



A STUDY ON THE PROFIT AND RISK OF TAIWANESE AND BRITISH BANKS

Hsu, Shao-Yin

Department of Accounting, Ming-Chuan University
E-mail: guday0323@gmail.com

Pei, Fan-Yi

Department of Accounting, Ming-Chuan University
E-mail: 08521685@me.mcu.edu.tw

Huang, Jia-An

Department of Accounting, Ming-Chuan University
E-mail: annieha1556@gmail.com

Xie, Xin-Ting

Department of Accounting, Ming-Chuan University
E-mail: cindy891023@gmail.com

Feng, Yu-Quan

Department of Accounting, Ming-Chuan University
E-mail: msq851fy2c3@gmail.com

Abstract

Many financial institutions have faced the challenge of declining profits and earnings in recent years due to the raging pandemic. British banks are not only affected by the pandemic but also the Brexit event that caught the eyes of the world. Although Taiwan and the United Kingdom are far apart, Taiwan is a proud nation with its chip production which has helped attract global attention to its economic development. The financial industry accounted for 6.4% GDP of Taiwan with a negative annual growth rate (-3.59%) results for the first time in the last decade. Therefore, Taiwanese banks and British banks are made as the research samples in this paper with the research period scheduled in 2015-2021. According to the empirical results, British banks are significantly affected by the pandemic while the said impact on Taiwanese banks is relatively minor.

Keywords: Taiwanese banks, British banks, profit, risk.

Introduction

The United Kingdom of Britain and Northern Ireland (also known as the United Kingdom, UK) is located in the northwest of the European continent and is composed of Great Britain Island, the northeast of Ireland, and a series of small islands for a total land area of 243,610 square kilometers, the 80th largest country in the world and the 11th largest country in Europe, a population around 63.18 million (ranked the 22nd in the world and the 3rd in Europe), one of the top five economy bodies in the world, and one of the richest and the most economically developed countries with the highest living standards. London, the capital of the UK, is the second largest financial center in the world and the largest financial center in Europe, which is second to New York in the United States only.

The economy in Taiwan developed rapidly in the 1980s with a high demand for capital. The capital allocation was inefficient due to the financial control at the time. Therefore, interest rate liberalization was implemented in 1989, and the Banking Act was formulated in July 1989; also, the “Standards Governing the Establishment of Commercial Banks” was passed in April 1990 to start accepting applications for the establishment of banks. The “Six Financial Acts” were gradually passed in 2002-2003 as the first financial reform, and the second financial reform was initiated in 2004-

2008. The banking industry in Taiwan has entered the market of perfect competition.

As the world’s financial center, the United Kingdom is with the economic support of the financial industry; also, the service industry accounts for 79% of GDP. Taiwan’s financial industry accounted for 6.73% of the GDP in 2021. Taiwan is known worldwide for the chip production, and the financial industry leads the Taiwan industry to go global. We would like to know whether the pandemic has affected the economic development of Taiwan and the UK in recent years; also, has Brexit affected the financial industry? Therefore, Taiwanese banks and British banks in 2015-2021 are made as the research samples in this paper to observe the changes in the profitability, solvency, liquidity, and operating ration of Taiwanese banks and British banks. The idea is to provide such economic changes to the government for reference in formulating financial policies; also, to make suggestions to the financial industry.

Literature Review

The literature related to profitability and Brexit are introduced in this chapter as follows:

Hsieh and Shen (2009) took 49 countries, including the United States, Germany, France, Sweden, Japan, and the Netherlands, from 1991 to 2002, as the research objects based on the modified model of Laeven and Majnoni (2003) to discuss whether the economy was influential to the earnings and allowance for bad debts. According to the empirical results, banks had appropriated higher allowance for bad debt when higher profit was generated in a good economy, otherwise, the banks had appropriated lower allowance for bad debts

when lower profit was generated, indicating a positive surplus effect in existence. On the contrary, banks had appropriated lower allowance for bad debt when higher profit was generated in a bad economy, otherwise, the banks had appropriated higher allowance for bad debts when lower profit was generated, indicating a reverse surplus effect in existence.

Lin and Chen (1997) studied the banks in Taiwan from December 1992 to June 2000 regarding their use of bad debt expenses and bill trading profits and losses to strategically manipulate book surplus and capital issues. According to the research results, there was a positive correlation between bad debt expenses and capital adequacy ratio, evidencing that banks had indeed applied bad debt expense to avoid costs. Yeh etc. (2010) studied the banks in Taiwan regarding the accounting earnings in 1993-2006 and the differences in the earnings management behavior of the banking industry. According to the empirical results, Taiwan's banking industry was affected by the earnings management in the first stage and by the Southeast Asian financial crisis in the second stage profoundly. Chen and Lee (2018) studied the banks in Taiwan regarding whether banks conducted earnings management in 2005-2009. Earnings management can be divided into two types: accrual earnings management and real earnings management. Accrual earnings management decreased significantly and real earnings management increased significantly, Real earnings management replaced accrual earnings management, in other words, there was a replacement and trade-off relationship between real earnings management and accrual earnings

management. Chang (2018) studied the banks in China regarding the inter-bank earnings management in 2007-2013. According to the empirical research, the government set a minimum capital adequacy ratio for the banking industry, causing managerial officers failed to increase the qualified capital as the numerator in the capital adequacy ratio calculation formula, or failed to decrease the risk assets as the denominator of the calculation formula, instead, the managerial officers applied the earnings to manipulate the capital adequacy ratio so to meet the 8% minimum capital adequacy ratio standard. Chen etc. (2005) studied the financial holdings and non-financial holdings in Taiwan regarding the earnings management in 2000-2003. According to the empirical research, there was a sign of earnings manipulation by non-financial holdings but not by financial holdings after the implementation of the Financial Holding Company Act. Shen and Wu (2010) took 16 countries in Europe, 2 countries in North America, 7 countries in South America, 13 countries in Asia, 4 countries in Africa, and 2 countries in Australia as the research objects.

According to the empirical results, there was a positive effect between the bank's market share and profit in 1998-2005. The higher concentration of the banks, the higher operating efficiency of the banks, in other words, the more restrictions imposed on the banks by the State, the market share would go up and the profit did too; therefore, the positive effect of bank's market share was then supported. Lin and Yu (2017) studied 27 banks in Taiwan from 2008Q1 to 2015Q3. According to the research results, the concentration of banks was with a negative impact on Taiwan's

banking industry that did not help generate higher profitability; however, inflation rate and economic growth rate had a positive effect on bank's profitability. Tsai and Yang (2007) studied the banks in Taiwan regarding the relationship between bank service quality and operating (cost) efficiency and profit efficiency in 1995-1999. A two-stage model was adopted to first evaluate the efficiency of each bank with DEA. According to the research performed, more machines, employees, and resources must be invested in order to improve service quality. Also, there was a positive correlation between the service quality and the target value of the machines and employees, in other words, the upgrade of service quality was helpful to operation efficiency and the profitability of the bank. Although the cost of the bank was increased, it was justified by the overall profits. Wu etc. (2020) studied the banks in the United Kingdom, Europe, and Taiwan with a focus on the meeting minutes, signed agreements, and law and regulations announced by the European and British governments for Brexit, including the views of the domestic banking industry and the researches of experts on this event. The main reason for the Brexit in 2020-2022 was due to the EU's requesting member states to take in immigrants, but the employment and social welfare issues caused by refugees had

resulted in the loss of employment opportunities for British citizens, adding more pressure to British society, not to mention the high membership fee of £8.4 billion; therefore, the United Kingdom took the Brexit option. The said Brexit option came with positive effects of reducing the UK's spending for the EU membership, broader application of the UK laws, and greater economic flexibility; however, there were also the negative effects of a declining economy, less foreign direct investment, and the impact on the financial market. Other non-EU countries may decide to have their financial industries established in EU countries instead of in the UK.

Research Methods

Study period and sampling

The profits and risks of banks in Taiwan and the United Kingdom under the raging Covid-19 pandemic in 2020 are evaluated in this paper in accordance with the financial ratios and Dynamic Slacks Measure (SBM DEA). A total of 59 British banks (including 22 local banks, 11 retail banks, and 26) and 32 Taiwanese banks during the 7-year research period in 2015-2021 are the research objects with the data retrieved from Bankfocus Database (Tables 1, 2).

Table 1. British Banks

Local banks		
AIB GROUP (UK) PLC	ARBUTHNOT BANKING GROUP PLC	BANK OF IRELAND (UK) PLC
BANK OF SCOTLAND PLC	C. HOARE & CO	CAMBRIDGE & COUNTIES BANK LIMITED
CHARITY BANK LIMITED (THE)	CLOSE BROTHERS GROUP PLC	CYNERGY BANK LIMITED
HAMPDEN & CO PLC	HAMPSHIRE TRUST BANK PLC	NATWEST MARKETS PLC
ONESAVINGS BANK PLC	PARAGON BANKING GROUP PLC BANK PLC	SCOTLAND INTERNATIONAL LIMITED
STANDARD CHARTERED BANK	THE ROYAL BANK OF SCOTLAND PLC	ULSTER BANK LIMITED
UNITED TRUST BANK LIMITED	UNITY TRUST BANK PLC	VIRGIN MONEY UK PLC
Retail banks		
BARCLAYS BANK PLC	CO-OPERATIVE BANK PLC	HBOS PLC
HSBC BANK PLC	LLOYDS BANK PLC	MARKS & SPENCER FINANCIAL SERVICES PLC
METRO BANK PLC	SAINSBURY'S BANK PLC	SECURE TRUST BANK PLC
SHAWBROOK BANK LIMITED	TESCO PERSONAL FINANCE PLC	
Royal Institute of British Architects		
CAMBRIDGE BUILDING SOCIETY	CHORLEY & DISTRICT BUILDING SOCIETY	COVENTRY BUILDING SOCIETY
DARLINGTON BUILDING SOCIETY	EARL SHILTON BUILDING SOCIETY	ECOLOGY BUILDING SOCIETY (THE)
FURNESS BUILDING SOCIETY	HANLEY ECONOMIC BUILDING SOCIETY (THE)	HARPENDEN BUILDING SOCIETY
HINCKLEY AND RUGBY BUILDING SOCIETY	LEEDS BUILDING SOCIETY	LEEK UNITED BUILDING SOCIETY
LOUGHBOROUGH BUILDING SOCIETY	MARKET HARBOROUGH BUILDING SOCIETY	MARSDEN BUILDING SOCIETY
MELTON MOWBRAY BUILDING SOCIETY	NATIONAL COUNTIES BUILDING SOCIETY	TIPTON & COSELEY BUILDING SOCIETY
PENRITH BUILDING SOCIETY	SAFFRON BUILDING SOCIETY	SCOTTISH BUILDING SOCIETY
SKIPTON BUILDING SOCIETY	SUFFOLK BUILDING SOCIETY	STAFFORD RAILWAY BUILDING SOCIETY
WEST BROMWICH BUILDING SOCIETY	YORKSHIRE BUILDING SOCIETY	

Data source : Bankfocus.

Table 2. Taiwanese Banks

BANK OF KAOHSIUNG[BOK]	BANK OF PANHSIN PUBLIC COMPANY[BOP]	BANK OF TAIWAN[BOT]
CATHAY UNITED BANK CO LTD[CUB]	CHANG HWA COMMERCIAL BANK LTD.[CHB]	COTA COMMERCIAL BANK[COTAB]
CTBC BANK CO LTD[CTBC]	E. SUN COMMERCIAL BANK[ESBC]	ENTIE COMMERCIAL BANK PUBLIC COMPANY[ECB]
FAR EASTERN INTERNATIONAL BANK PUBLIC COMPANY[FEIB]	FIRST COMMERCIAL BANK[FCB]	FUBON BANK (CHINA) CO., LTD[TFB]
HUA NAN COMMERCIAL BANK[HNB]	HWATAI BANK[HB]	JIH SUN INTERNATIONAL BANK PUBLIC COMPANY[JSB]
KGI BANK PUBLIC COMPANY[KGNB]	KING'S TOWN BANK[KTB]	LAND BANK OF TAIWAN([LBOT])
MEGA INTERNATIONAL COMMERCIAL BANK CO LTD[MICB]	O-BANK CO., LTD[OB]	SINOPAC FINANCIAL HOLDING[BSP]
STANDARD CHARTERED BANK (TAIWAN) LIMITED[SCBL]	SUNNY BANK[SB]	TAICHUNG COMMERCIAL BANK[TB]
TAIPEI STAR BANK[TSB]	TAISHIN INTERNATIONAL BANK PUBLIC COMPANY[TIB]	TAIWAN BUSINESS BANK,LTD[TBB]
TAIWAN COOPERATIVE BANK PUBLIC COMPANY[TCB]	TAIWAN SHIN KONG COMMERCIAL BANK CO LTD[SKB]	THE SHANGHAI COMMERCIAL & SAVINGS BANK, LTD - DONG NAI BRANCH[SCSB]
UNION BANK OF TAIWAN PUBLIC COMPANY[UBT]	YUANTA COMMERCIAL BANK CO., LTD[YB]	

Data source : Bankfocus

Notes: Abbreviation for bank name is in [.]

Financial Ratios

The profitability and risk indicators of British banks and Taiwanese banks are measured with six financial ratios in this paper: Return on assets (ROA), Return on equity (ROE), Non-performing loan ratios (NPL), Equity ratios (ER), Current assets ratios (CR), and Deposit ratios (DR).

Data Envelopment Analysis

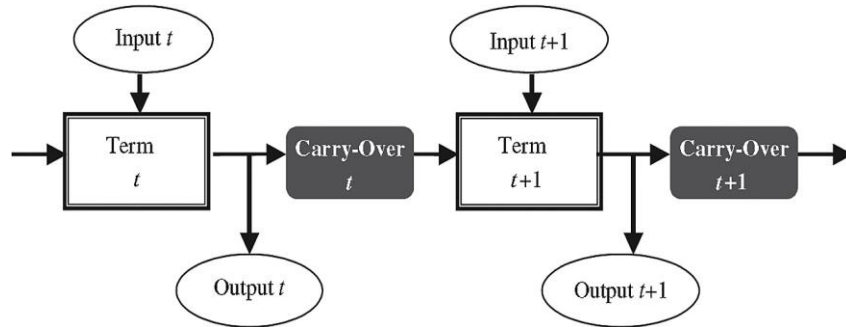
Data Envelopment Analysis (DEA) is a non-parametric mathematical

programming, in other words, it is to evaluate the relative efficiency of input and output decision-making units (Decision Making Unit, DMU) within the evaluated unit. Data Envelopment Analysis (DEA) is utilizing the “Production Possibility Set” and the maximum output combination derived from the input combination to form the maximum production possibility set, which is known as the “Efficiency Frontier” of the Production Possibility Set. Project the input and output variables of all the evaluated units in the space to be enveloped by isoquant lines. Express the efficiency value as 0-1 according to the distance

between the projection point and the production boundary with “1” indicating the best efficiency value on the line, and the closer to 1, the higher the efficiency value will be.

In order to make the analysis in this paper more precise, in addition to adopting financial ratio analysis, the Dynamic

Slack-Based Measure (SBM) based on the assumption of Tone and Tsutsui (2010) is implemented for the efficiency evaluation of British banks and Taiwanese banks. There are T groups and n DMUs assumed in this model; also, each DMU has different input, output, and carry-over in period t and is then connected from period t to period t+1.



The coefficients of the six variables in this paper, in order to, for avoiding the shortcomings of radiation, a non-radial and non-oriented model is adopted in this paper:

Set n DMUs ($j=1, \dots, n$) through T terms ($t=1, \dots, T$). DMUs in each phase have f discrete input items ($i=1, \dots, p$, r non-discrete (fixed) input items ($i=1, \dots, r$), S output items ($i=1, \dots, s$) and ν Non-discretionary (fixed) output items ($i=1, \dots, \nu$), $x_{ijt} (i=1, \dots, f)$, $x_{ijt}^{fix} (i=1, \dots, q)$, $y_{ijt} (i=1, \dots, s)$, $y_{ijt}^{fix} (i=1, \dots, \nu)$ To measure the value of DMU in term T. Carry-over has four forms z^{good} , z^{bad} , z^{free} , z^{fix} .

The following is the linear programming formula of the DSBM basic model. The production of the basic model may be set as follows: $\{x_{it}\}$, $\{x_{it}^{fix}\}$, $\{y_{it}\}$, $\{y_{it}^{fix}\}$, $\{z_{it}^{good}\}$, $\{z_{it}^{bad}\}$, $\{z_{it}^{free}\}$, $\{z_{it}^{fix}\}$ The definition is as follows:

$$\begin{aligned}
 x_{it} &\geq \sum_{j=1}^n x_{ijt} \lambda_j^t, (i=1, \dots, p; t=1, \dots, T) \\
 x_{it}^{fix} &= \sum_{j=1}^n x_{ijt}^{fix} \lambda_j^t, (i=1, \dots, r; t=1, \dots, T) \\
 y_{it} &\leq \sum_{j=1}^n y_{ijt} \lambda_j^t, (i=1, \dots, s; t=1, \dots, T) \\
 y_{it}^{fix} &= \sum_{j=1}^n y_{ijt}^{fix} \lambda_j^t, (i=1, \dots, \nu; t=1, \dots, T) \\
 z_{it}^{good} &\leq \sum_{j=1}^n z_{ijt}^{good} \lambda_j^t, (i=1, \dots, ngood; t=1, \dots, T) \\
 z_{it}^{bad} &\geq \sum_{j=1}^n z_{ijt}^{bad} \lambda_j^t, (i=1, \dots, nbad; t=1, \dots, T)
 \end{aligned}$$

$$\begin{aligned}
 z_{it}^{free} &: \text{free}, (i=1, \dots, n_{free}; t=1, \dots, T) \\
 z_{it}^{fix} &= \sum_{j=1}^n z_{ijt}^{fix} \lambda_j^t, (i=1, \dots, n_{fix}; t=1, \dots, T) \\
 \lambda_j^t &\geq 0, (j=1, \dots, n; t=1, \dots, T) \\
 \sum_{j=1}^n \lambda_j^t &= 1, (t=1, \dots, T) \\
 \lambda_j &\in R^n (t=1, \dots, T)
 \end{aligned} \tag{1}$$

Represents the intensity vector of the t period. Equation (2) is a mathematical formula that satisfies the inter-temporal variability conditions from period t to period t+1, and is an important restriction for DSBM to link activities from period t to period t+1. (2) β It can be expressed as good, bad, free and fix, which respectively represent the number of good links, bad links, changeable links and immutable links. In order to ensure the connectivity of the period t to t+1, the following assumptions must be met:

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

Using (2) for production mode, we can set the DMU_o ($o=1, \dots, n$) as follows:

$$\begin{aligned}
 x_{iot} &= \sum_{j=1}^n x_{ijt} \lambda_j^t + s_{it}^-, (i=1, \dots, p; t=1, \dots, T) \\
 x_{iot}^{fix} &= \sum_{j=1}^n x_{ijt}^{fix} \lambda_j^t, (i=1, \dots, r; t=1, \dots, T) \\
 y_{iot} &= \sum_{j=1}^n y_{ijt} \lambda_j^t - s_{it}^+, (i=1, \dots, s; t=1, \dots, T) \\
 y_{iot}^{fix} &= \sum_{j=1}^n y_{ijt}^{fix} \lambda_j^t, (i=1, \dots, v; t=1, \dots, T) \\
 z_{iot}^{good} &= \sum_{j=1}^n z_{ijt}^{good} \lambda_j^t - s_{iot}^{good}, (i=1, \dots, n_{good}; t=1, \dots, T) \\
 z_{iot}^{bad} &= \sum_{j=1}^n z_{ijt}^{bad} \lambda_j^t + s_{it}^{bad}, (i=1, \dots, n_{bad}; t=1, \dots, T) \\
 z_{iot}^{free} &= \sum_{j=1}^n z_{ijt}^{free} \lambda_j^t + s_{it}^{free}, (i=1, \dots, n_{free}; t=1, \dots, T) \\
 z_{iot}^{fix} &= \sum_{j=1}^n z_{ijt}^{fix} \lambda_j^t, (i=1, \dots, n_{fix}; t=1, \dots, T) \\
 \sum_{j=1}^n \lambda_j^t &= 1 (t=1, \dots, T) \\
 \lambda_j^t &\geq 0, s_{it}^- \geq 0, s_{it}^+ \geq 0, s_{it}^{good} \geq 0, s_{it}^{bad} \geq 0 \text{ and } s_{it}^{free}: free(\forall i, t) \\
 s_{it}^-, s_{it}^+, s_{it}^{good}, s_{it}^{bad}, s_{it}^{free}
 \end{aligned} \tag{3}$$

They represent excessive input, insufficient output, insufficient linkage, excessive linkage, and linkage gap. In three directions: input-oriented, output-oriented and non-oriented, $(\{\lambda^t\}, \{s_t^-\}, \{s_t^+\}, \{s_t^{good}\}, \{s_t^{bad}\}, \{s_t^{free}\}, \{s_t^{fix}\})$

Assessment DMU_o ($o=1, \dots, n$), and this paper uses the unguided model, which is explained as follows: Non-oriented combination of input-oriented and output-oriented, overall efficiency value ρ_o^* :

$$\rho_o^* = \min \frac{\frac{1}{T} \sum_{t=1}^T w^t \left[1 - \frac{1}{p+nbad} \left(\sum_{i=1}^p \frac{w_i^- s_{it}^-}{x_{iot}} + \sum_{t=1}^{nbad} \frac{s_{it}^{bad}}{z_{iot}^{bad}} \right) \right]}{\frac{1}{T} \sum_{t=1}^T w^t \left[1 + \frac{1}{s+ngood} \left(\sum_{i=1}^s \frac{w_i^+ s_{iot}^+}{y_{iot}} + \sum_{i=1}^{ngood} \frac{s_{iot}^{good}}{z_{iot}^{good}} \right) \right]} \quad (4)$$

When the difference is 0, the overall efficiency value is

1. $\{\lambda_o^{t*}\}, \{s_{ot}^{-*}\}, \{s_{ot}^{+*}\}, \{s_{ot}^{good*}\}, \{s_{ot}^{bad*}\}, \{s_{ot}^{free*}\}, \{s_{ot}^{fix*}\}$ bring in (4)

ρ_{ot} :

$$\rho_{ot} = \frac{1 - \frac{1}{p+nbad} \left(\sum_{i=1}^p \frac{w_i^- s_{it}^{-*}}{x_{iot}} + \sum_{t=1}^{nbad} \frac{s_{it}^{bad*}}{z_{iot}^{bad*}} \right)}{1 + \frac{1}{s+ngood} \left(\sum_{i=1}^s \frac{w_i^+ s_{iot}^{+*}}{y_{iot}} + \sum_{i=1}^{ngood} \frac{s_{iot}^{good*}}{z_{iot}^{good*}} \right)} \quad (5)$$

In this study, Input, Output and Carry-over have six variables (Table 3)

Table 3. Input and Output Variables

Input		Carry-Over	Output	
Equity rations	Current rations	NPL ratio	Return on assets	Return on equity

Data Resource: Author's collection.

Empirical results

The empirical results of this study include two parts: (1) performing analyses with financial ratios; (2) performing analyses with Dynamic Slacks Measure (SBM DEA).

Bank's capital is classified into three categories: large, medium, and small. A small bank is with a capital of NT\$0-10 billion, a medium bank is with a capital of NT\$10-100 billion, and a

large bank is with a capital of more than NT\$100 billion. According to the statistics, there are 30 small banks, 19 medium banks, and 10 large banks in the UK; also, there are 1 small bank (TIB), 16 medium banks, and 17 large banks in Taiwan. There are more small banks in the UK than in Taiwan. Baorui Chen, Wenqing Tseng, and Qiurong Guo (2001) indicated that there were significantly more financial institutions setup in Taiwan after 1990, resulting in a small number of small banks remained in

operation, while more large banks in service. However, the capital of large banks in Taiwan is much lower than that of large banks in the UK, indicating that the scale of bank in Taiwan remains incomparable to those in the advanced countries (Tables 4 and 5).

Financial Ratio Analysis

Profitability

ROA and ROE are used as profitability indicators in this study (Table 4 and 5).

1. British banks

The ROA of medium banks is the highest, then followed by small banks. Except for the year of 2020, the ROA of medium banks is between 0.37% and 1.07%, while the ROA of large banks is between 0.09% and 0.46%, which is much lower than that of the medium banks.

ROA increased significantly in 2016. The ROA of small banks had gone up by 0.66% as the highest, which was due to the negative impact of British banks' breaking away from the European debt crisis completely. The ROA of large banks increased year by year from 2016 to 2019, while the ROA of small banks and medium banks declined slightly; however, the ROA of small banks and medium banks remained higher than that of the large banks.

The ROE of medium banks is the highest in the range of 3.87%-10.14%. The ROE of large banks was increasing year by year, and it was higher than that

of the small banks in 2021, in other words, the ROE of large banks was higher than that of the small banks. Overall, the trend of ROE was similar to the ROA, both had gone up in 2016, dropped significantly in 2020, and then rebounded in the following year.

The profitability of British banks was severely affected by the pandemic negatively, but the UK quickly found the countermeasures to recover it immediately and regain its profitability in the following year.

2. Taiwanese banks

The ROA of large banks is the highest in the range of 0.68%-0.47%, and the ROA of small banks is the lowest. The ROA of large banks reached 0.66% in 2019, but it dropped in the following year due to the impact of the pandemic, then it was recovered to 0.53% in 2021. The ROA of medium banks was not affected by the pandemic.

The ROE of large banks is the highest in the range of 9.68%-6.77%, and the ROE of small banks is the lowest in the range of 3.65%-4.13%. The ROE of large banks dropped by 1.55% in 2020 due to the impact of the pandemic, which had gone back up by 0.63% in the following year. Overall, the ROE of Taiwanese banks has been sluggish for years, and the profit efficiency of shareholders is poor.

In summary, the larger the banks in Taiwan, the higher the profitability generated. However, the profitability of Taiwanese banks has declined slightly in recent years. The ROA and ROE of 32

banks in Taiwan were affected by the pandemic, and the performance of large banks remained more satisfactory.

Risk: discuss solvency risk, operating risk, and liquidity risk.

1. Solvency

The Current assets ratios (CR) and Equity ratios (ER) are used as solvency indicators in this study (Table 4 and 5).

①British banks

There are long-term and short-term solvency. Current assets ratios (CR) are used to analyze short-term solvency and Equity ratios (ER) are used to analyze long-term solvency in this study.

The Current assets ratios (CR) of large British banks are the highest in the average range of 26.48%-32.26%, followed by medium banks. The Current assets ratios (CR) of all British banks in all sizes dropped in 2016, of which, the medium banks with a drop of 2.33% was the worst that was due to the Brexit referendum held in 2016; therefore, Brexit did affect the current ratio. The Equity ratios (ER) of the large banks in the UK are the lowest in the range of 5%-6% in average, and the Equity ratios (ER) of the small banks and medium banks remain unchanged. The reason why the Equity ratios (ER) of large banks are lower than small banks and medium banks may be because that large banks have large assets and high liabilities; therefore, the Equity ratios (ER) are relatively low.

②Taiwanese banks

The Current assets ratios (CR) of medium banks in Taiwan are the highest in the range of 26.15%-30.98% in average, and the Current assets ratios (CR) of small banks is the lowest. The information on the small bank may be inaccurate since there is only one small bank included in this study. The Equity ratios (ER) of the medium banks in Taiwan is the highest, while the Equity ratios (ER) of the small banks are slightly lower than the average. Overall, the trend of the Equity ratios (ER) is stable without significant fluctuations; therefore, the long-term solvency is stable.

2. Operating risk

The non-performing loan ratios (NPL ratios) are used to analyze operating risk in this study (See Table 4 and 5 for details).

①British banks

The non-performing loan ratios (NPL ratios) of the small banks in the UK are the lowest in the range of 0.82%-1.91%, and the non-performing loan ratios (NPL ratios) of the medium banks are the highest. Although the average non-performing loan ratios of the large banks are higher than that of the small banks, the maximum value is generally distributed in the small banks. The non-performing loan ratios (NPL ratios) of British banks dropped in 2015-2017. The non-performing loan ratios (NPL ratios) of medium banks had reached 3% again in 2020 since 2015 due to the impact of the pandemic and the official

Brexit. The non-performing loan ratios (NPL ratios) of the large banks remained at 2.22% in 2021, indicating that the large banks and medium banks in the UK were greatly affected by Brexit and the pandemic, and the operating activities were at a relatively high risk.

② Taiwanese banks

The non-performing loan ratios (NPL ratios) of the medium banks in Taiwan were the highest in the range of 0.9%-1.68%, and the maximum values fell in the medium banks. The non-performing loan ratios (NPL ratios) of some medium banks even exceeded 3% in some years for a reason similar to those of the British banks. The non-performing loan ratios (NPL ratios) of the large banks and medium banks in Taiwan were affected by the global economic depression in 2016; therefore, the non-performing loan ratios (NPL ratios) were increased by 0.55% and 0.38%, respectively, and then dropped and hit the lowest record in 2021. The non-performing loan ratios (NPL ratios) of large banks is only 0.78%, indicating that the loan quality of Taiwanese

banks has been improved in recent years, and the deposit security is enhanced. Overall, the non-performing loan ratios (NPL ratios) of Taiwanese banks are generally lower than 3%; therefore, the operating risk is low.

Liquidity: Deposit ratios (DR) are used as an indicator for the analysis of liquidity (Table 4 and 5).

1. British banks

The deposit ratios (DR) of the medium banks in the UK are the highest in the range of 84%-109%. The deposit ratios (DR) of the large banks dropped every year, and the deposit ratios (DR) of large banks were much lower than that of the small banks and medium banks in 2021.

2. Taiwanese banks

The deposit ratios (DR) of the large banks in Taiwan were the highest in the range of 67%-76% for seven years, except for the year 2016. The deposit ratios (DR) of the small banks

Table 4. British banks Financial Ratios of capital scale

units : %

		2021	2020	2019	2018	2017	2016	2015	
Profitability	ROA Large	Mean	0.46	0.13	0.105	0.38	0.29	0.15	0.09
			0.86	0.39	0.71	1.45	0.59	0.77	0.56
		Max.	LLOYDS BANK PLC	THE ROYAL BANK OF SCOTLAND PLC	THE ROYAL BANK OF SCOTLAND PLC	THE ROYAL BANK OF SCOTLAND PLC	HBOS PLC	HBOS PLC	HBOS PLC
			-0.21	-0.22	-0.62	-0.33	-0.1	-0.59	-0.59
		Min.	NATWEST MARKETS PLC	HSBC BANK PLC	STANDARD CHARTERED BANK	VIRGIN MONEY UK PLC	BARCLAYS BANK PLC	NATWEST MARKETS PLC	VIRGIN MONEY UK PLC
			0.88	-0.05	0.37	0.67	0.68	1.07	0.79
	Max.	2.01	1.01	1.94	2.07	2.12	9.97	2.83	

		MARKS & SPENCER FINANCIAL SERVICES PLC	CLOSE BROTHERS GROUP PLC	CLOSE BROTHERS GROUP PLC	CLOSE BROTHERS GROUP PLC	CLOSE BROTHERS GROUP PLC	SECURE TRUST BANK PLC	SECURE TRUST BANK PLC
		-1.1	-1.85	-2.04	-0.42	-0.61	-1.48	-1.87
Min.	METRO BANK PLC	SAINS-BURY'S BANK PLC	MARKS & SPENCER FINANCIAL SERVICES PLC	SAINS-BURY'S BANK PLC	CO-OPERATIVE BANK PLC (THE)	CO-OPERATIVE BANK PLC (THE)	CO-OPERATIVE BANK PLC (THE)	CO-OPERATIVE BANK PLC (THE)
Mean	0.68	0.36	0.5	0.47	0.48	0.72	0.06	
Max.	MARSDEN BUILDING SOCIETY	MARSDEN BUILDING SOCIETY	MARSDEN BUILDING SOCIETY	MARSDEN BUILDING SOCIETY	MARSDEN BUILDING SOCIETY	ARBUTHNOT BANKING GROUP PLC	UNITED TRUST BANK LIMITED	
Min.	HAMPDEN & CO PLC	HAMPDEN & CO PLC	HAMPDEN & CO PLC	HAMPDEN & CO PLC	HAMPDEN & CO PLC	HAMPDEN & CO PLC	HAMPDEN & CO PLC	
Mean	9.19	2.2	1.98	7.02	6.15	3.78	2.35	
Max.	THE ROYAL BANK OF SCOTLAND PLC	HBOS PLC	THE ROYAL BANK OF SCOTLAND PLC	THE ROYAL BANK OF SCOTLAND PLC	BANK OF SCOTLAND PLC	BANK OF SCOTLAND PLC	BANK OF SCOTLAND PLC	
Min.	NATWEST MARKETS PLC	HSBC BANK PLC	STANDARD CHARTERED BANK	VIRGIN MONEY UK PLC	BARCLAYS BANK PLC	NATWEST MARKETS PLC	VIRGIN MONEY UK PLC	
Mean	10.14	-0.19	3.87	8.26	7.53	9.81	9.37	
Max.	BANK OF IRELAND (UK) PLC	ONESAVINGS BANK PLC	ROYAL BANK OF SCOTLAND INTERNATIONAL LIMITED	ONESAVINGS BANK PLC	ONESAVINGS BANK PLC	SECURE TRUST BANK PLC	ONESAVINGS BANK PLC	
Min.	METRO BANK PLC	METRO BANK PLC	MARKS & SPENCER FINANCIAL SERVICES PLC	CO-OPERATIVE BANK PLC (THE)	CO-OPERATIVE BANK PLC (THE)	CO-OPERATIVE BANK PLC (THE)	METRO BANK PLC	
Mean	6.52	2.75	4.51	4.31	5.66	7.93	4.71	
Max.	UNITED TRUST BANK LIMITED	UNITED TRUST BANK LIMITED	UNITED TRUST BANK LIMITED	BRIDGE & COUNTIES BANK LIMITED	CAMBRIDGE & COUNTIES BANK LIMITED	ARBUTHNOT BANKING GROUP PLC	UNITED TRUST BANK LIMITED	
Min.	HAMPDEN & CO PLC	HAMPDEN & CO PLC	HAMPDEN & CO PLC	HAMPDEN & CO PLC	HAMPDEN & CO PLC	HAMPDEN & CO PLC	HAMPDEN & CO PLC	
Mean	29.26	26.77	32.26	30.01	27.73	26.48	27.87	

R	premium	Max.	53.25 HSBC BANK PLC	49.56 BAR-CLAYS BANK PLC	57.61 BAR-CLAYS BANK PLC	57.1 BAR-CLAYS BANK PLC	66.62 THE ROYAL BANK OF SCOTLAND PLC	66.86 THE ROYAL BANK OF SCOTLAND PLC	65.16 THE ROYAL BANK OF SCOTLAND PLC
		Min.	5.92 HBOS PLC	7.73 HBOS PLC	12.57 VIRGIN MONEY UK PLC	12.42 VIRGIN MONEY UK PLC	1.17 BANK OF SCOTLAND PLC	2.33 BANK OF SCOTLAND PLC	3.59 BANK OF SCOTLAND PLC
		Mean	25.3	23.1	21.22	21.55	24.71	20.64	22.97
		Max.	100 UL-STER BANK LIMITED	69.39 UL-STER BANK LIMITED	67.67 UL-STER BANK LIMITED	67.61 UL-STER BANK LIMITED	72.31 ROYAL BANK OF SCOTLAND INTERNATIONAL LIMITED	69.74 ROYAL BANK OF SCOTLAND INTERNATIONAL LIMITED	73.41 ROYAL BANK OF SCOTLAND INTERNATIONAL LIMITED
	Min.	8.99 PARAGON BANKING GROUP PLC	9.16 TESCO OPERATIONAL FINANCE PLC	5.75 SECURE TRUST BANK PLC	9.03 PARAGON BANKING GROUP PLC	10.94 PARAGON BANKING GROUP PLC	8.51 ONE-SAVINGS BANK PLC	9.24 PARAGON BANKING GROUP PLC	
	Mean	20.16	20.34	19.78	21.36	22.78	23.39	24.97	
	small	Max.	54.53 UNIT Y TRUST BANK PLC	57.23 UNIT Y TRUST BANK PLC	56.38 UNIT Y TRUST BANK PLC	65.68 UNIT Y TRUST BANK PLC	72.24 UNIT Y TRUST BANK PLC	74.28 UNIT Y TRUST BANK PLC	78.66 UNIT Y TRUST BANK PLC
		Min.	1.12 TIP-TON & COSELEY BUILDING SOCIETY	2.92 TIP-TON & COSELEY BUILDING SOCIETY	2.06 TIP-TON & COSELEY BUILDING SOCIETY	2.74 TIP-TON & COSELEY BUILDING SOCIETY	3.38 TIP-TON & COSELEY BUILDING SOCIETY	6.5 TIP-TON & COSELEY BUILDING SOCIETY	9.16 TIP-TON & COSELEY BUILDING SOCIETY
		Mean	5	5	5	6	6	5	6
		Max.	7 STANDARD CHARTERED BANK	6 STANDARD CHARTERED BANK	7 STANDARD CHARTERED BANK	8 THE ROYAL BANK OF SCOTLAND PLC	8 NATWEST MARKETS PLC	8 VIRGIN MONEY UK PLC	9 VIRGIN MONEY UK PLC
Min.	3 HSBC BANK PLC	3 HSBC BANK PLC	3 HSBC BANK PLC	3 BANK OF SCOTLAND PLC	3 BANK OF SCOTLAND PLC	4 BANK OF SCOTLAND PLC	4 BANK OF SCOTLAND PLC		
ER	premium	Max.	17 TESCO PERSONAL FINANCE PLC	18 TESCO PERSONAL FINANCE PLC	15 AIB GROUP (UK) PLC	15 AIB GROUP (UK) PLC	15 AIB GROUP (UK) PLC	32 ULSTER BANK LIMITED	18 ULSTER BANK LIMITED
		Min.	3 ULSTER BANK LIMITED	3 ULSTER BANK LIMITED	4 COVENTRY BUILDING SOCIETY	4 ULSTER BANK LIMITED	4 COVENTRY BUILDING SOCIETY	4 CO-OPERATIVE BANK PLC (THE)	4 COVENTRY BUILDING SOCIETY
	Mean	7	7	8	8	8	8	9	
	Max.	13	14	14	13	18	19	53	
	Mean	8	8	8	8	8	10	9	
	Max.	7	6	7	8	8	8	9	

		CAM-BRIDGE & COUNTIES BANK LIMITED	CAM-BRIDGE & COUNTIES BANK LIMITED	CAM-BRIDGE & COUNTIES BANK LIMITED	HAMPDEN & CO PLC	HAMPDEN & CO PLC	HAMPDEN & CO PLC	HAMPDEN & CO PLC	
		4	4	5	5	5	5	5	
Operating	NPL ratios	Min.	WEATHERBYS BANK LIMITED	SAFFRON BUILDING SOCIETY	NATIONAL COUNTIES BUILDING SOCIETY	SAFFRON BUILDING SOCIETY	SUFFOLK BUILDING SOCIETY	CYNERGY BANK LIMITED	SAFFRON BUILDING SOCIETY
		Mean	2.22	2.69	2.37	2.9	2.14	2.07	2.56
		Max.	4.64	5.65	4.62	7.96	4.59	3.74	4.78
		Min.	STANDARD CHARTERED BANK	STANDARD CHARTERED BANK	STANDARD CHARTERED BANK	NATWEST MARKETS PLC	NATWEST MARKETS PLC	STANDARD CHARTERED BANK	STANDARD CHARTERED BANK
		Mean	1.31	1.18	1.1	1.25	0.47	0.69	0.86
		Min.	NATWEST MARKETS PLC	VIRGIN MONEY UK PLC	VIRGIN MONEY UK PLC	LLOYDS BANK PLC	YORKSHIRE BUILDING SOCIETY	YORKSHIRE BUILDING SOCIETY	VIRGIN MONEY UK PLC
	premium	Mean	3.09	3.19	2.58	2.72	1.94	2.6	3.75
		Max.	8	9.14	14.21	10.26	5.3	8.85	22.14
		Min.	0.36	0.44	0.41	0.44	0.07	0.22	0.4
		Mean	0.82	1.05	0.86	0.9	1.17	1.44	1.91
		Max.	3.69	4.74	5.53	5.6	8.13	8.53	9.39
		Min.	0	0	0.04	0.04	0	0	0
	small	Mean	68	71	70	73	82	91	93
		Max.	102	105	113	106	141	146	143
		Min.	19	19	16	17	15	34	36
		Mean	84	87	92	92	93	99	109
		Max.	120	132	166	194	260	315	472
		Min.	UNTY TRUST BANK PLC	UNTY TRUST BANK PLC	UNTY TRUST BANK PLC	HINCKLEY AND RUGBY BUILDING SOCIETY	HAMPSHIRE TRUST BANK PLC	HAMPSHIRE TRUST BANK PLC	HAMPSHIRE TRUST BANK PLC
Liquidity	DR	Mean	68	71	70	73	82	91	93
		Max.	102	105	113	106	141	146	143
		Min.	19	19	16	17	15	34	36
	large	Mean	84	87	92	92	93	99	109
		Max.	120	132	166	194	260	315	472
		Min.	NATWEST MARKETS PLC	NATWEST MARKETS PLC	NATWEST MARKETS PLC	NATWEST MARKETS PLC	NATWEST MARKETS PLC	THE ROYAL BANK OF SCOTLAND PLC	THE ROYAL BANK OF SCOTLAND PLC

		CLOS E BROTH- ERS GROUP PLC	PARA GON BANK- ING GROUP PLC	PARA GON BANK- ING GROUP PLC	PARA GON BANK- ING GROUP PLC	PARA GON BANK- ING GROUP PLC	PARA GON BANK- ING GROUP PLC	PARA GON BANK- ING GROUP PLC
		29	33	38	37	30	33	29
Min.		ULSTER BANK LIM- ITED	ULSTER BANK LIM- ITED	ULSTER BANK LIM- ITED	ULSTER BANK LIM- ITED	ROYAL BANK OF SCOTLAND INTERNA- TIONAL LIMITED	ROYAL BANK OF SCOTLAND INTERNA- TIONAL LIMITED	ROYAL BANK OF SCOTLAND INTERNA- TIONAL LIMITED
Mean		83	84	85	84	82	0.82	80
Max.		112	106	110	116	118	1.08	112
		NATIONAL COUNTIES BUILDING SOCIETY	NATIONAL COUNTIES BUILDING SOCIETY	HAMPSHIRE TRUST BANK PLC	NATIONAL COUNTIES BUILDING SOCIETY	NATIONAL COUNTIES BUILDING SOCIETY	NATIONAL COUNTIES BUILDING SOCIETY	NATIONAL COUNTIES BUILDING SOCIETY
Min.		48	45	47	36	30	0.28	23
		UNITY TRUST BANK PLC	UNITY TRUST BANK PLC	UNITY TRUST BANK PLC	UNITY TRUST BANK PLC	UNITY TRUST BANK PLC	UNITY TRUST BANK PLC	UNITY TRUST BANK PLC

Data Resource: Author's collection.

Table 4. Taiwanese banks Financial Ratios of capital scale

units : %

			2021	2020	2019	2018	2017	2016	2015	
Profitability	O A	Large	Mean	0.53	0.47	0.66	0.64	0.62	0.61	0.68
			Max.	1.05	0.72	1.20	1.21	1.15	1.17	1.28
			Min.	0.27	0.22	0.22	0.21	0.21	0.35	0.19
		pre- mium	Mean	0.53	0.54	0.51	0.46	0.48	0.53	0.65
			Max.	1.68	1.81	1.21	1.05	2.18	1.98	1.56
			Min.	0.22	0.20	0.19	0.05	-0.77	0.02	0.21
	small		0.24(TIB)	0.61(TIB)	0.23(TIB)	0.25(TIB)	0.23(TIB)	0.26(TIB)	0.24(TIB)	
	O E	large	Mean	7.40	6.77	8.32	8.40	8.36	8.67	9.68
			Max.	10.17	9.45	11.94	11.21	11.49	11.06	14.67
			Min.	3.89	3.02	3.31	3.42	3.68	6.24	3.49
		pre- mium	Mean	6.41	6.18	6.30	5.76	5.49	6.61	8.69
			Max.	11.80	12.55	8.93	9.31	16.09	15.59	13.25
Min.			2.68	2.86	2.78	0.69	-11.77	0.28	3.38	
small		3.89	3.83	3.83	4.13	3.73	4.03	3.65		
large	Mean	24.68	23.75	23.74	23.25	25.38	25.40	23.25		

C R	Max.	38.21	38.38	38.08	40.60	44.62	42.96	40.60	
		BOT	ESCB	BOT	BOT	BOT	BOT	BOT	
	Min.	10.79	9.72	11.59	10.73	13.40	13.18	10.73	
		LBOT	LBOT	LBOT	LBOT	SKB	HNB	LBOT	
	pre- mium	Mean	26.15	27.09	26.71	26.95	30.24	30.98	26.95
		Max.	63.95	48.99	59.87	58.49	59.72	58.81	58.49
			OB	SB	OB	OB	OB	OB	OB
	Min.	9.16	10.84	10.41	11.56	11.86	18.61	11.56	
		BOP	BOP	BOP	BOP	COTAB	BOK	BOP	
	small		14.38	14.97	15.56	13.05	16.24	14.61	13.05
E R	large	Mean	7	7	8	7	7	7	
		Max.	10	10	10	9	9	10	10
			BSP	BSP	BSP	BSP	BSP	BSP	BSP
	Min.	5	6	5	5	5	5	5	
		TCB	TCB	TCB	TCB	TCB	TCB	TCB	
	pre- mium	Mean	8	8	8	8	8	8	7
		Max.	15	14	15	14	14	13	12
			KTB	KTB	KTB	KTB	KTB	KTB	KTB
	Min.	6	5	6	5	5	5	5	
		TFB	TFB	BOK	BOK	BOK	BOK	BOK	
small		6	6	6	6	6	7	7	
Operating N P L	large	Mean	0.78	0.86	0.85	0.84	1.14	1.39	0.84
		Max.	1.54	2.07	1.70	1.55	1.76	1.82	1.55
			TCB	TCB	SKB	SKB	TBB	SKB	SKB
	Min.	0.27	0.14	0.15	0.32	0.63	0.63	0.33	
		BSP	CUB	CUB	CHB	SCBL	SCBL	CHB	
	Premi- uml	Mean	0.90	0.99	1.27	1.26	1.68	1.64	1.26
		Max.	3.90	2.76	2.88	3.08	4.65	2.45	3.08
			ECB	ECB	ECB	ECB	HB	OB	ECB
	Min.	0.02	0.01	0.08	0.22	0.45	1.23	0.22	
		KTB	KTB	KTB	KTB	KGIB	COTAB	KTB	
small		0.44	0.71	2.14	0.45	0.31	1.26	0.45	
Liquidity D R	large	Mean	67	68	70	71	69	76	51
		Max.	76	78	77	77	80	160	60
			HNB	TCB	CHB	TCB	TCB	SCBL	BSP
	Min.	58	62	64	61	55	55	50	
		YB	YB	BOT	BOT	BOT	SKB	SKB	
	pre- mium	Mean	65	66	67	67	67	64	50
		Max.	74	76	77	78	81	81	51
			ECB	ECB	ECB	COTAB	COTAB	COTAB	TFB
	Min.	37	45	42	43	41	41	50	
		OB	TFB	OB	OB	OB	OB	HB	
small		65	63	60	61	59	79	50	

Data Resource: Author's collection.

were the lowest, but an insignificant difference occurred. The deposit ratios

(DR) had gone up in 2016 variously, of which, the deposit ratios (DR) of small

banks had gone up the highest by 29%. Bank liquidity risk is low, but insignificant bank lending amount may lead to insufficient income.

*Dynamic Slack-Based Measure,
SBM DEA (Table 6 and 7)*

1. The overall efficiency value of 59 British banks in 2015-2021: 0.6087, 0.6169, 0.641, 0.6814, 0.6615, 0.5929, and 0.565, indicating that the overall efficiency of the banking industry had not declined after Brexit, but it was greatly affected by the pandemic in 2019. The overall efficiency value had declined from 0.6615 to 0.565 in the 3-year period, and the overall efficiency value declined by 17.59%, indicating a severe impact had occurred.
2. The overall efficiency value of 32 Taiwanese banks in 2015-2021: 0.8509, 0.922, 0.8048, 0.8708, 0.8578, 0.7879, and 0.859, indicating that the 32 banks in Taiwan remained under the influence of the pandemic, which began to ease since 2019, but was affected the worst in 2020. The said value began to go back up to 0.859 in 2021. The overall efficiency value of the 32 banks in Taiwan declined by 8.1% in 2019-2020.

According to the Dynamic Slack-Based Measure (SBM), the banks in the United Kingdom are greatly affected by the pandemic, and the 32 banks in Taiwan remain under the influence of the pandemic, but not as severe as British banks.

Conclusions and Recommendations

The analysis is performed in this study in accordance with the financial ratio and Dynamic Slack-Based Measure (SBM) with the empirical results explained as follows:

In terms of profitability, performed analyses with ROA and ROE: The ROA and ROE of the medium banks in the UK were the best; however, the said two ratios had begun to drop as much as 72% and 53% since 2019, respectively, due to the severe impact of the pandemic. The ROA and ROE of the large banks in Taiwan were the best; however, the said two ratios had begun to drop as much as 28% and 18% since 2019, respectively, due to the severe impact of the pandemic. The impact of the pandemic on the banks in the UK is more severe. In terms of profitability, the ROA of the banks in Taiwan outperformed British

Table 6 . British banks (59 banks) efficiency from 2015 to 2021

No	DMU	Overall Score	Rank	2015	2016	2017	2018	2019	2020	2021
1	ARBUTHNOT BANKING GROUP PLC	0.2868	33	0.8167	1	0.154	0.8223	0.3139	0.7199	0.089
2	CAMBRIDGE & COUNTIES BANK LIMITED	0.6659	20	0.8496	1	1	1	0.999	0.3337	0.308
3	CAMBRIDGE BUILDING SOCIETY	0.2179	39	0.1144	1	0.362	0.2109	0.1773	0.1836	0.256
4	CHARITY BANK LIMITED (THE)	0.4259	25	0.7317	0.5369	0.539	0.6766	0.1202	0.994	1
5	CHORLEY & DISTRICT BUILDING SOCIETY	0.1307	51	0.2111	0.2221	0.563	0.12	0.1125	0.0696	0.08
6	CYNERGY BANK LIMITED	0.1717	46	0.0426	0.8785	0.085	0.4038	1	1	0.318
7	DARLINGTON BUILDING SOCIETY	0.189	44	0.1851	0.1157	0.198	0.3146	0.2886	1	0.083
8	EARL SHILTON BUILDING SOCIETY	0.138	50	0.1572	0.2033	0.325	0.1897	0.1023	0.0746	0.093
9	ECOLOGY BUILDING SOCIETY (THE)	0.2382	37	0.5661	0.5956	0.576	0.3346	0.3261	0.1011	0.109
10	FURNESS BUILDING SOCIETY	0.1531	48	0.1896	0.1623	0.553	0.4482	0.3355	0.0591	0.071
11	HAMPDEN & CO PLC	0.774	17	0.4153	0.6491	0.696	1	1	0.8368	0.821
12	HAMPSHIRE TRUST BANK PLC	0.1869	45	0.6245	0.07	0.474	0.7945	0.7633	0.0766	0.327
13	HANLEY ECONOMIC BUILDING SOCIETY (THE)	1	1	1	1	1	1	1	1	1
14	HARPENDEN BUILDING SOCIETY	0.0181	56	0.8025	0.7225	0.827	0.8167	0.0958	0.0237	0.003
15	HINCKLEY AND RUGBY BUILDING SOCIETY	0.254	36	1	1	1	1	1	1	0.045
16	LEEK UNITED BUILDING SOCIETY	0.2085	40	0.8278	0.6213	0.828	1	1	0.0518	0.102
17	LOUGHBOROUGH BUILDING SOCIETY	0.0074	59	0.6016	0.1375	0.427	0.6038	0.0398	0.0012	0.106
18	MARKET HARBOROUGH BUILDING SOCIETY	0.4819	24	0.3051	0.185	0.447	0.7891	1	1	1
19	MARSDEN BUILDING SOCIETY	1	1	1	1	1	1	1	1	1
20	MELTON MOWBRAY BUILDING SOCIETY	0.0116	58	0.6143	0.353	0.536	0.6831	0.1564	0.0019	0.033
21	NATIONAL COUNTIES BUILDING SOCIETY	0.1593	47	0.0637	0.0926	0.201	0.8554	0.1401	0.2886	1
22	PENRITH BUILDING SOCIETY	0.0932	53	0.0662	0.0428	0.052	0.0617	1	1	1

23		SAFFRON BUILDING SOCIETY	0.1422	49	0.4536	0.1313	0.69	0.0292	1	1	1
24		SCOTTISH BUILDING SOCIETY	0.4202	27	0.5509	1	0.613	1	1	1	0.101
25	ETY	STAFFORD RAILWAY BUILDING SOCI-	0.3151	32	1	0.5899	0.514	1	1	0.1204	0.11
26		SUFFOLK BUILDING SOCIETY	0.2042	41	0.3562	0.3223	0.546	0.4234	0.136	0.1277	0.108
27	ETY	TIPTON & COSELEY BUILDING SOCI-	1	1	1	1	1	1	1	1	1
28		UNITED TRUST BANK LIMITED	1	1	1	1	1	1	1	1	1
29		UNITY TRUST BANK PLC	1	1	1	1	1	1	1	1	1
30		WEATHERBYS BANK LIMITED	1	1	1	1	1	1	1	1	1
31		AIB GROUP (UK) PLC	0.2015	42	0.5635	0.0756	0.229	0.2704	0.2278	0.5196	0.308
32		BANK OF IRELAND (UK) PLC	0.2313	38	0.3344	0.2122	0.465	0.4934	0.2523	0.0773	1
33		C. HOARE & CO	1	1	1	1	1	1	1	1	1
34		CLOSE BROTHERS GROUP PLC	0.5062	23	0.7058	0.3926	1	0.7389	0.7083	0.2577	0.309
35		CO-OPERATIVE BANK PLC (THE)	0.6948	19	1	1	0.968	0.7053	0.7075	0.8757	0.324
36		COVENTRY BUILDING SOCIETY	1	1	1	1	1	1	1	1	1
37		LEEDS BUILDING SOCIETY	0.2646	35	0.5216	0.3975	0.483	0.3562	0.2092	0.1466	0.166
38	VICES	MARKS & SPENCER FINANCIAL SER- PLC	0.4213	26	0.3983	0.7379	0.758	0.1404	0.6596	0.7196	0.809
39		METRO BANK PLC	1	1	1	1	1	1	1	1	1
40		ONESAVINGS BANK PLC	1	1	1	1	1	1	1	1	1
41		PARAGON BANKING GROUP PLC	0.5463	22	0.4045	0.2094	0.787	1	1	0.51	0.798
42	NATIONAL	ROYAL BANK OF SCOTLAND INTER- LIMITED	0.9079	15	1	1	1	1	1	0.5757	1
43		SAINSBURY'S BANK PLC	0.0397	55	0.0346	0.599	0.071	0.5453	0.0221	0.5584	0.013
44		SECURE TRUST BANK PLC	0.9999	12	1	1	1	1	1	0.9997	1
45		SHAWBROOK BANK LIMITED	0.5787	21	1	1	0.717	0.6884	0.579	0.2224	0.59
46		SKIPTON BUILDING SOCIETY	0.3326	30	0.4975	0.3791	0.657	0.5065	0.2656	0.1686	0.264
47		TESCO PERSONAL FINANCE PLC	0.2802	34	0.4447	0.2537	0.289	0.2762	0.1703	0.4974	0.252
48		ULSTER BANK LIMITED	0.4176	28	0.3805	0.0919	1	1	1	1	1
49		WEST BROMWICH BUILDING SOCIETY	0.0826	54	0.0676	0.6411	0.062	0.1213	0.8454	0.0333	0.081
50		BANK OF SCOTLAND PLC	1	1	1	1	1	1	1	1	1
51		BARCLAYS BANK PLC	0.3247	31	0.0868	0.2613	0.781	0.2671	1	1	1
52		HBOS PLC	0.9456	14	0.865	0.8846	0.889	1	1	1	1
53		HSBC BANK PLC	0.7195	18	0.5199	0.9708	0.358	1	1	1	1
54		LLOYDS BANK PLC	0.1295	52	0.0607	0.0741	0.324	0.3922	0.1294	0.1017	0.696
55		NATWEST MARKETS PLC	0.9926	13	0.9558	0.9923	1	1	1	1	1

56	STANDARD CHARTERED BANK	0.018	57	0.5459	0.5731	0.257	0.138	0.679	0.0027	0.247
57	THE ROYAL BANK OF SCOTLAND PLC	0.8056	16	1	1	1	0.9474	0.4742	0.641	1
58	VIRGIN MONEY UK PLC	0.4083	29	0.5789	0.7959	0.24	0.7118	0.8013	0.9054	0.176
59	YORKSHIRE BUILDING SOCIETY	0.2012	43	0.4033	0.2224	0.289	0.3233	0.188	0.1047	0.126
	Overall Score	0.4736	Av-	0.6087	0.6169	0.641	0.6814	0.6615	0.5929	0.565

Data Resource: Author's collection.

Table 7 Taiwanese banks (32 banks) efficiency from 2015 to 2021

No	DMU	Over Score	Rank	2015	2016	2017	2018	2019	2020	2021
1	BOK	0.8119	20	1	1	0.434	1	0.8274	1	0.811
2	BOP	0.7094	24	1	1	0.2524	1	1	1	1
3	BOP	0.4709	29	0.4067	1	1	1	0.2688	0.2708	0.401
4	CUB	1	1	1	1	1	1	1	1	1
5	CHB	0.9765	10	1	1	0.8547	1	1	1	1
6	COTAB	0.8377	19	0.8792	1	1	1	1	0.6076	0.565
7	CTBC	1	1	1	1	1	1	1	1	1
8	ESCB	0.9771	9	0.8505	1	1	1	1	1	1
9	ECB	0.6106	27	1	1	0.4197	0.533	0.5407	0.5342	0.535
10	FEIB	0.6295	26	0.9	0.914	0.5663	0.6708	0.5766	0.4268	0.582
11	FCB	0.9045	14	0.8285	1	0.7243	0.9323	1	0.9263	1
12	TFB	0.8932	15	0.5207	1	1	1	1	1	1
13	HNB	0.7882	21	1	1	0.5901	0.8782	0.7391	0.7299	0.738
14	HB	0.0805	32	0.6978	0.033	0.0377	0.0515	0.2412	0.3275	1
15	JSB	0.4505	30	0.6572	0.52	0.3889	0.5774	0.599	0.3935	0.296
16	KGIB	0.5993	28	0.7217	1	1	0.4077	0.4494	0.5276	0.491

17	KTB	1	1	1	1	1	1	1	1	1
18	LBOT	1	1	1	1	1	1	1	1	1
19	MICB	0.7702	22	0.9171	1	0.7134	0.8548	0.8601	0.5956	0.615
20	OB	0.7184	23	0.4369	1	1	1	1	0.3702	1
21	BSP	0.8713	16	0.7897	1	0.7999	1	1	0.642	1
22	SCBL	0.8487	17	0.7334	1	1	0.7816	1	0.6188	1
23	SB	0.2042	31	0.1936	0.037	1	1	1	1	0.664
24	TB	0.9776	8	1	1	1	1	0.8614	1	1
25	TSB	1	1	1	1	1	1	1	1	1
26	TIB	1	1	1	1	1	1	1	1	1
27	TBB	0.8393	18	1	1	0.6241	0.667	0.7643	1	1
28	TCB	1	1	1	1	1	1	1	1	1
29	SKB	0.9392	12	1	1	1	0.7211	0.9157	1	1
30	SCSB	0.9663	11	1	1	1	0.9737	0.8068	1	1
31	UBT	0.9171	13	0.8347	1	1	1	1	0.6936	1
32	YB	0.6861	25	0.8625	1	0.3481	0.8134	1	0.548	0.791
Overall Score		0.7962	Average	0.8509	0.922	0.8048	0.8707	0.8578	0.7879	0.859

Data Resource: Author's collection.

banks ($0.56 > 0.48$), and the ROE of the banks in Taiwan outperformed British banks ($7.2 > 5.68$).

In terms of risk, based on the analysis of the current assets ratio, equity ratio, deposit ratios (DR), and non-performing loan ratios (NPL): According to the empirical results, the current ratio of large British banks is better, and the equity ratios of small banks and medium banks are better. The deposit ratios of the medium banks in the UK are better, and the non-performing loan ratios (NPL ratios) of the medium banks are better. The current ratio of the medium banks in Taiwan is better, and the equity ratios of the medium banks are better. The deposit ratios of the large banks are better. Apparently, the solvency of the large banks in the UK is better, but the medium banks have the capital utilized more efficiently since it is more difficult to operate with a large capital. The solvency and capital operation of the medium banks in Taiwan are better; however, the public prefers large banks in the sense of taking out a loan; therefore, the non-performing loan ratio of the medium banks is the highest. In terms of risk - current ratio, Taiwanese banks outperform British banks ($25.74 > 23.29$). In terms of equity ratios, British banks outperform Taiwanese banks ($7.71 > 7.14$). In terms of deposit ratios (DR), British banks outperform Taiwanese banks ($85.71 > 65.42$). In terms of non-performing loan ratios, Taiwanese banks outperform British banks ($1.92 > 1.12$).

In addition, according to the overall efficiency value of the 59 British banks in 2015-2021 derived in accordance with

the Dynamic Slacks-Measure (SBM DEA), the efficiency of the banking industry did not go down after Brexit; however, it was under a severe impact of the pandemic in 2019 with the value dropped from 0.6615 to 0.565 in the 3-year period, and the overall efficiency value declined by 17.59%, indicating a severe impact had occurred. In addition, Taiwan remained under the influence of the pandemic by observing the overall efficiency value of the 32 Taiwanese banks in 2015-2021, which had begun to go down since the year of 2019, but the worst hit had occurred in 2020. The banks in the United Kingdom are greatly affected by the pandemic, and the 32 Taiwanese banks remain under the influence of the pandemic, but not as severely as British banks.

In addition, Taiwanese banks and British banks are classified as two groups for efficiency analysis in accordance with the Dynamic Slacks-Measure (SBM DEA) in this study. It is suggested to establish a common boundary for all banks in the two countries in the future study before calculating the efficiency of the banks in the two nations.

References

- Wu, P. S., Li, W. Z., Chen, Y. G., Lai, S. R., 2020. The impact of Brexit on the European financial landscape And the Strategy Research and Analysis of my country's Banking Industry. Taiwan of Banking and Finance.
- Shen, C. H., Wu, M. W., 2010. Revisit the Market Share Effect in

- Banking industry-The use of Cross Country data. *Journal of financial studies* 18,,1-53.
- Li, W. W., Chen, Y. C.,1997. An Empirical Study on Taiwan's Commercial Bank Accruals Management via Loan Loss Provisions and Securities Gains and Losses. *NTU Management Review* 8,2,33-65.
- Lin, M. C. . Yu, M. S.,2017. Bank-specific, Industry-specific and Macroeconomic Determinants of Bank Profitability – A Study of Taiwan’s Banking Industry. *Journal of Financial Review* 26,43-54.
- Chen, C. Y., Li, C. A., 2018.Substitution between Economic Cost Management and Real Earnings Management: Taiwan Banking Industry. *Sun Yat-sen Management Review* 26, 3, 511-558.
- Chen, Y. C., Lee, H. Y., 2005. Empirical Study of Earnings Management for Commercial Banks Joining Financial Holding Company. *Journal of Chinese Trend and Forward* 1,2,25-42.
- Chang, H. H., 2018. The Relationship between Earnings Management and Corporate Governance: Evidence from Chinese Banking Industry. Review of accounting and auditing studies <http://raas.acc.ntu.edu.tw/> 8,1,49-80.
- Huang, Y. L., Shen, C. H., 2009. The Effect of Earnings Management on the Bank Cost of Debt-The Credit Rating Approach. *Journal of Management and Business Research* 26, 6, 599-623.
- Tsai, L. C., Yang, Y. F., The Relationships between Service Quality, Operating Efficiency and Profitability in Taiwanese Banking Industry, *Journal of contemporary* 8,1,51-83.
- Hsieh, M.F.;Shen, C.H. 2009. Bank Provisioning, Business Cycle and Regulation: A Study of 49 Countries. *NTU Management Review* 20,2,131-155.
- Peng, J. N., Peng, S. B., Dong, P. S., Lin, Q. Z., 2019. Research and Analysis on the Establishment of my country's Financial Industry Risk Index. *Taiwan of Banking and Finance*.
- Tone, K., Tsutsui, M. 2009, “Network DEA: A slacks-based measure approach,” *European Journal of Operational Research*, 197(1), 243-252.
- Tone, K., Tsutsui, M. 2010, “Dynamic DEA: A slacks-based measure approach,” *Omega*, 38(3-4), 145-156.