



Are Small- and Medium-sized Enterprise Lending and Credit Guarantees Conducive to Bank Efficiency?

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ABSTRACT

Financing difficulties for small and medium-sized enterprises (SMEs) have always been a problem, especially following the spread of the COVID-19 epidemic, showing that a government's stabilizing support policies play an important role as the source of their funds. This research thus adopts the data envelopment analysis (DEA) model and Tobit regression model to study the relationships among SME lending, credit guarantee, bank revenue efficiency, cost efficiency, and profit efficiency. The results herein reveal when SME credit guarantee funds increase that the risk of bank failure drops, while revenue efficiency rises. However, because banks undertake a portion of the default costs, their cost efficiency also falls, resulting in less profit efficiency. Consequently, banks that increase their lending to SMEs may incur significantly reduced profit efficiency and revenue efficiency, but cost efficiency is not significantly impacted.

Keyword: Small- and Medium-sized Enterprise Lending, Credit Guarantee, Revenue Efficiency, Cost Efficiency, Profit Efficiency

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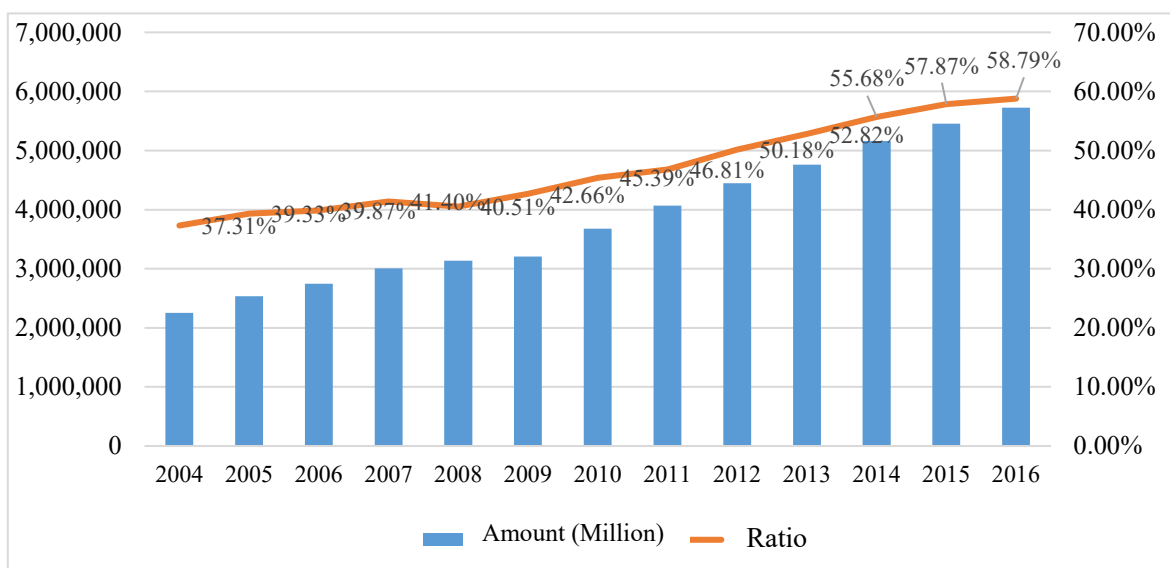
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1. Introduction

Small and medium-sized enterprises (SMEs) accounted for 97.64% of all enterprises in 2018 in Taiwan. SMEs offer positive externalities for the economy and society and provide major contributions to the promotion of innovation, employment, social stability, and economic growth (Carter and Jones-Evants, 2006). When the income of a country increases, the positive contributions of SMEs to gross domestic product (GDP) and employment also rise. SMEs are key factors for any successful economy, because they can be considered as the fuel of economic growth (Birch, 1987; Ball and Shivakumar, 2005).

According to the Organization for Economic Co-operation and Development (OECD) (2006), the most effective method for SMEs to address capital financing gaps is through the banking system. Therefore, governments worldwide have proactively encouraged banks to put more emphasis on SME financing. For the purpose of encouraging banks to increase loans to SMEs, the Taiwan government initiated “Project of Enhancing Loans by Local Banks to Small and Medium Enterprises”, while at the same time strengthening the use of credit guarantee funding. Following policy implementation, the amount of bank lending to SME has notably increased. By the end of 2005, SME lending accounted for 37.31% of total enterprise lending, and this percentage has been increasing annually, reaching 58.79% in 2016 (Fig. 1).



Resource: Banking Bureau of the Financial Supervisory Commission R.O.C. (Taiwan).

Figure 1 Amount and Ratio of Bank Lending to SMEs

Taiwan’s SME credit guarantee scheme was established in 1974, and over the last 30 years, SME credit guarantee funds have contributed enormously toward enhancing such firms’ access to finance. Credit guarantee balances account for 3.6% of GDP, and in 2016 the guarantee amount reached NT\$964.9 billion, contributing NT\$1,291.4 billion toward SME lending. Therefore, the goal of Taiwan’s credit guarantee is to strengthen the lack of collateral or insufficient credit problems of enterprises by providing the funds needed. Although credit guarantees have inherent limitations of their own risks and are difficult to control, they are an irreplaceable scheme for assisting newly-founded businesses, SMEs, and disadvantaged communities.

Banks face the problem of adverse selection and moral hazard when lending to SMEs with a lack of information transparency. The effect on bank efficiency from loans to SMEs and credit guarantee is

therefore an important topic in the literature. The issue of whether credit guarantees can effectively reduce the problem of information asymmetry is worth further exploration. In contrast to other studies that have only individually discussed the impact of credit guarantees on SMEs' operations or the effects of SME lending on bank efficiency, this present study integrates these topics to discuss the impacts of bank loans to SMEs and credit guarantee funds on bank efficiency under the support of the credit guarantee scheme. Efficiency can be further categorized into revenue efficiency, cost efficiency, and profit efficiency, thereby allowing for a more comprehensive examination for the impacts of SME lending and credit guarantee mechanisms on different types of bank efficiency. Our goal is to verify the difference between more accurate measures of bank efficiency.

To explore the impact of SME lending and credit guarantees on the revenue efficiency, cost efficiency, and profit efficiency of banks, this study adopts the New-Revenue-DEA, New-Cost-DEA, and New-Profit-DEA models as proposed by Tone (2002). Estimates are obtained based on the data of 31 Taiwanese banks that provided SME lending from 2006 to 2016. In addition, we utilize Tobit regression analysis to determine the impacts of banks providing SME lending and SME credit guarantee funds on the revenue efficiency, cost efficiency, and profit efficiency of banks.

2. Related Literature and Hypothesis Development

2.1 SME Lending and Bank Efficiency

Due to the limited quantity and accuracy of information available (Berger and Udell, 2007; Mason and Stark, 2004), banks continue to struggle at distinguishing SMEs that will repay their loans from those that will not. Information generation and management are expensive for both banks and SMEs, even if they produce benefits for both. Berger and Udell (1994) suggested that bank loans to SMEs are comparatively risky due to their relatively low collateral and heavy dependence on banks for raising funds. The quality of a SME's performance is found to be the major factor in explaining the risk-adjusted profitability of banks. However, the length and scope of the two entities' relationship and loan dimensions also play an important role (Fredriksson and Moro, 2014).

Kozo and Takahiro (2006) suggested that main banks that have raised short-term interest rates on existing loans or requested to increase savings are more likely to improve their cost efficiency. Hence, we expect a negative relationship between bank lending to SMEs and banks' revenue, cost, and profit efficiencies. Hence, we state the first hypothesis (H1) related to SME lending as follows.

H1a: An increase in SME lending has a negative impact on bank revenue efficiency.

H1b: An increase in SME lending has a negative impact on bank cost efficiency.

H1c: An increase in SME lending has a negative impact on bank profit efficiency.

2.2 Credit Guarantee on SME Lending and Bank Efficiency

Credit guarantee schemes are designed to diminish the risk associated with lending to SMEs. They can reduce information asymmetry and alleviate high collateral requirements. Therefore, credit guarantee schemes can improve loan terms and facilitate access to formal credit for small firms. Brault and Signore (2019) found that guaranteed loans between 2002 to 2016 positively affected growth of firms' assets, share of intangible assets, sales, and employment and lowered the probability of default metrics. Duarte, Gama, and Gulamhussen (2018) presented a negative correlation between loan guarantees and default. Their findings are relevant for SME policies aimed at facilitating access to credit, reducing the cost of borrowing, and decreasing default, which can help in the risk management of banks.

Many banks decrease lending during bad times when they encounter loan losses and their capitalization drops. This may affect the real economy, as SMEs, which need to finance their small businesses, may be cut off from credit. There is also a need to promote diversification of financing options for small firms and SMEs by providing various credit supporting policies (Akinsola and Ikhida, 2019). The impact of public credit guarantees on SMEs is increasing credit availability and reducing borrowing costs, without compromising their financial sustainability (Zecchini and Ventura 2009). Hence, we expect a negative relationship between bank lending to SMEs and bank revenue (cost/profit) efficiency. Hence, the second hypothesis (H2) related to SME lending can be restated as follows.

H2a: An increase in credit guarantee on SME lending has a positive impact on bank revenue efficiency.

H2b: An increase in credit guarantee on SME lending has a negative impact on bank cost efficiency.

H2c: An increase in credit guarantee on SME lending has a positive impact on bank profit efficiency.

3. Methodology

This study uses the New-Revenue Model, New-Cost Model and New-Profit Model proposed by Tone under the DEA framework to measure the revenue efficiency, cost efficiency, and profit efficiency of banks that engage in SME lending. We then apply the Tobit regression model to examine the relationships among SME lending, credit guarantee, revenue efficiency, cost efficiency, and profit efficiency.

3.1 Data Envelopment Analysis(DEA)

DEA uses linear programming method to construct a piecewise linear surface or frontier over the investigated data. DEA searches for points with the lowest unit cost for any given output, and connecting those points to form the efficiency frontier. Any company not on the frontier is considered inefficient. A numerical coefficient is assigned to each firm, defining its relative efficiency (between 0 and 1) in comparison with efficient peers.

3.1.1 New-Revenue DEA

In order to resolve the irrationality latent in the traditional Revenue model, Tone (2002) have developed the New-Revenue model, using the price-based production possibility set is defined as eq. (1):

$$p_p = \{(x, \bar{y}) | x \geq X\lambda, \bar{y} \leq \bar{Y}\lambda, \lambda \geq 0\} \quad (1)$$

where $\bar{Y} = (\bar{y}_1, \dots, \bar{y}_n)$ with $\bar{y}_j = (p_{1j}y_{1j}, \dots, p_{sj}y_{sj})$. Using the set P_p , we solve the eq.(2) Linear Programming (LP) for each DMU (x_0, y_0) .

$$[\text{New-Revenue}] \max e \bar{y} \quad (2)$$

$$\text{Subject to } x_0 \geq X\lambda, \bar{y} \leq \bar{Y}\lambda, \lambda \geq 0$$

Where e is a row vector with all elements equal to one. Using LP to find the optimal solution \bar{y}_0^* . Then, the New-Revenue Efficiency (NRE) is defined as eq. (3):

$$\text{NRE} = \frac{e\bar{y}_0}{e\bar{y}_0^*} \tag{3}$$

3.1.2 New-Cost DEA

According to the New-Cost model proposed by Tone (2002), the model utilizes the cost-based production possibility set as defined by eq. (4)

$$p_c = \{(\bar{x}, y) \mid \bar{x} \geq \bar{X}\lambda, y \leq Y\lambda, \lambda \geq 0\} \tag{4}$$

Where $\bar{X} = (\bar{x}_1, \dots, \bar{x}_n)$ with $\bar{x}_j = (c_{1j}x_{1j}, \dots, c_{mj}x_{mj})$. Using the set p_c , we solve the eq. (5) Linear Programming (LP) for each DMU(x_0, y_0).

$$[\text{New-Cost}] \min e\bar{x} \tag{5}$$

$$\text{Subject to } \bar{x} \geq \bar{X}\lambda, y_0 \leq Y\lambda, \lambda \geq 0$$

Where e is a row vector with all elements equal to one. Using LP to find the optimal solution \bar{x}_0^* . Then, the New-Cost Efficiency (NCE) is defined as eq. (6):

$$\text{NCF} = \frac{e\bar{x}_0^*}{e\bar{x}_0} \tag{6}$$

3.1.3 New-Profit DEA Model

According to the New-Profit model proposed by Tone (2002), the model utilizes the cost- and price-based production possibility set as defined by eq. (7)

$$p_{cp} = \{(\bar{x}, \bar{y}) \mid \bar{x} \geq \bar{X}\lambda, \bar{y} \leq \bar{Y}\lambda, \lambda \geq 0\} \tag{7}$$

Where $\bar{X} = (\bar{x}_1, \dots, \bar{x}_n)$ with $\bar{x}_j = (c_{1j}x_{1j}, \dots, c_{mj}x_{mj})$, and $\bar{Y} = (\bar{y}_1, \dots, \bar{y}_n)$ with $\bar{y}_j = (p_{1j}y_{1j}, \dots, p_{sj}y_{sj})$.

Using the set p_{cp} , we solve the eq. (8) Linear Programming (LP) for each DMU(x_0, y_0).

$$[\text{New-Profit}] \max e\bar{y} - e\bar{x} \tag{8}$$

$$\text{Subject to } \bar{x}_0 \geq \bar{x} = \bar{X}\lambda, \bar{y}_0 \leq \bar{y} = Y\lambda, \lambda \geq 0$$

Where e is a row vector with all elements equal to one. Using LP to find the optimal solution $(\bar{x}_0^*, \bar{y}_0^*)$. Then, the New-Profit Efficiency(NPE) is defined by eq. (9)

$$\text{NPE} = \frac{e\bar{y}_0 - e\bar{x}_0}{e\bar{y}_0^* - e\bar{x}_0^*} \tag{9}$$

3.2 Tobit Regression Model

We next utilize the Tobit regression model to determine the relationships among SME lending, credit guarantee, bank characteristics variable, control variable, bank revenue efficiency, cost efficiency, and profit efficiency. The explained variables in the Tobit regression model are obtained from the efficiency in the DEA model.

The efficiency scores (as the explained variable) from DEA are limited to a value between 0 and 1. Because the explained variable in the regression equation cannot be expected to have a normal distribution, we thus cannot expect the regression error to also meet the assumption of normal distribution. The OLS method as a result often leads to biased and inconsistent parameter estimates (Greene, 1981). We thus use the Tobit estimation (1958) in this study. The empirical model is set as follows.

$$y_i^* = \beta x_i + \varepsilon_i \tag{10}$$

$$\begin{cases} 1 & \text{if } y_i^* \geq 1 \\ y_i^* & \text{if } 0 < y_i^* < 1 \end{cases}$$

3.3 Data and Definition

This study adopts Taiwanese banks that have conducted SME lending as the sample. Data cover the period from 2006 to 2016 with 341 observations from 31 banks over the entire sample period. The data sources are from the Taiwan Financial Supervisory Commission, Taiwan Economic Journal (TEJ) database, Taiwan Central Bank, annual reports from bank official websites, and SME credit guarantee funds. There are many ways to define and categorize input and output variables in the banking literature. This study refers to Berger and Humphrey (1992) and employs the most commonly adopted intermediation approach to define input and output (i.e., the three-input three-output model). Table 1 lists the definitions of input and output variables.

Table 1 Definitions of Input and Output Variables

Variable	Definition	Literature
Output Variable		
Total loans (Y1)	Total of short-term and long-term loans	Haque and Brown (2017) Lee and Chih (2013) Pasiouras (2008)
Investment (Y2)	Includes short- and long-term investments	Lee and Chih (2013)
Non-interest income (Y3)	Fee income	Pasiouras (2008)
Output Price		
Price of loans (Q1)	Interest income on loans divided by total loans (Y1)	Lee and Chih (2013)
Price of investment (Q2)	Other operating income divided by investments (Y2)	Lee and Chih (2013)
Price of non-interest income (Q3)	Fee income minus fee expense divided by fee income (Y3)	Gaganis and Pasiouras (2013)
Input Variable		
Labor (X1)	The number of employees	Haque and Brown (2017)
Fixed assets (X2)	The sum of physical capital and premises	Haque and Brown (2017) Lee and Chih (2013)
Funds (X3)	Total deposits plus total borrowed funds	Lee and Chih (2013)
Input Price		
Price of labor (P1)	Employee salary expenses divided by number of	Haque and Brown (2017)

	employees (X1)	
Price of fixed assets (P2)	Operating expenses divided by the fixed assets (X2)	Haque and Brown (2017)
Price of funds (P3)	Interest expenses on customer deposits plus other interest expenses divided by total funds (X3)	Haque and Brown (2017)

Source: The study collated information from the related literature.

We next utilize the Tobit regression model to determine the relationships among SME lending, credit guarantee, bank characteristics variable, control variable, bank revenue efficiency, cost efficiency, and profit efficiency. The explained variables in the Tobit regression model are obtained from the efficiency in the DEA model.

Table 2 Definition of research variable

Variable	Definition	Data source
The explained variable		
Revenue efficiency (RE)	The revenue efficiency is obtained from the New Revenue Model in the DEA model.	Taiwan Economic Journal (TEJ) Database and annual reports from bank official websites
Cost efficiency (CE)	The cost efficiency is obtained from the New Cost Model in the DEA model.	Taiwan Economic Journal (TEJ) Database and annual reports from bank official websites
Profit efficiency (PE)	The profit efficiency is obtained from the New Profit Model in the DEA model.	Taiwan Economic Journal (TEJ) Database and annual reports from bank official websites
The explanatory variable		
SME lending to total lending Ratio (SME)	the ratio of SME lending to total lending	Taiwan Financial Supervisory Commission
Credit guaranteed mount to the total lending amount Ratio(GUR)	the proportion of credit guaranteed amount to the total lending amount.	Taiwan Financial Supervisory Commission
Bank characteristics variable		
Income diversification (ID)	The diversification across different sources of bank income. The income diversification is	Taiwan Economic Journal (TEJ) Database and annual reports from bank

	$1 - \left[\left(\frac{NII}{NII + NOI} \right)^2 + \left(\frac{NOI}{NII + NOI} \right)^2 \right]$ <p><i>NII</i> and <i>NOI</i> respectively represents net interest income and non-interest income.</p>	official websites
Cost to income ratio (CI)	bank operating cost divided by operating income	Taiwan Economic Journal (TEJ) Database
Z-score	<p>a bank measure of financial risk calculated as</p> $Z = \frac{\left(\frac{E}{A} + \mu_{ROA} \right)}{\sigma_{ROA}}$ <p>logarithm of</p> <p>E : the average of equity A : the average of asset μ_{ROA} : the average of ROA σ_{ROA} : the standard error of ROA</p>	Taiwan Economic Journal (TEJ) Database
Loan to deposit ratio (DL)	the ratio of loans to deposits of bank	Taiwan Economic Journal (TEJ) Database
Control variable		
Government shareholding ratio (GR)	the government shareholding ratio	Statistics Bureau of Taiwan Central Bank
Foreign shareholdings ratio (FR)	the foreign shareholdings ratio	Statistics Bureau of Taiwan Central Bank
Financial holding company (FHC)	<i>FHC_{it}</i> is a dummy variable, which is set <i>FHC_{it}</i> =1 for banks belonging to a financial holding company and others =0	annual reports from bank official websites
Total Asset(TA)	the natural log of total assets	Taiwan Economic Journal (TEJ) Database
M1B	the quantity of money as a monetary macroeconomic variable	Statistics Bureau of Taiwan Central Bank

Source: The study collated information from the related literature.

3.4 Empirical Model

The explained variables in the Tobit regression model are obtained from the revenue efficiency score, cost efficiency score, and profit efficiency score in the New Revenue Model, New Cost Model, and New Profit Model. Next, we estimate the relationships among the explainable variable, bank characteristics variable, control variable, revenue efficiency, cost efficiency, and profit efficiency. Thus, the Tobit regression model for our empirical model is:

$$Eff_{j,i,t} = a_0 + b_1 \times SME_{i,t} + b_2 \times GUR_{i,t} + b_3 \times ID_{i,t} + b_4 \times CI_{i,t} + b_5 \times DL_{i,t} + b_6 \times Z-Score_{i,t} + b_7 \times TA_{i,t} + b_8 \times GR_{i,t} + b_9 \times FR_{i,t} + b_{10} \times FHC_{i,t} + b_{11} \times MIB_{i,t} + \varepsilon_{i,t}$$

Here, $Eff_{j,i,t}$ is the efficiency score, j represents revenue efficiency, cost efficiency, and profit efficiency, respectively; i represents the bank; and t represents the time during the period 2006 and 2016. The main explanatory variables are SME_{it} and GUR_{it} . SME_{it} is the ratio of SME lending by bank i at time t , which is calculated as the ratio of SME lending to total lending; GUR_{it} is the credit guarantee ratio of bank i at time t , which refers to the proportion of credit guaranteed amount to the total lending amount. Bank characteristics variables include ID_{it} , CI_{it} , DL_{it} , and $Z-score_{it}$. ID_{it} is the income diversification ratio, which is defined as a measure of diversification across different sources of income.¹ CI_{it} is the cost to income ratio of bank i at time t , where it is bank operating cost divided by operating income, in order to measure the operation effect of banks. DL_{it} represents the ratio of loans to deposits of bank i at time t .

$Z-score_{i,t}$ represents a bank measure of financial risk calculated as logarithm of $Z = \frac{(\frac{E}{A} + \mu_{ROA})}{\sigma_{ROA}}$.

Control variables include TA_{it} , GR_{it} , FR_{it} , FHC_{it} , and MIB_{it} . TA_{it} is calculated as the natural log of total assets. GR_{it} is the government shareholding ratio. FR_{it} is the foreign shareholdings ratio. FHC_{it} is a dummy variable, which is set $FHC_{it}=1$ for banks belonging to a financial holding company and others =0. MIB_{it} is the quantity of money as a monetary macroeconomic variable.

Model I

The relationship between the explainable variable, bank characteristics variable, control variable and revenue efficiency

$$Y(RE) = a_0 + b_1 \times SME_{i,t} + b_2 \times GUR_{i,t} + b_3 \times ID_{i,t} + b_4 \times CI_{i,t} + b_5 \times Z-score_{i,t} + b_6 \times TA_{i,t} + b_7 \times DL_{i,t} + b_8 \times GR_{i,t} + b_9 \times FR_{i,t} + b_{10} \times FHC_{i,t} + b_{11} \times MIB_{i,t} + \varepsilon_{i,t}$$

Model II

The relationship between the explainable variable, bank characteristics variable, control variable and cost efficiency

$$Y(CE) = a_0 + b_1 \times SME_{i,t} + b_2 \times GUR_{i,t} + b_3 \times ID_{i,t} + b_4 \times CI_{i,t} + b_5 \times Z-score_{i,t} + b_6 \times TA_{i,t} + b_7 \times DL_{i,t} + b_8 \times GR_{i,t} + b_9 \times FR_{i,t} + b_{10} \times FHC_{i,t} + b_{11} \times MIB_{i,t} + \varepsilon_{i,t}$$

Model III

The relationship between the explainable variable, bank characteristics variable, control variable and profit efficiency

¹ Commercial banks' activities are classified between traditional (taking deposits and making loans) and non-traditional (e.g., securities and foreign exchange trading and provision of fee-based services). We consider income diversification under two categories, net interest income (NII) and non-interest income (NOI). Net interest income (NII) is interest income minus interest expense and non-interest income (NOI), including investment income, foreign exchange income, gain (or loss) on sale of securities, trading account income, and commissions and fees. We construct income diversification as $1 - \left[\left(\frac{NII}{NII + NOI} \right)^2 + \left(\frac{NOI}{NII + NOI} \right)^2 \right]$. A smaller value means a lower diversification level and vice versa.

$$Y(PE) = a_0 + b_1 \times SME_{i,t} + b_2 \times GUR_{i,t} + b_3 \times ID_{i,t} + b_4 \times CI_{i,t} + b_5 \times Z\text{-score}_{i,t} \\ + b_6 \times TA_{i,t} + b_7 \times DL_{i,t} + b_8 \times GR_{i,t} + b_9 \times FR_{i,t} + b_{10} \times FHC_{i,t} + b_{11} \times M1B_{i,t} + \varepsilon_{i,t}$$

4. Empirical analysis

To avoid the problem of high collinearity between variables, this study conducts a correlation coefficient test for all variables. The correlation coefficients between variables are all less than 0.6, indicating no collinearity. Table 3 shows the empirical results of regression analysis. The main explanatory variables are the ratio of banks providing SME lending and the ratio of SME credit guarantee funds. The variables of bank characteristics are income diversification, cost to income ratio, loan to deposit ratio, and Z-score. The control variables are asset size, government shareholding ratio, foreign shareholding ratio, financial and non-financial holding company, and monetary aggregate.

4.1 SME Lending Ratio (SME_{it})

This section explores whether the SME lending ratio contributes to increasing bank efficiency. SME lending can increase the operational performance of banks. To obtain lending from banks, SMEs must maintain good relationships with their lender and provide comprehensive information disclosure so as to reduce the problem of information asymmetry.

The empirical results show that increasing SME lending reduces the profit and revenue efficiencies of banks. This is because Taiwanese SMEs are small scale and exhibit information asymmetry or poor financial transparency. Consequently, when banks increase SME lending, their profit and revenue efficiencies decrease. Therefore, the empirical results support Hypotheses 1a and 1c. However, because cost efficiency is not up to a value that is statistically significant, Hypothesis 1b is not supported.

4.2 Credit Guarantee Funds Ratio (GUR_{it})

Beck et al. (2008) and Honohan (2010) reviewed and compared credit guarantee projects in various countries and stated that at the beginning of such projects, cash outflow is relatively limited. However, the number and amount of lending can rapidly increase. Before a credit guarantee organization provides a guarantee, a credit check and review of the lender are typically conducted. This compensates for the information asymmetry of SMEs, but creates the problems of higher lending costs and higher risk of adverse selection.

Table 3 reveals that credit guarantees compensate for the higher cost of SME lending and credit risk-sharing mechanism, thus increasing revenue efficiency. However, because banks are responsible for a portion of the default and lending costs, cost efficiency is reduced. Therefore, the credit guarantee ratio does not significantly affect bank profit efficiency. The empirical results support Hypotheses 2a and 2b. However, the coefficient for credit guarantee has a positive effect on profit efficiency, but it is not significant. Therefore, Hypothesis 2c is not supported.

4.3 Bank Characteristics Variables

Because the rate spread between deposits and loans has fallen in recent years, banks have sought revenue diversification. For banks in the U.S. and Germany, the ratio of non-traditional business to bank income has significantly increased (Lepetit et al., 2008; Busch and Thomas, 2009). Table 3 indicates that a high degree of bank revenue diversification raises a bank's cost efficiency. However, it does not significantly affect profit efficiency and revenue efficiency. This might be because diversification increases the volatility of profit and reduces the risk-adjusted return, thereby cutting the benefit of diversified

operations in business departments (DeYoung and Rice, 2004). Therefore, revenue diversification has no significant effect on profit efficiency and revenue efficiency.

The cost to income ratio means the cost a bank must pay for every unit of income. In other words, a lower cost to income ratio implies that banks have higher profitability. The empirical results find that a bank with a lower cost-income ratio will have higher profit efficiency and revenue efficiency. However, a higher cost-income ratio implies higher cost efficiency. The loan to deposit ratio is a critical reference index for evaluating the liquidity risk of a bank. The empirical results reveal that the loan to deposit ratio has no significant influence on cost efficiency, profit efficiency, and revenue efficiency. The study chooses Z-score as a proxy for bank risk. The empirical results show that the lower the bank's risk is, the higher is its profit efficiency. However, the Z-score has no significant effect on cost efficiency and revenue efficiency.

4.4 Control Variables

The empirical results of Banz (1981), Shrieves and Dah (1992), and Leung and Young (2002) pointed out that banks with larger asset size have more strategies to diversify the risk of investment portfolios, thus indicating that asset size has a positive effect on profit performance. Previous studies showed that when the bank asset size is large, banks exercise more effectiveness over their product scope, thus increasing profit efficiency.

Bonin, Hasan, and Wachtel (2005) found that, although government-controlled banks have lower profits than privately-owned banks, their efficiency is not necessarily lower than privately-owned banks. Our results show that banks with a higher government shareholding ratio can enhance their cost efficiency and revenue efficiency. However, because their profitability is lower than privately-owned banks, their profit efficiency is reduced.

An increase in the foreign shareholding ratio of banks can effectively increase their operational performance and profitability and reduce their operational risk. Banks with a higher ratio of foreign shareholding or foreign directors can employ their experience in international investment to provide a sound supervision mechanism (Choi and Hasan, 2005). Results revealed that a higher foreign shareholding ratio implies higher cost efficiency and revenue efficiency, but lower profit efficiency.

The study chooses a dummy variable to indicate whether a bank belongs to a financial holding company. The empirical results show that banks under financial holding companies, which have diverse businesses and economies of scope, have higher profit efficiency than other banks.

This study chooses M1B as the macroeconomic control variable. The empirical results indicate that an increase in M1B increases the cost efficiency, profit efficiency, and revenue efficiency of a bank. Therefore, expansionary monetary policy increases the momentum of market funds and is conducive to increasing bank efficiency. Table 2 describes the empirical result of the regression model.

Table 3 Empirical Result of the Regression Model

Efficiency Type Variable	New-Revenue		New-Cost		New-Profit	
	Coef.	Z	Coef.	Z	Coef.	Z
Main Variable						
SME	-0.0035**	-2.95	0.0013	0.66	-0.0035***	-2.35
GUR	0.0047***	4.92	-0.0047***	-2.96	-0.0008	-0.68

Efficiency Type Variable	New-Revenue		New-Cost		New-Profit	
Bank Characteristics Variable						
ID	0.1263	1.22	0.3324*	1.89	-0.1905	-1.43
CI	-0.6105***	-5.08	0.8855***	4.11	-0.6317***	-3.91
DL	0.0003	0.26	0.0021	0.93	0.0018	1.13
Z-score	-0.0075	-1.11	-0.0058	-0.48	0.0288***	3.08
Control Variable						
TA	-0.0157	-1.13	-0.0930***	-3.06	0.0998***	5.71
GR	0.0016***	3.27	0.0040***	4.39	-0.0019***	-3.06
FR	0.0010***	2.41	0.0013*	1.65	-0.0010*	-1.93
FHC	-0.0138	-0.64	0.0198	0.51	0.1388***	5.09
M1B	1.04E-06***	2.33	2.04E-06***	2.33	1.76E-06***	3.12

Notes: *, **, and *** indicate that the mean difference is significant at the 10%, 5%, and 1% levels, respectively. SME is the SME lending ratio, GUR is the credit guarantee funds ratio, ID is the income diversification ratio, CI is the cost to income ratio, DL represents the ratio of loans to deposits, Z-score represents a bank measure for financial risk, TA is the natural log of total assets, GR is the government shareholding ratio, FR is the foreign shareholdings ratio, FHC is set to whether a bank belongs to financial holding company, and M1B is a monetary aggregate variable.

5. Conclusion

Taiwanese SMEs are small in scale and have the problems of information asymmetry or poor financial statements. Consequently, when a bank increases lending to SMEs, its profit efficiency and revenue efficiency decrease, but the influence on cost efficiency is non-significant. The results support Hypotheses 1a and 1c by showing that when banks conduct SME lending, they cannot improve their revenue efficiency and profit efficiency.

Empirical results also show that when banks increase their credit guarantees to SMEs, they can reduce risk and increase revenue, thereby increasing revenue efficiency. However, because banks must also assume part of the default costs, their cost efficiency is reduced. The results support Hypotheses 2a and 2b by indicating that SME lending and credit guarantees are conducive to increasing bank effectiveness. However, when facing moral hazard risk and adverse selection, banks must still pay relatively high costs. Therefore, profit efficiency is not significantly affected.

A high degree of revenue diversification in a bank increases its cost efficiency. A low cost to income ratio leads to strong earnings ability for a bank, which is conducive to increasing revenue efficiency and profit efficiency. When the risk for a bank is low, its profit efficiency is high. Increasing bank asset size increases its profit efficiency. The government shareholding ratio and foreign shareholding ratios both increase cost efficiency and revenue efficiency of banks. If a bank is a subsidiary of a financial holding company, then its profit efficiency is higher, because of the holding company's diversified business and economies of scale. The increase in the M1B monetary aggregate is conducive to increasing bank efficiency.

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