relevant issues of so-called "world-class" or "top" universities, most of them have focused on the efficiency of their teaching and research, and there has been no research on their financial performance. Also, there are relatively many studies on the merger of HEIs, but very few studies focused on the merger of "top universities". As far as this study was aware, there were only [40, 42, 44, 45]. Among others, Liu *et al.* [40], Chen [44], and Chen [45] have empirically demonstrated that mergers involving top universities did not bring in the post-merger HEIs positive effect on research performance or technical efficiency. In addition, none of them has empirically examined the impact of mergers on the financial performance of top university by means of Financial Ratio Analysis (FRA). However, whether mergers actually contribute to better financial management capabilities and thus improve the financial performance of post-merger HEIs remains academically and practically debated [7, 41]. This study argued that FRA is the more

intuitive assessment method to inspect an organization's financial status and trends from a multi-facet perspective, pinpoint its problems, and further put forward effective suggestions for improvement. Moreover, FRA needed to specify neither the function form nor the measures of input and output, so it can avoid the model misspecification and measurement biases.

Based on the above, this study attempted to call on the government and HEIs to take into account financial management capabilities and performance while pursuing high growth in innovation and development. Therefore, this article aimed to examine the impact of mergers on their financial performance by adopted FRA to evaluate the post-merger financial performance of top universities, and find out the factors that affect the post-merger financial performance, so as to provide policy makers and HEI managers with a reference basis in the pursuit of innovation grow while maintaining well cost control, resources allocation and sound financial health.

Finally, this study attempted to appeal that regardless of whether the purpose of the merger of HEIs is to resolve the financial austerity under the impact of the declining birth rate, or to enhance international competitiveness and status, from the perspective of USR and SDGs, financial management capabilities and performance are very critical, especially for Taiwan, which mainly depended on tuition fees and government budget to finance in the long-run though is suffering from falling population of children and worsening government fiscal deficits. Financial performance is the key to ensure that HEIs fulfill USR and SDGs. Without stable and efficient finances, let alone ensuring the quality of education and research and development, it is even more difficult to provide high-quality social services.

In light of above, this study purposed to empirically verify the financial performance of two cases of merger of top universities in Taiwan after the merger with FRA from 2012 to 2021, so as to provide a practical reference for governments' policy makers and HEIs' managers.

The article was structured as follows. Section II contained literature reviews. Section III illustrated the data and methodology employed in this study. Section IV manifested empirical results. Section V concluded the results, along with making some suggestions.

## II. LITERATURE REVIEW

There were already many studies that exploited the performance of HEIs, and most of which investigated from the perspective of production efficiency or cost efficiency. Such as [43, 50–58]. Nevertheless, the literature that empirically examines the performance of the so-called "world-class university" or "top universities" was relatively rare, although growing. Besides, most of them focused on evaluating the performance of "top universities" from the perspective of research productivity, especially in terms of world rankings. There was very little literature focused on the assessment of the financial performance of "top universities", especially on the efficiency of resource use and financial soundness. Until recently, Agasisti *et al.* [49] employed the Meta-frontier Malmquist Productivity

Index (MMPI) to examine and compare the efficiency of a sample of Chinese and European elite universities from 2011 to 2015. The study showed that the productivity growth of Chinese “elite universities” was faster than that of European “elite universities”, although the technical efficiency of European “elite universities” was still higher than Chinese “elite universities”.

Furthermore, there were also various studies on the merger of HEIs, such as [38, 44, 45, 47, 48, 59–68]. However, it may be limited by the limited number of merger cases of top universities worldwide, and very few studies focused on the tracking and verification of the performance of top universities after mergers. As far as this study is concerned, so far only [40, 42, 44, 45].

Liu *et al.* [40] employed OLS to evaluate the impacts of mergers on productivity of publications for 29 HEIs in China and 8 HEIs in Nordic countries from 2000 to 2010. The study found that Nordic HEIs experienced inconsistent growth rate of publication after the mergers. Danish and Finnish HEIs’ publication significantly grew, while Swedish HEIs’ ones declined after the mergers. Instead, Chinese HEIs experienced a small and positive growth rate of publication after the mergers, whereas the effect only displayed in the mergers involving non-Project 985 and varied-scaled HEIs, as well as mergers between comprehensive and medical HEIs.

Ripoll-Soler and de-Miguel-Molina [42] adopted the content analysis and semi-structured in-depth interviews to trace the post-merger ranking for 5 world-class universities, which merged from 2004 to 2015 in the European Union. The study revealed that 4 universities moved into the Top 100 after the merger, and all of them were merger cases with obvious complementary and varied-scale. They are the Aalto University in Finland, the Centrale-Supélec in France, the University of Lisbon in Portugal, and the University of Manchester in the UK. However, in the case of University of Strasbourg in France, which was a new HEI via the merger of three universities with clear overlaps in disciplines, they found vague and non-persistent results. Namely, the university upgraded its ranking into Top 100 from 2005 to 2015, yet fell out of the Top 100 since 2016.

Chen [44] applied nonparametric Data Envelopment Analysis (DEA) to examine the impacts of merger on technical efficiency of two post-merger universities in Taiwan from 2012 to 2017. The study demonstrated that the top university, NTHU’s technical efficiency declined due to the worsening of both pure technical efficiency and scale efficiency after the merger. Rather, NPYU, which was established via the merger involving non-top universities, performed efficiently after the merger. Not only optimized its scale efficiency, but also maintained pure technical efficiency. Since the pre-merger HEIs were pure technical efficiency, the result seemed to manifest that the merger of HEIs which have well management efficiency will be conducive to post-merger efficiency. However, since the data in this study only included the first year after the merger, the long-term impact of the merger on this case still needs to be tracked and verified.

Chen [45] used DEA to trace the impacts of merger on technical efficiency of three post-merger universities in

Taiwan from 2012 to 2020. The study presented that the merger of NTHU not only failed to better its management efficiency, but also turned it into decreasing return to scale. Furthermore, the results demonstrated the merger brought in NTHU diseconomies of scale and scope. Accordingly, this study demonstrated the undesired effect of merger on efficiency even in the long-run. Besides, what the most crucial factor on post-merger efficiency is ability of management of pre-merger HEIs, rather than whether pre-merger HEIs are “top universities”.

Although the above studies provided us with an understanding of the research performance or efficiency of top universities after the mergers in many countries over the past two decades, none of them empirically verify the changes and trends in the financial efficiency and soundness of top universities following the mergers. However, this study argues that top universities concentrate a large amount of social resources, including talents, funds, and other resources. If they can make good use of resources to ensure the achievement of teaching and research, it will be beneficial to the cultivation of professional talents and the development of scientific research innovation in the country, so as to benefit the international competitiveness of the country. However, in the rapid development, if financial efficiency and soundness are not taken into account, not only will the expected achievements of teaching and research not be fulfilled, but resources may be abused and wasted. If it even involves high debts, it will even cause an additional burden on the national finances. More importantly, once the top universities are merged, the scale will expand rapidly and resources will be more concentrated, and the scientific research achievements brought by them will be more expected. The challenges and potential risks it faces are also worthy of attention and inspection [41, 43–45]. For example, the research productivity may not be promoted and even decline [40, 46], the teaching quality may be sacrificed for cost-efficiency [69, 70] or for higher research production [4], the possible diseconomies of scale and scope following the mergers [44, 45, 68], the reduction in local mission achievement [3, 4], the organization and culture cannot be smoothly and successfully integrated [47, 65], the internal friction caused by cross-campus interests and resource competition [3, 71], the faculty and staff cannot establish a good identity for the post-merger HEIs [48, 72]. However, so far there were very few related studies focused on the mergers of “top universities”. Moreover, these very few studies focus on the verification of teaching and research productivity, without examining it from a financial perspective.

What this research wanted to appeal is that we are happy to see the merger of top universities, but it must take into account the financial performance to ensure its resource utilization efficiency and financial soundness. Only in this way can we ensure the steady and sustainable development of a country’s HEIs and achieve their mission of teaching and research.

Finally, due to the still ambiguous definition about “world-class” or “elite” or “top” universities in literature [4, 10, 49], the so-called “top universities” in this study

referred to the universities which were funded by the “Aim for the Top University Project” since 2006 to 2017 and the “Whole-School Program”, which was the second part of the “Sustained Progress and Rise of Universities in Taiwan (SPROUT) Project” since 2018 to 2022. Namely, the NTHU and NCTU.

In view of what was described above, this study purposed to apply FRA to empirically examine the financial performance of two cases of top university mergers in Taiwan after the merger. It was hoped that the findings of this research call on government policy makers and managers of HEIs to pay attention to the financial performance of top universities, especially resources allocation efficiency and financial stability of top universities involved in mergers. And hope that the results of this study can provide them with relevant references to optimize the policy and management of HEIs.

### III. DATA AND METHODOLOGY

#### A. Data

So far, there were two cases of mergers involving top universities in Taiwan. Here so-called ‘top universities’ in this study were those had long been highly funded by ‘Aim for the Top University Project’ in Taiwan. The two cases of top university mergers were described as follows.

##### 1) National Tsing Hua University (NTHU)

NTHU is a prestigious university with a long history [73]. As early as in 1911, Tsing Hua Academy was founded at Tsing Hua Garden in Beijing, China. In 1928, it was renamed as NTHU. In 1956, NTHU was rebuilt in Hsinchu, Taiwan. Since then, NTHU has transformed from a research institution focusing on nuclear science and technology to a comprehensive research university comprising science, engineering, humanities, society, and technology management. On November 1, 2016, NTHU formally merged with National Hsinchu University of Education (NHCUE), which was a much smaller HEI relative to NTHU and mainly consisted of schools of education, art, and science. NTHU has long been one of Taiwan’s top universities and has been perceived as the best incubator for future industry leaders and scholars, after the merger, he has further expanded to fields of education and arts. NTHU were so-called top university funded by “Aim for the Top University Project” in Taiwan from 2006 to 2016 and the “Whole-School Program” which was the second part of the “Sustained Progress and Rise of Universities in Taiwan (SPROUT) Project” during 2018 and 2022.

##### 2) National Yang Ming Chiao Tung University (NYCU)

NYCU is a new university generated via the merger of National Yang Ming University (NYMU), the relatively small-sized HEI, and National Chiao Tung University (NCTU), the relatively large-sized HEI, on February 1, 2021 [74]. NYMU was formerly National Yang-Ming College of Medicine founded in 1975 and upgraded to NYMU in 1994, the first medicine-oriented university in Taiwan. Over time, NYMU has built on its strengths in medicine while expanding its focus to the broader

biomedical sciences. NCTU was founded in the suburbs of Shanghai in 1896 and dissolved in 1949. In 1957, NCTU was reestablished to develop the electronic industry for the national economy and defense at its present location in Hsinchu, Taiwan. NCTU has long been a leader in Taiwan in the fields of electronics, information communication and management, science and engineering, and established the goal of developing the field of biomedicine twenty years ago, including biomedical information, biomedical materials, biomedical electronics, biomedical medical science, etc. It is expected to be a pioneer in the development of biomedical technology industry in Taiwan by spanning telecommunications and biomedicine. In recent years, it has been committed to building NCTU into a forward-looking R&D base for biomedical engineering in Taiwan, and creating a new milestone in BioICT, a biomedical electrical engineering project. In view of the different fields of the two universities and the needs of the times, the two universities expect to complete the major tasks of teaching and research across fields (especially the two fields of BioICT and Digital Bio-Medicine) through the merger. Both of NYMU and NCTU were so-called top university funded by “Aim for the Top University Project” in Taiwan from 2006 to 2016, and NCTU was funded by the “Whole-School Program”, which was the second part of the “Sustained Progress and Rise of Universities in Taiwan (SPROUT) Project” from 2018 to 2022.

#### B. Methodology

This study employed Financial Ratio Analysis (FRA) to evaluate the impacts of merger on financial performance of two cases of top university mergers. Four oriented financial ratios adopted in this study were described as follows.

Firstly, this study employed Current Ratio (CR) to evaluate the short-run solvency of universities. CR was formulated as follows:

$$\text{Current Ratio (CR)} = \frac{\text{Current Assets}}{\text{Current Liabilities}}$$

CR assesses how much liquid assets a university has to cover each dollar of current liabilities. The higher the CR, the better the short-term solvency of the university, the higher liquidity and the lower the liquidity risk.

Secondly, this study employed Debt Ratio (DR) to evaluate the long-run solvency of universities. DR was formulated as follows:

$$\text{Debt Ratio (DR)} = \frac{\text{Total Debts}}{\text{Total Assets}} \times 100\%$$

DR assesses a university’s liabilities as a percentage of its total assets. Since the debt has the obligation to repay the principal and interest on a regular basis, the higher the DR, the lower the university’s own capital and the worse the long-term solvency, that is, the lower the financial soundness (i.e., financial stability) and the higher the default risk.

Thirdly, this study employed two financial ratios, namely, Total Assets Turnover Ratio (TATR) and Fixed

Assets Turnover Ratio (FATR) to evaluate the abilities of utilizing assets to generate net sales of universities.

TATR evaluated the efficiency of utilizing overall assets to generate net sales of universities. TATR was formulated as follows:

$$\begin{aligned} \text{Total Assets Turnover Ratio (TATR)} \\ = \frac{\text{Net Sales}}{\text{Total Assets}} \times 100\% \end{aligned}$$

TATR assesses a university's ability to use all of its assets to generate net sales. The higher the TATR, the higher the efficiency of the university in using all assets to generate net sales.

FATR evaluated the efficiency of utilizing fixed assets to generate net sales of universities. FATR was formulated as follows:

$$\begin{aligned} \text{Fixed Assets Turnover Ratio (FATR)} \\ = \frac{\text{Net Sales}}{\text{Fixed Assets}} \times 100\% \end{aligned}$$

FATR assesses a university's ability to use all of its fixed assets to generate net sales. The higher the FATR, the higher the efficiency of the university in using fixed assets to generate net sales.

Fourthly, this study employed four financial ratios, namely, Gross Profit Margin (GPM), Operational Profit Margin (OPM), Net Profit Margin (NPM), and rate of return on total assets (ROA) to evaluate the profitability of universities.

GPM evaluated the capabilities to generate gross profits of universities. GPM was formulated as follows:

$$\begin{aligned} \text{Gross Profit Margin (GPM)} &= \frac{\text{Gross Profits}}{\text{Net Sales}} \times 100\% \\ &= \frac{(\text{Net Sales} - \text{Costs of Sales})}{\text{Net Sales}} \times 100\% \end{aligned}$$

GPM assesses a university's ability to generate gross profits. Since gross profits are net sales minus cost of sales, GPM can simultaneously evaluate a university's ability to generate net sales and control cost of sales. The higher the GPM, the higher the gross profits. Revealing the university has either the better ability to generate net sales, or the better ability to control cost of sales, or both.

OPM evaluated the capabilities to generate operational profits of universities. OPM was formulated as follows:

$$\begin{aligned} \text{Operational Profit Margin (OPM)} \\ &= \frac{\text{Operational Profits}}{\text{Net Sales}} \times 100 \\ &= \frac{(\text{Gross Profits} - \text{Operational Expenses})}{\text{Net Sales}} \times 100\% \end{aligned}$$

OPM assesses a university's ability to generate operational profits. Since operational profits are gross profits minus operational expenses, by comparing GPM and OPM can further reveal a university's ability to control operational expenses. The higher the OPM, the higher the operational profits. Revealing the university has either the better ability to generate gross profits, or the better ability to control operational expenses, or both.

NPM evaluated the capabilities to generate net profits of universities. NPM was formulated as follows:

$$\begin{aligned} \text{Net Profit Margin (NPM)} &= \frac{\text{Net Profits}}{\text{Net Sales}} \times 100\% \\ &= \frac{(\text{Operational Profits} + \text{Nonoperational Profits})}{\text{Net Sales}} \times 100\% \end{aligned}$$

where:

$$\begin{aligned} \text{Nonoperational Profits} &= \text{Operational Profits} \\ &+ \text{Nonoperational Income} \\ &- \text{Nonoperational Expenses} \end{aligned}$$

NPM assesses a university's ability to generate net profits. Since net profits are operational profits plus nonoperational profits (i.e., nonoperational income minus nonoperational expenses), by comparing OPM and NPM can further reveal a university's ability to generate profits via nonoperational activities. The higher the NPM, the higher the net profits. Revealing the university has either the better ability to generate net profits, or the better ability to generate profits via nonoperational activities, or both.

ROA evaluated the capabilities of utilizing overall assets to generate net profits of universities. ROA was formulated as follows:

$$\begin{aligned} \text{Rate of Return on Total Assets (ROA)} \\ &= \frac{\text{Net Profits}}{\text{Total Assets}} \times 100\% \\ &= \frac{\text{Net Sales}}{\text{Total Assets}} \times \frac{\text{Net Profits}}{\text{Net Sales}} \times 100\% \\ &= \text{TATR} \times \text{NPM} \end{aligned}$$

ROA assesses a university's ability of utilizing overall assets to generate net profits. Since ROA can be decomposed as TATR multiplied by NPM, the higher the NPM, the higher the TATR or NPM or both. Revealing the university has either the better ability to well use total assets to generate net sales, or the better ability to generate net profits given the net sales, or both.

The data used in this study were all taken from the financial statements disclosed on the official websites of the sample universities. The data description was revealed in Table I.

TABLE I. SAMPLE STATISTICS DESCRIPTION (UNIT: NT\$10 MILLION)

		Total Assets	Current Assets	Net Fixed Assets	Total Debts	Current Liabilities	Net Sales	Gross Profits	Operational Profits	Net Profits
<b>Case I: NTHU</b>										
MEAN	NTHU	2015	213	946	921	142	484	32	-53	-48
	NHCUE	369	98	108	170	11	90	14	-2	3
STD	NTHU	198	20	62	235	75	16	13	11	8
	NHCUE	26	18	3	13	2	2	1	1	2
MAX.	NTHU	2353	246	1026	1335	247	511	45	-44	-38
	NHCUE	410	120	113	192	12	92	15	0	5
MIN.	NTHU	1852	197	876	765	58	469	13	-71	-56
	NHCUE	343	76	106	160	9	87	12	-3	0
<b>Case II: NYCU</b>										
MEAN	NCTU	2292	251	839	1395	325	553	9	-52	-39
	NYMU	1128	185	295	730	104	238	6	-20	-6
STD	NCTU	220	158	87	227	71	48	10	9	11
	NYMU	71	11	55	54	25	8	6	8	2
MAX.	NCTU	2596	407	949	1672	441	630	30	-35	-17
	NYMU	1229	202	347	817	146	248	13	-11	-3
MIN.	NCTU	2020	73	734	1116	231	511	-6	-67	-53
	NYMU	1017	173	210	663	67	224	-4	-33	-8

IV. EMPIRICAL RESULTS

A. The Case of NTHU

1) Short-run solvency analysis

Fig. 1 shows the CR for NTHU and NHCUE from 2012 to 2021. From 2012 to 2016, the period before the merger, NTHU’s CR was greatly lower than that of NHCUE in all years. That was because the current assets of NTHU were larger than that of NHCUE, while its current liabilities were much larger than that of NHCUE. NTHU’s current assets were 1.8 to 2.61 times that of NHCUE, but its current liabilities were as high as 6.56 to 20.03 times that of NHCUE. On average, NTHU’s current assets were only 2.23 times that of NHCUE, while its current liabilities were as high as 12.79 times.

In terms of trends, NTHU’s CR dropped sharply from 3.41 in 2012 to 0.99 in 2016, since the growth rates of current assets were much smaller than those of current liabilities. On the contrary, NHCUE’s CR increased from 8.57 in 2012 to 9.7 in 2016, because the growth rates of current assets were larger than those of current liabilities. This resulted in a mean of CR of 1.88 for NTHU and 9.20 for NHCUE. The results manifested that the short-run solvency of NTHU was much poorer than NHCUE, namely, NTHU’s liquidity risk was much higher than NHCUE before the merger. Moreover, the short-run solvency of NTHU regressed seriously, indicating that its liquidity risks surged in the period, whereas the short-run solvency of NHCUE enhanced, revealed that its liquidity risks were relatively lower in the period.

After the merger of the two universities, the post-merger university NTHU’s CR first decayed to 0.8 in 2017, and then increased to 1.28 in 2021. This was because current assets first decreased in 2017, and then increased year by year, while current liabilities continued to increase. For NTHU, although the CR of each year after the merger was mostly higher than the CR of the year before the merger, i.e. 0.99, they are all far lower than the level of 3.41 in 2012. Moreover, in terms of means, the NTHU’s mean of CR after the merger was 1.16. For NTHU, its mean of CR decreased by 0.72, while for NHCUE, its mean of CR

largely decreased by 8.03. The results indicated that NTHU’s short-term solvency did not be significantly improved by the merger. That was, the merger did not reduce its liquidity risk. Furthermore, for NHCUE, the post-merger CR was much lower than the level of each year before the merger, indicating that its short-term solvency has deteriorated sharply after the merger, namely, the merger has greatly increased its liquidity risk.



Fig. 1. Current ratios of NTHU and NHCUE from 2012 to 2021.

2) Long-run solvency analysis

Fig. 2 displays the DR for NTHU and NHCUE from 2012 to 2021. Before the merger, NTHU’s DR was lower than NHCUE’s, except to 2016. That was because NTHU’s total debts were 4.79 to 5.28 times of NHCUE’s, while its total assets were 5.37 to 5.40 times of NHCUE’s. However, in 2016, NTHU’s DR significantly increased by 12.93% due to its great increase in total debts by 51.25%, thus pushing up its DR to 56.74%, surpassing NHCUE’s 47%. This resulted in that, on average, NTHU’s total debts were 5.37 times that of NHCUE, while its total assets were 5.46 times.

In terms of trends, NTHU’s DR was mainly on the rise, because its debt growth rates were greater than its asset growth rates. On the contrary, NHCUE’s DR was on a downward trend except for 2016, because its debt growth rates were smaller than its asset growth rates. This resulted in a mean of DR of 45.21 for NTHU and 46.09 for NHCUE. The results showed that the long-run solvency of NTHU continued to decline before the merger, and it was already lower than that of NHCUE in 2016, that is, the default risk of NTHU in the year before the merger has surpassed that

of NHCUE. Overall, in the period before the merger, NTHU's DRs increased from 41.3% in 2012 to 56.74% in 2016, while NHCUE's DRs slightly increased from 46.54% in 2012 to 47% in 2016.

After the merger, NTHU, the post-merger university, its DR increased to 58.1% in 2021 due to its greater increase in debt growth rates than its asset growth rates. Comparing to 2016, for NTHU, its DR kept increasing by 1.36%, while NHCUE's DR largely increased by 11.1%. In terms of means, the NTHU's mean of DR after the merger was 56.67%. For NTHU, its mean of DR increased by 11.46%, while for NHCUE, its mean of DR largely increased by 10.58%. That manifested the merger did not improve long-run solvency for both pre-merger universities, rather, their default risk was higher after the merger, especially for NHCUE. Moreover, the trend of increase in DR seemed to be ongoing.

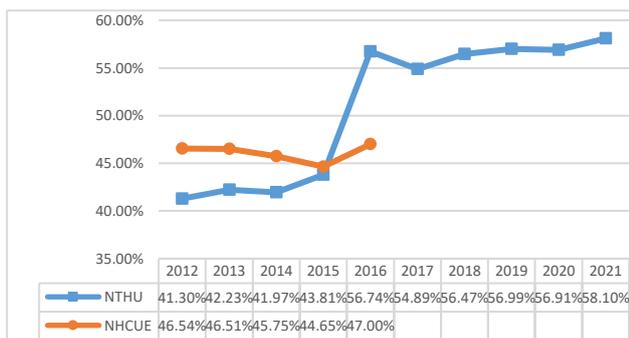


Fig. 2. Debt ratios of NTHU and NHCUE from 2012 to 2021.

### 3) Assets utilization efficiency analysis

Fig. 3 displays the TATR for NTHU and NHCUE from 2012 to 2021. Before the merger, NTHU and NHCUE's TATR were neck and neck. NTHU's net sales were 5.27 to 5.68 times of NHCUE's, while its total assets were 5.37 to 5.75 times of NHCUE's. On average, NTHU's net sales were 5.4 times that of NHCUE, while its total assets were 5.46 times.

Moreover, both of their TATR were trending down as their growth rates of net sales were much lower than those of total assets. Actually, their net sales were even in decline in 2012 and 2013. That resulted in NTHU's TATR dropped from 27.59% in 2012 to 20.51% in 2016, and NHCUE's TATR declined from 26.21% in 2012 to 22.38% in 2016. In addition, it also resulted in an average TATR of 24.21% and 24.42% for NTHU and NHCUE, respectively. This result demonstrated that, prior to the merger, both universities had comparable abilities to use all assets to generate net sales. Furthermore, the efficiency with which both universities used their assets to generate net sales continued to decline.

After the merger, NTHU's TATR was 20.7% in 2021. Compared with 2016, it was a slight increase of 0.19% for NTHU, but a decrease of 1.68% for NHCUE. In addition, the TATR of NTHU showed a trend of rising first and then falling because the growth rates of net sales were higher than those of total assets at first, and then lower than those of total assets. In terms of means, the NTHU's mean of TATR after the merger was 21.75%. For NTHU, it was a decrease of 2.47%, while 2.67% for NHCUE. The results

showed that the merger did not enhance but indeed deteriorated the ability of the two universities to utilize total assets to generate net sales.

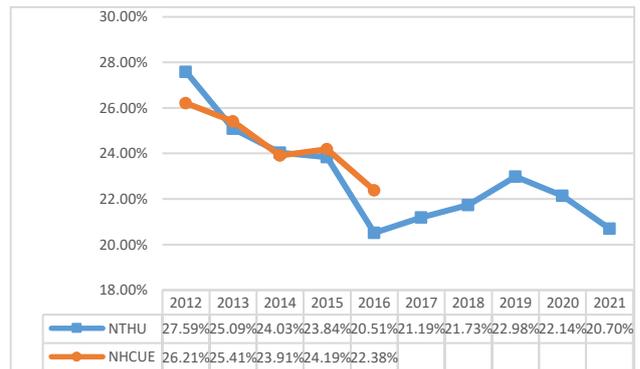


Fig. 3. Total asset turnover ratios of NTHU and NHCUE from 2012 to 2021.

Fig. 4 displays the FATR for NTHU and NHCUE from 2012 to 2021. Before the merger, NTHU's FATR was far lower than NHCUE's in all years. That was because NTHU's net sales were 5.27 to 5.68 times of NHCUE's, while its fixed assets were 8.33 to 9.68 times of NHCUE's. On average, NTHU's net sales were 5.4 times that of NHCUE, while its fixed assets were 8.77 times.

Besides, NTHU's FATR was trending down as net sales growth rate declined while fixed assets growth rate rose. Conversely, NHCUE's FATR was on the rise due to a decrease in fixed asset growth rate and an increase in net sales growth rate. This caused the FATR of NTHU dropped from 58.36% in 2012 to 47.06% in 2016, while the FATR of NHCUE increased from 79.52% in 2012 to 86.56% in 2016. Furthermore, this also resulted in a mean of FATR of 51.38% for NTHU, whereas a high mean of FATR of 83.11% for NHCUE. This result stated that before the merger, NTHU's ability to generate net sales using fixed assets was far poor to that of NHCUE. Furthermore, NTHU's efficiency in utilizing fixed assets to generate net sales declined hugely between 2012 and 2016, while NHCUE's improved.

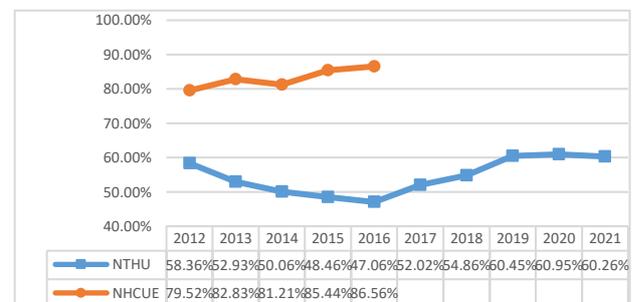


Fig. 4. Fixed asset turnover ratios of NTHU and NHCUE from 2012 to 2021.

After the merger, NTHU's FATR was increasing from 52.02% in 2017 to 60.26% in 2021 due to the higher growth rates of net sales relative to fixed assets. Comparing to 2016, it was a substantial increase of 13.2% for NTHU, while a deep decrease of 26.3% for NHCUE. In terms of means, the NTHU's mean of FATR after the merger was 57.71%. For NTHU, it was an increase of

6.33%, while for NHCUE, a substantial decrease of 25.41%. That meant, for NHCUE, its efficiency of using fixed assets to generate net sales greatly declined and has still not recovered to the level before the merger until 2021.

4) Profitability analysis

Fig. 5 displays the GPM for NTHU and NHCUE from 2012 to 2021. Before the merger, NTHU's GPM was far lower than NHCUE's in all years. As NTHU's gross profits were merely 1.02 to 3.04 times of NHCUE's, whereas its net sales were 5.27 to 5.68 times of NHCUE's. On average, NTHU's gross profits were 2.34 times of NHCUE's, while its net sales were 5.4 times. The results revealed that NTHU's ability to control costs of sale was poorer than NHCUE's.

Besides, the GPM of NTHU and NHCUE were both on the rise as their growth rates of gross profit were greater than those of net sales in most years. This resulted in the GPM of NTHU increased from 4.83% in 2012 to 9.31% in 2016, and the GPM of NHCUE increased from 13.87% in 2012 to 16.12% in 2016. Moreover, this also resulted in a mean of GPM of 6.73% for NTHU, while a mean of GPM of 15.25% for NHCUE. The results revealed that before the merger, the abilities to control costs of sale were improving for both NTHU and NHCUE.

After the merger, NTHU's GPM rose first from 10.13% in 2017 to 13.01% in 2019 and fell later to 11.24% in 2020 and further to 5.78% in 2021. That was because the growth rates of gross profit were higher than those of net sales first, and then turned to be lower than those of net sales. Compared with 2016, it was a decrease of 3.53% for NTHU, while a deep decrease of 10.34% for NHCUE. In terms of means, the NTHU's mean of GPM after the merger was 10.15%. For NTHU, it was an increase of 3.42%, while for NHCUE, a substantial decrease of 5.09%. By 2021, the GPM of NTHU has not recovered to the level before the merger for both pre-merger universities. The results manifested that although the merger conducive to growth of net sales, it did not contribute to enhance the abilities to control costs of sale for both NTHU and NHCUE, and consequently did not improve the GPM of the post-merger university.

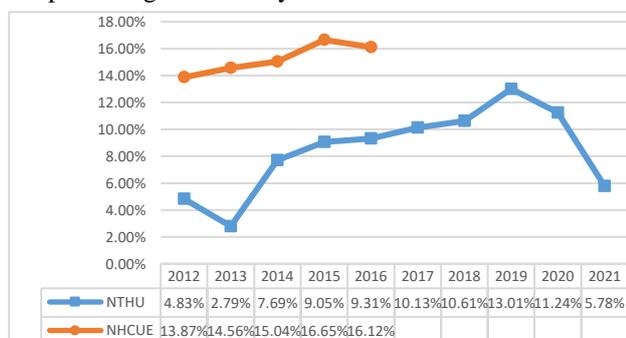


Fig. 5. Gross profit margins of NTHU and NHCUE from 2012 to 2021.

Fig. 6 displays the OPMs for NTHU and NHCUE from 2012 to 2021. Before the merger, the OPMs of both universities were negative in all years, because their operational profits were all negative. That indicated the operational expenses were too high to make profits for both pre-merger universities. Moreover, NTHU's OPMs

were much lower than NHCUE's in all years since its operational profits were just 0.0002 to 0.06 times of NHCUE's, though its net sales were 5.27 to 5.68 times of NHCUE's. On average, NTHU's operational profits were 0.03 times of NHCUE's, while its net sales were 5.4 times. The results revealed that NTHU's ability to control operational expenses was poorer than NHCUE's.

In terms of trends, the OPMs of NTHU and NHCUE were mainly upward trends as their growth rates of operational profits were greater than those of net sales in most years. NTHU's OPM was increased from -11.16% in 2012 to -9.93% in 2016, and NHCUE's OPM was increased from -3.11% in 2012 to -0.01% in 2016. This led to a mean of OPM of -10.94% for NTHU, while -2.17 for NHCUE. The results revealed that before the merger, the abilities to control operational expenses were improving for both NTHU and NHCUE.

After the merger, NTHU's OPMs were first increasing and up to -2.29% by 2020 though dropped to -4.63% in 2021. That was caused by the higher growth rates of operational profit than those of net sales from 2017 to 2020. Compared to 2016, as of 2021, NTHU's OPM was up 5.3%, but NHCUE was down 4.62%. In terms of means, the NTHU's mean of OPM after the merger was -4.59%. For NTHU, it was an increase of 6.34%, while for NHCUE, a decrease of 2.42%. By 2021, the OPM of NTHU has not recovered to the levels before the merger for NHCUE. The results manifested that the merger did not contribute to enhance the abilities to control operational expenses for both NTHU and NHCUE. Most importantly, the merger did not turn the post-merger university from operational losses into operational profits, but it was improving, except to 2021.

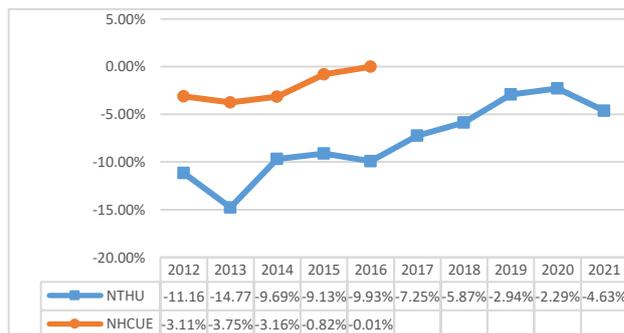


Fig. 6. Operational profit margins of NTHU and NHCUE from 2012 to 2021.

Fig. 7 displays the NPM for NTHU and NHCUE from 2012 to 2021. Before the merger, the NPMs of NTHU were negative in all years, because its net profits were all negative. On the contrary, the positive net profits made NHCUE's NPMs were positive in all years, except 2013. NTHU's net profits were only -37.48 to 0.001 times of NHCUE's, while its net sales were 5.27 to 5.68 times of NHCUE's. This led to that NTHU's NPMs were far lower than NHCUE's. On average, NTHU's net profits were -13.07 times of NHCUE's, while its net sales were 5.4 times. The results implied NTHU's capability to gain from nonoperational activities was much poor than that of NHCUE.

In terms of trends, the NPMs of NTHU and NHCUE were mainly upward trends as their growth rates of net profits were greater than those of net sales in most years. NTHU's NPM was increased from -10.68% in 2012 to -8.38% in 2016, and NHCUE's OPM was increased from 1.62% in 2012 to 5.98% in 2016. This led to a mean of NPM of -9.83% for NTHU, while 3.42 for NHCUE. The results revealed that before the merger, the abilities to profit from nonoperational activities were improving for both NTHU and NHCUE.

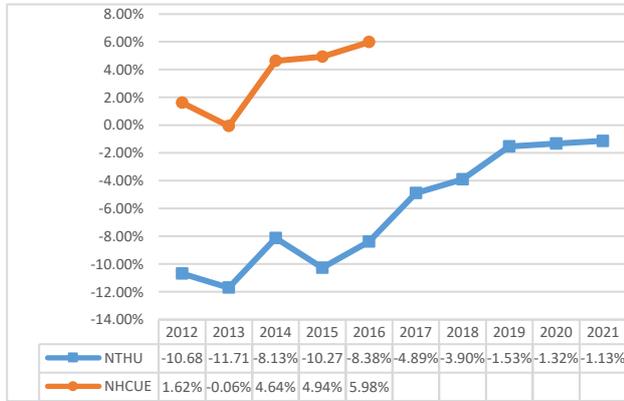


Fig. 7. Net profit margins of NTHU and NHCUE from 2012 to 2021.

After the merger, NTHU's NPMs were increasing and up to -1.13% by 2021. That was caused by the higher growth rates of net profit than those of net sales. Compared to 2016, as of 2021, NTHU's NPM was up 7.25%, but NHCUE was down 7.11%. In terms of means, the NTHU's mean of NPM after the merger was -2.55%. For NTHU, it was an increase of 7.28%, while for NHCUE, a decrease of 5.98%. By 2021, the NPM of NTHU has not recovered to the levels before the merger for NHCUE. The results showed the merger did not turn the post-merger university from net losses into net profits, but fortunately it was on the rise.

Fig. 8 displays the ROA for NTHU and NHCUE from 2012 to 2021. Before the merger, the ROAs of NTHU were negative in all years as its net losses. Instead, the ROAs of NHCUE were positive caused by positive net profits in all years, except 2013. NTHU's net profits were only -37.48 to 0.001 times of NHCUE's, while its total assets were 5.37 to 5.75 times of NHCUE's. On average, NTHU's net profits were -13.07 times of NHCUE's, while its total assets were 5.46 times. This led to that NTHU's ROAs were far lower than NHCUE's. The results implied NTHU's capability to generate net profits via well utilize overall assets was much poorer than that of NHCUE.

In terms of trends, the ROAs of NTHU and NHCUE were mainly upward trends as their growth rates of net profits were greater than those of total assets in most years. NTHU's ROA was increased from -2.95% in 2012 to -1.72% in 2016, and NHCUE's ROA was increased from 0.42% in 2012 to 1.34% in 2016. This led to a mean of ROA of -2.4% for NTHU, while 0.81 for NHCUE. The results showed that before the merger, the abilities to generate net profits via well utilize overall assets were improving for both NTHU and NHCUE.

After the merger, NTHU's ROAs were increasing and up to -0.23% by 2021. That was caused by the higher growth rates of net profit than those of total assets. Compared to 2016, as of 2021, NTHU's ROA was up 1.49%, but NHCUE was down 1.57%. In terms of means, the NTHU's mean of ROA after the merger was -0.55%. For NTHU, it was an increase of 1.85%, while for NHCUE, a decrease of 1.36%. By 2021, the ROA of NTHU has not recovered to the levels before the merger for NHCUE. The results showed the ROA of post-merger university did not yet turn into positive by 2021, but fortunately it was on the rise.

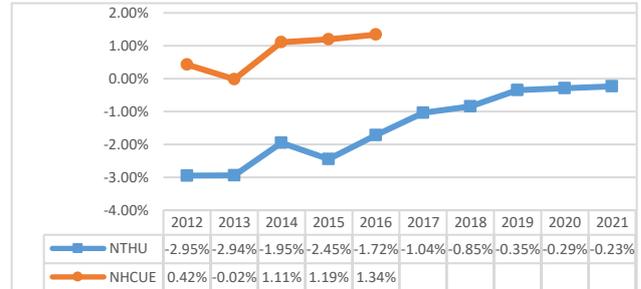


Fig. 8. Rates of return on total asset of NTHU and NHCUE from 2012 to 2021.

## B. The Case of NYCU

### 1) Short-run solvency analysis

Fig. 9 displays CRs of NCTU and NYMU, the two pre-merger universities, and NYCU, the post-merger universities from 2012 to 2021. From 2012 to 2020, the period before the merger, NCTU's CRs were lower than that of NYMU in all years. Because the current assets of NCTU were only 0.39 to 2.3 times that of NYMU, but its current liabilities were as high as 2.59 to 3.44 times that of NYMU. On average, NCTU's current assets were only 1.35 times that of NYMU, while its current assets were as high as 3.14 times.

In terms of trends, CRs of both NCTU and NYMU decayed seriously, since the growth rates of current assets were much smaller than those of current liabilities. In fact, their current assets were even largely declined in several years. NCTU's CRs fell from 1.55 in 2012 to 0.22 in 2020, while NYMU's CRs fell from 2.89 in 2012 to 1.38 in 2020. This resulted in a mean of CR of 0.88 for NCTU and 1.88 for NYMU. The results indicated that the short-run solvency of NCTU was poor than NYMU, namely, NCTU's liquidity risk was higher than NYMU before the merger. Nevertheless, the short-run solvency of both the two pre-merger HEIs regressed seriously, indicating that their liquidity risks have surged in the period.

After the merger of the two universities and formed the new university, NYCU, NYCU's CR was 0.26 in 2021. While CR increased by 0.04 for NCTU, CR decreased by 1.12 for NYMU. So far, NYMU's short-run solvency still did not recover to the level before the merger. That was since after the merger, for NCTU, the growth rate of current assets was higher than that of current liabilities. However, for NYMU, its current assets decreased, its current liabilities though largely increased.

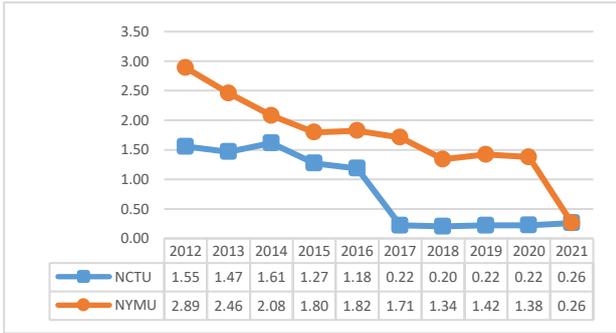


Fig. 9. Current ratios of NYMU and NCTU from 2012 to 2021.

2) Long-run solvency analysis

Fig. 10 displays the DRs of NYMU, NCTU, and NYCU from 2012 to 2021. As depicted in Fig. 10, NCTU's DRs were lower than NYMU from 2012 to 2017, while higher than NYMU from 2018 to 2020. This was because before 2018, NCTU's total debts were 1.65 to 1.86 times that of NYMU, while its total assets were as high as 1.89 to 1.99 times that of NYMU. However, since 2018, NCTU's total debts increased sharply to 2.15 times that of NYMU, while its total assets only increased to 2.12 times that of NYMU, making its DR slightly higher than that of NYMU until 2020. The results manifested that the long-run solvency of NCTU was better than NYMU before 2018, however, slightly poorer than NYMU since 2018. That was, NCTU had a lower default risk and thus higher financial stability than NYMU from 2012 to 2017, nevertheless, a higher default risk and thus lower financial stability than NYMU from 2018 to 2020. On average, NCTU's total debts were 1.91 times that of NYMU, while its total assets were 2.03 times.

In terms of trend, NCTU's DRs showed an upward trend due to the continuous increase of total debts and total assets and higher growth rates of total debts relative to total assets. Quite differently, NYMU's DR showed a trend of rising first and then falling, because its total debts and total assets continued to rise to a peak in 2016 and then declined. This resulted in the means of DR of 60.5% for NCTU and 64.69% for NYMU. The results showed that before the merger, NCTU's long-term solvency continued to deteriorate rapidly, while NYMU's long-term solvency continued to improve since 2018. That is, NCTU's default risk was increasing and its financial stability was decreasing, while NYMU's default risk peaked in 2016 and has decreased in recent years, so its financial stability has enhanced in recent years. Overall, in the period before the merger, NCTU's DRs increased from 55.26% in 2012 to 64.4% in 2020, while NYMU's DRs decreased from 65.19% in 2012 to 62.26% in 2020.

After the merger, NYCU's DR was 63.61% in 2021. For NCTU, DR slightly decreased by 0.79%, while increased by 1.35% for NYMU. This was because after the merger, the growth rates of debts were lower than those of total assets for NCTU, however, the growth rates of debts were higher than those of total assets for NYMU. So far, for NYMU, its long-term solvency has not returned to pre-merger levels.

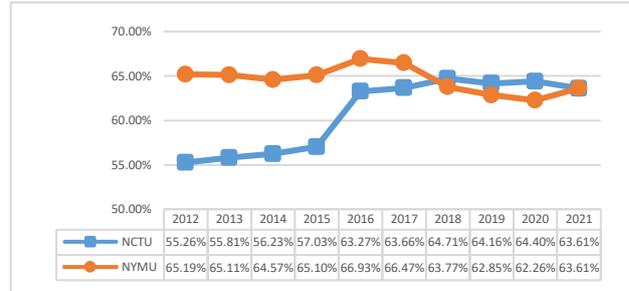


Fig. 10. Debt ratios of NYMU and NCTU from 2012 to 2021.

3) Assets utilization efficiency analysis

Fig. 11 displays the TATRs of NYMU, NCTU, and NYCU from 2012 to 2021. In the pre-merger period, NCTU's TATRs were consistently higher than NYMU in all years before the merger, this was because NCTU's net sales were about 2.15 to 2.57 times that of NYMU, while its assets were only 1.89 to 2.27 times. On average, NCTU's net sales were 2.32 times that of NYMU, while its assets were only 2.03 times.

Further, in terms of the trend, both of their TATR obviously declined to their nadir in 2016 and 2017, but the reasons for their TATR bottoming out were different. NCTU was due to an increase in total assets, while NYMU was due to a decrease in net sales and an increase in total assets at the same time. This resulted in a mean of TATR of 24.18% for NCTU and 21.19% for NYMU. The result showed that NCTU was capable of utilizing overall assets to generate net sales more efficiently than NYMU. Overall, in the period before the merger, NCTU's TATRs decreased from 25.83% in 2012 to 23.69% in 2020, while NYMU's TATRs decreased from 23.87% in 2012 to 21.69% in 2020.

After the merger, NYCU's TATR was 23.15% in 2021. Comparing to 2020, it was a slight decrease of 0.54% for NCTU, but an increase of 1.46% for NYMU. That was since after the merger, the growth rate of net sales lower than that of total assets for NCTU, though the growth rate of net sales higher than that of total assets for NYMU. This result manifested that although the merger slightly reduced the overall asset utilization efficiency of NCTU by 0.54%, it improved that of NYMU by 1.46%.

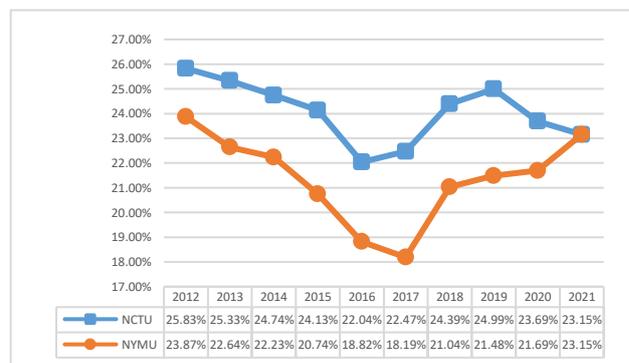


Fig. 11. Total asset turnover ratios of NYMU and NCTU from 2012 to 2021.

Fig. 12 displays the FATRs of NYMU, NCTU, and NYCU from 2012 to 2021. NCTU's FATR were

consistently lower than NYMU in all years before the merger, this was because NCTU's net sales were about 2.15 to 2.57 times that of NYMU, while its assets were as high as 2.54 to 3.49 times that of NYMU. On average, NCTU's net sales were 2.32 times that of NYMU, while its fixed assets were 2.9 times that of NYMU.

Further, in terms of trend analysis, NCTU's FATR fluctuated more flatly in trend, though its FATR also bottomed out in 2017 due to a great increase of 8.4% in fixed assets. Relatively, NYMU's FATR was dropping since 2013 and to its nadir in 2017. This was because NYMU's net sales declined from 2013 to 2017 and fixed assets increased at the same time, leading to its FATR sharply drop. In 2017, NYMU's net sales declined 2.15% and fixed assets increased 3.63% so as to make its FATA to bottom out in 2017. Overall, these resulted in a mean of FATR of 83.71% for NYMU and 66.06% for NCTU. The result revealed that NCTU relative to NYMU was less capable of utilizing fixed assets to generate net sales efficiently. Overall, in the period before the merger, NCTU's FATRs decreased from 71.05% in 2012 to 65.06% in 2020, while NYMU's FATRs sharply decreased from 115.58% in 2012 to 71.43% in 2020.

After the merger, NYCU's TATR was 68.78%. Compared to 2020, NCTU was up 3.72%, but NYMU was down 2.65%. That was since after the merger, the growth rate of net sales higher than that of total assets for NCTU, though the growth rate of net sales was lower than that of total assets for NYMU. This result manifested that although the merger significantly increased the fixed asset utilization efficiency of NCTU by 3.72%, it also greatly reduced that of NYMU by 2.65%.

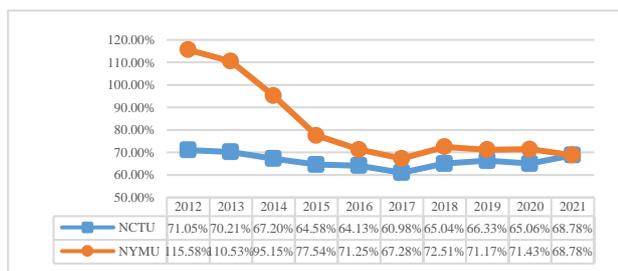


Fig. 12. Fixed asset turnover ratios of NYMU and NCTU from 2012 to 2021.

#### 4) Profitability analysis

Fig. 13 displays the GPMs of NYMU, NCTU, and NYCU from 2012 to 2021. During the period before the merger, NCTU's GPMs were lower than that of NYMU until 2018 and began to surpass NYMU in 2018. This was because before 2018, NCTU's gross profits were only -0.57 to 1.55 times that of NYMU, but its net sales were 2.15 to 2.40 times that of NYMU. However, this phenomenon reversed since 2018. In 2018, NCTU's net sales were 2.46 times that of NYMU, and its gross profits surged to 3.63 times that of NYMU, making its GPM surpass NYMU in one fell swoop. To make matters worse, from 2019 to 2020, NYMU's gross profits even turned negative, making NCTU's net sales 2.57 and 2.48 times that of NYMU, while its gross profits were as high as 8.31 and 8.04 times that of NYMU in 2019 and 2020,

respectively. The reason was that NYMU's net sales declined in 2016 and 2017, while the decrease in cost of sales was less than that of net sales. Subsequently, although net sales rose from 2018 to 2020, the increase in cost of sales was higher than that of net sales. As a result, NYMU's GPM began to be lower than that of NCTU in 2018. On average, NCTU's gross profits were -1.02 times of NYMU's, while its net sales were 2.32 times. The results revealed that NCTU's ability to control costs of sale was poor than NYMU's, especially before 2016.

In terms of trends, NCTU's GPMs were on the rise, while NYMU's was on the decline. NCTU's GPM increased from -0.3% in 2012 to 2.5% in 2020, whereas NYMU's GPM decreased from 5.12% in 2012 to -0.77% in 2020. This was because the growth rates of gross profits were significantly greater than those of net sales in most years for NCTU, while growth rates of gross profits were much lower than those of net sales since 2015 for NYMU. Overall, NCTU's and NYMU's means of GPM were 1.61% and 2.68%, respectively. The results revealed that although NCTU's ability to control costs of sale was poor than NYMU's, NCTU's ability was enhancing, while NYM's ability was decaying.

After the merger, NYCU's GPM was 3.54%. Compared with 2020, for the two pre-merger universities, the GPM has improved significantly due to the higher growth rates of gross profits relative to net sales. The GPM of NCTU and NYUM increased by 1.04% and 4.31%, respectively. It was obvious that the merger aided in the growth of net sales as well as ability to control costs of sales, and accordantly was beneficial to increase GPM for both the two top universities.

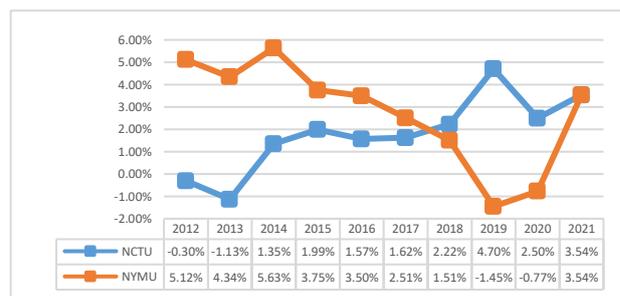


Fig. 13. Gross profit margins of NYMU and NCTU from 2012 to 2021.

Fig. 14 displays the OPMs of NYMU, NCTU, and NYCU from 2012 to 2021. Before the merger, through the peer and trend analyses of the OPMs of the two universities, it seemed to be very similar to the results of the GPM, namely, the OPM of NCTU also began to surpass the OPM of NYMU in 2018. Additionally, the OPM of NCTU was on the rise, while OPM of NYMU was on the decline. However, comparing the net sales and operational profit of the two universities revealed that the operational profits of the two universities has been negative for a long time. This was a question worthy of attention. It was obvious that the capabilities of operating expenses control for the two pre-merger universities needed to be improved! Moreover, in the period before the merger, NCTU's operational profits never surpassed NYMU. Just because NCTU's operating profit started to

rise from 2014, while NYMU's operating profit started to decline in 2015, it caused NCTU's OPM to surpass NYMU's from 2018.

Overall, NCTU's operational profits were 0.43 times of NYMU's, while its net sales were 2.32 times. Additionally, NCTU's and NYMU's means of OPM were -9.51% and -8.48%. Finally, NCTU's OPMs apparently increased from -11.71% in 2012 to -6.81% in 2020, whereas NYMU's OPMs dropped from -5.54% in 2012 to -12.59% in 2020. The results indicated that although NCTU's ability to control operating expenses was poorer than that of NYMU, NCTU's ability was greatly improving, while NYMU's ability was substantially decaying.

After the merger, NYCU's OPM was -6.39%. Compared with 2020, the OPM of post-merger university has improved for both pre-merger universities, although it was still in a state of loss. It was an improvement of 0.42% for NCTU, while 6.2% for NYMU. This was because of the higher growth rates of operational profits relative to net sales. However, since NCTU's growth rate of OPM was lower than that of GPM, indicating that the merger aided in well controlling operational expenses for NYMU, rather than for NCTU. Most importantly, the results showed the merger did not turn the post-merger university from operational losses into operational profits.

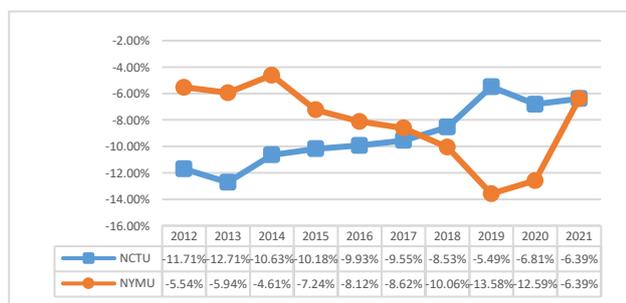


Fig. 14. Operational profit margins of NYMU and NCTU from 2012 to 2021.

Fig. 15 displays the NPMs of NYMU, NCTU, and NYCU from 2012 to 2021. Before the merger, the profits from nonoperational activities largely offset the losses caused by operational activities, especially for NYMU. However, their NPMs were still negative in overall pre-merger period. Moreover, throughout the pre-merger period, NCTU's NPM was lower than NYMU's, except for 2019. Overall, NCTU's net profits were 0.18 times of NYMU's, while its net sales were 2.32 times. It showed that NCTU's ability to generate profits through nonoperational activities was much worse than that of NYMU.

In terms of trend, the NPMs of NCTU showed a sharply upward trend, while downward trend for NYMU. For NCTU, this was because its growth rates of net profits were greater than those of net sales. Rather, for NYMU, this was because its net profits decreased, although its net sales increased at the same time. This resulted in NCTU's NPMs largely increased from -8.47% in 2012 to -4.25% in 2020, whereas NYMU's NPMs dropped from -2.37% in 2012 to -3.17% in 2020. Overall, this resulted in a mean of NPM of -7.22% for NCTU, while -2.48% for NYMU.

The results indicated that although NCTU's ability to generate profits through nonoperational activities was poor than that of NYMU, NCTU's ability was greatly improving, while NYMU's ability was slightly decaying.

After the merger of the two universities to form NYCU, NYCU's NPM was -3.12% in 2021. Compared to 2020, this was an increase of 1.13% for NCTU and 0.05% for NYMU due to the higher growth rates of net profits relative to net sales. Moreover, since NCTU's growth rate of NPM was higher than that of OPM, indicating that the merger was beneficial to NCTU's ability to gain from nonoperational profits. However, for NYMU, its NPM in 2021 remained below what it was in most years prior to the merger. Most importantly, the results showed the merger did not yet turn the post-merger university from net losses into net profits.

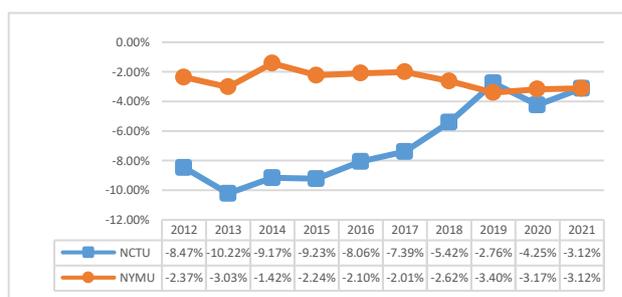


Fig. 15. Net profit margins of NYMU and NCTU from 2012 to 2021.

Fig. 16 displays the ROAs of NYMU, NCTU, and NYCU from 2012 to 2021. Before the merger, due to the negative value of net income for both pre-merger universities, their ROA were all negative. Moreover, NCTU's ROA was greatly lower than NYMU's, except for 2019, since NCTU's net profits was much lower than NYMU's, but NCTU's total assets were much higher than NYMU's. NCTU's net profits was 0.07 to 0.48 times that of NYMU, while its TA is 1.89 to 2.27 times that of NYMU. Overall, NCTU's net profits were 0.18 times of NYMU's, while its total assets were 2.03 times.

In terms of trend, NCTU's ROA was greatly on the rise, while NYMU's ROA was slightly on the decline. For NCTU, this was since its growth rates of net profits were greater than those of total assets. Rather, for NYMU, this was because its net profits slightly decreased, although its net sales increased at the same time. This resulted in NCTU's ROAs largely increased from -2.19% in 2012 to -1.01% in 2020, whereas NYMU's ROAs slightly declined from -0.57% in 2012 to -0.69% in 2020. Overall, this resulted in a mean of ROA of -1.75% for NCTU, while -0.53% for NYMU. The results indicated that although NCTU's ability to generate net profits through well using total assets was poor than that of NYMU, NCTU's ability was improving, while NYMU's ability was slightly decaying.

After the merger, NYCU's ROA was -0.72% in 2021. For NCTU, its ROA improved by 0.29%, while for NYMU, its ROA decreased by 0.03%. This was caused by the higher growth rates of net profits relative to total assets for NCTU, but a slightly lower growth rates of net profits relative to total assets for NCTU. Moreover, for NYMU,

NYCU's ROA in 2021 remained below what it was in all years prior to the merger, except for 2019. Most importantly, the results showed the merger did not yet turn the post-merger university's ROA from negative value into positive value.

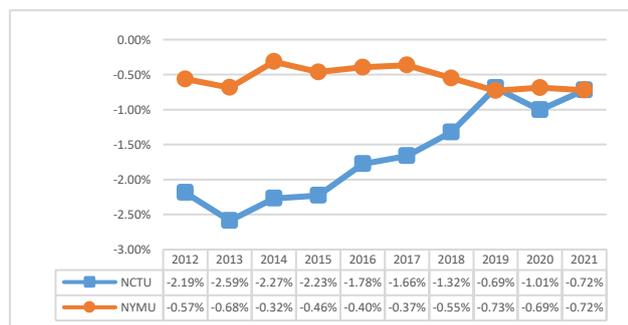


Fig. 16. Rates of return on total assets of NYMU and NCTU from 2012 to 2021.

### V. CONCLUSIONS AND SUGGESTIONS

This study adopted FRA to assess the impacts of merger on the financial performance of two post-merger top universities in Taiwan from 2012 to 2021.

In the case of NTHU, before the merger, the financial performance of NTHU, a top university, was much worse than that of NHCUE in almost all aspects, except for long-term solvency and total asset utilization efficiency. NTHU's long-term solvency was slightly higher than that of NHCUE before 2015. However, NTHU's debt ratio has increased dramatically to 56.74% in 2016, making its long-term solvency much lower than that of NHCUE. Similarly, NTHU's total asset utilization efficiency was only slightly higher than NHCUE's in 2012 and 2014, and slightly lower than NHCUE's in the rest of the year. It showed that the financial management ability of the top university was not better than that of non-top university, making its resource utilization efficiency and financial soundness no better than those of non-top university.

After the merger, the merger did not improve short-term and long-term solvency for both pre-merger HEIs, i.e., NTHU and NHCUE. Instead, the merger has greatly increased their liquidity risk and default risk, especially for NHCUE. NHCUE's short-term and long-term solvency were much worsened than the level of each year before the merger. The results implied the merger did not improve financial stability significantly for post-merger university. In terms of asset utilization efficiency, although the merger enhanced the ability of using fixed assets to generate net sales for NTHU, it much worsened for NHCUE. Moreover, the merger did not enhance but indeed worsened the efficiency of utilizing total assets to generate net sales for both the two pre-merger universities. That implied the merger did not aid in enhancing asset utilization efficiency for post-merger university. In terms of profitability, although the merger conducive to growth of net sales, it did not improve the ability to control costs of sale for both NTHU and NHCUE, and consequently did not significantly improve the GPM of the post-merger university, especially in 2021. Moreover, although the

merger improved the OPM, NPM, and ROA for NTHU, it made largely decay of OPM, NPM, and ROA for NHCUE. By 2021, NHCUE's OPM, NPM, and ROA have not recovered to the levels before the merger. Most importantly, although NHCUE owing to its better ability to make nonoperational profits has turned its net income and thus NPM and ROA from negative into positive in all of the years before the merger except to 2013, the OPM, NPM and ROA of the post-merger university were still negative values as the merger did nothing to improve post-merger university's ability to control operating expenses and profit from non-operating activities. The results indicated that the merger was only improving post-merger university's net sales, rather than to improve the ability of control costs of sales, operating expenses and gain from non-operating activities. That was, the merger did not improve post-merger university's ability of financial management, just expanded net sales. In Taiwan, where the fertility rate continues to decline sharply, if the merger only increased net sales without improving financial management capabilities, the merger will hardly help improve NTHU's profitability in the long run.

In the case of NYCU, before the merger, the financial performance of the two top universities was that NCTU was mostly inferior to NYMU, except for the total asset utilization efficiency as well as long-term solvency and profitability since 2018. NCTU's total asset utilization efficiency was better than NYMU in all years before the merger. Moreover, although NCTU's long-term solvency and profitability were inferior to NYMU, NCTU's performance was enhancing, while NYMU's performance was decaying. Consequently, NCTU's long-term solvency and profitability surpassed those of NYMU since 2018.

After the merger, both short-term and long-term solvency were improved slightly for NCTU, whereas both were worsened substantially for NYMU. That implied the merger did not improve financial stability significantly for post-merger university. In terms of asset utilization efficiency, the merger largely enhanced the ability of using overall assets to generate net sales for NYMU, though slightly worsened for NHCUE. Moreover, the merger enhanced the fixed asset utilization efficiency of NCTU by 3.72%, but it also substantially reduced that of NYMU by 2.65%. That implied the merger seemed to somewhat improve asset utilization efficiency for post-merger university. In terms of profitability, the merger significantly improved the GPM, OPM, NPM and ROA for both the two top universities due to the improvement in net sales and in ability to control costs of sales. Besides, the merger aided in NYMU's ability to well control operational expenses and NCTU's ability to generate profits via nonoperational activities. However, for NYMU, its NPM and ROA in 2021 were still below the levels in almost all years prior to the merger. Last but not least, the results showed the merger did not turn the post-merger university from net losses into net profits. The OPM, NPM and ROA of the post-merger university were still negative values after the merger. Since this study only includes data for the first year after the merger, the impact of the merger on NYCU's profitability remains to be tracked to confirm.

To sum up, it was obvious that whether it was a top university merging a non-top university, or a merger between two top universities, neither can improve the short-term and long-term solvency of the post-merger universities, so the mergers were not conducive to improving the financial stabilities of the post-merger universities. The case of NTHU even showed that the long-term solvency after the merger continued to decrease as the debt ratio increased. It was obvious that the financial stability after the merger had not improved but deteriorated.

Furthermore, although NYCU's asset utilization efficiency seemed to be slightly improved in the first year after the merger, NTHU's ones did not. Since there has been some literature manifested that the positive effect of merger on performance was only in the first year, and subsequently turned around [42, 45, 67, 68, 75–77], the long-run impacts are still needed to be traced and verified.

Finally, the merger only brought in NTHU more net sales, rather than bettering its ability to control costs of sales, operating expenses, and gain from non-operating activities. If the management of NTHU will not change this situation, it can be foreseeable that in Taiwan, where the birth rate is declining sharply, the long-term profitability will deteriorate. For NYCU, its profitability in the first year post-merger appeared to get better, and follow-up is yet to be tracked to confirm the true impact of the merger on profitability. Most importantly, the mergers did not turn the two post-merger universities from net losses into net profits. The OPM, NPM, and ROA of the two post-merger universities were still negative values after the merger.

This study showed that Taiwan's top universities were not outstanding in terms of financial management capabilities, including abilities to well control costs, to utilize assets efficiently, and to maintain sound financial stability. Moreover, mergers involving top universities may not necessarily improve the financial management abilities of the post-merger university, and may even worsen its financial stability. The national policy of concentrating resources on developing top universities should be open to question. Policies that hope to enhance the competitiveness of universities by encouraging university mergers should also think twice. Without good financial management capabilities, the policy of concentrating resources on the development of top universities or even encouraging the merger of top universities to rapidly improve competitiveness may not bring the expected results, but may cause the financial deterioration of HEIs and even the country. In light of this, this paper calls on higher education policy makers and HEIs' administrators to pay more attention to the universities' financial management capabilities and financial performance, especially cost control, resource utilization efficiency, and financial soundness, while pursuing innovative development and high competitiveness. Only in this way can we ensure the improvement of the competitiveness of top universities and the long-term sustainable development of the country and universities.

## CONFLICT OF INTEREST

The author declares no conflict of interest.

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