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Article

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Full length article

The impact of SMEs' lending and credit guarantee on bank efficiency in South Korea

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Abstract

This study examines how small and medium-size enterprises' (SMEs') lending and credit guarantee affect Korean banks' efficiency, by employing the stochastic frontier approach on 14 banks over the period 2001–2010. When lending increases to SMEs, the findings indicate that banks' cost efficiency decreases due to information asymmetry. However, the increased proportion of credit guarantee can improve their cost efficiency. This proves that South Korea's credit guarantee system can indeed share SMEs' credit risk of lending in order to help raise bank efficiency.

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JEL classifications: C33; G21; G30

Keywords: SME lending; Credit guarantee; Bank efficiency

1. Introduction

Small and medium-size enterprises (SMEs) create various positive externalities on economies and social benefit, because they make important contributions to investment, innovation, employment, and social stability (Carter and Jones-Evans, 2006). In other words, SMEs are the engine that accelerates economic growth in both developed and developing countries (Birch, 1979, 1987; Ball and Shivakumar, 2005; Boocock and Shariff, 2005). However, as SMEs have significant gaps in information and skills needed to access external finance (OECD, 2006), they are often subject to more stringent credit restrictions as compared to large enterprises (Stiglitz and Weiss, 1981), making it hard for them to obtain funding from the market. Thus, financing gaps¹ exist in SMEs (Cassar, 2004; Howorth 2001; Wingborg and Landström, 2000) and are more pervasive in emerging markets than in developed countries.

The financing gap is by no means insurmountable, but for many countries, how to surmount this gap or deepen and broaden financial access should be an important public policy objective (OECD, 2006; Ratnovski and Narain, 2007). In the development phase of their expansion, SMEs depend highly upon the banking sector to obtain funding (Boocock and Wahab, 2001). Specific practices can strongly encourage or guide the financial system to enhance its services to SMEs, move SME counselor institutions and related authorities up the ranks, implement a credit guarantee system, raise SME project loan funds, and so forth.

Governments worldwide actively encourage banks to make loans available to SMEs, and the credit guarantee scheme² has become the most widely used method³ (Green, 2003). A large portion of banks' profits comes from loan interest rates, owing to the banking industry mainly depending on accepting deposits and making loans. When doing business with an opaque SME, a bank faces problems such as adverse selection and moral hazard

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¹ OECD (2006) showed that there is no commonly agreed definition of this gap, but the term is basically used to mean that a sizeable share of economically significant SMEs cannot obtain financing from banks, capital markets, or other suppliers of finance.

² A credit guarantee scheme provides third-party credit risk mitigation to lenders through the absorption of a portion of the lender's losses on the loans made to SMEs in case of default, typically in return for a fee.

³ It is widely accepted that a credit guarantee system attempts to overcome imperfections in the credit market, which disadvantages SMEs when trying to get formal loans, by allowing lenders to shift loan recovery risks to the guarantee program (Vogel and Adams, 1997).

(Stiglitz and Weiss, 1981; Moro et al., 2012). Therefore, the biggest risk for a bank making a loan to a SME lies in loan default. Although SMEs make up a large proportion of a bank's credit accounts, lending to SMEs still implies a certain degree of credit risk.

The credit guarantee system exactly compensates for the aforementioned credit risk (Craig et al., 2008), because it is intended to address this market failure, by reducing the financial loss suffered by financial institutions in the case of defaults. At present, there are more than 170 countries using the credit guarantee program (Nitani and Riding, 2005) to help SMEs obtain easier access to working capital (Levitsky, 1997; Listeri, 1997). Once a loan is approved by a credit guarantee, the guarantee is essentially equivalent to an increase in the expected return of a loan, and the actual loss is significantly reduced even if a bad debt occurs. Requiring the participating banks to have a minimum acceptable level of interest rate helps suppress interest rates, and to some extent the credit guarantee alleviates the moral hazard. Hence, SME lending with the credit guarantee scheme has become a key approach in the United Kingdom, the United States, Japan, Taiwan, Germany, and other advanced countries. However, it is undeniable that SMEs applying for loans via the credit guarantee scheme probably lack collateral or exhibit a relatively high risk.

South Korea in recent years has demonstrated incredible economic development mostly through the rapid growth of well-known large enterprises (the so-called chaebols). However, there are still about three million SMEs accounting for 99.9% of all Korean enterprises with their 10.5 million employees accounting for 87.5% of the nation's employment. In total, the SMEs' industrial output value is 49.4%, obvious showing that the development and contributions of SMEs act as a key factor in the growth of South Korea's economy. According to OECD (2012) data, SME loans account for more than 80% of all loans there. In addition, the volume of outstanding guarantees amount to 6.2% of GDP, or second only to 7.3% in Japan. In view of this, this study takes South Korea as the research subject.

Whether in developed or developing countries, SMEs always play an important, foundational role in economic development, but there are many constraints on their development, with financing difficulty being the most significant aspect. Although the banking industry can rely on the government-promoted credit guarantee scheme for sharing the risk of engaging in SME financing, many banks still face the risk of default. Even so, SMEs are important clients for banks' financing and profits owing to their importance and universality. Therefore, this study's focus is on how SME financing and credit guarantee affect bank efficiency. We also input some control variables into the model, such as profitability, management capability, capital adequacy ratio, regional banks, and financial crisis. To address these issues, this paper employs stochastic frontier analysis (SFA)⁴ to investigate the uncertain relationship between the extent of SME lending, credit guarantee, and the cost effi-

ciency of Korean banks. Based on Battese and Coelli (1995), we implement the maximum likelihood estimation method to simultaneously estimate the stochastic cost function and the inefficient model.

We construct the remainder of this paper as follows. Section 2 is a review of the relevant literature. Section 3 discusses the methodology and data used in the study. Section 4 presents an analysis of the empirical results. Finally, Section 5 provides a conclusion.

2. Literature review

SMEs generate positive economic, social, and political externalities, but due to incomplete structural characteristics of credit market information, they often present problems concerning credit rationing (Stiglitz and Weiss, 1981). As a result of an ambiguous information structure and low economic status, SMEs are often subject to more stringent credit constraints compared to large enterprises, making their survival and development more difficult and severe. For this reason, many countries apply measures approved by public financial institutions, such as policy-oriented loans or a government-supported credit guaranteed scheme, in order to make up for the inadequate market mechanism or market failure.

Financial institutions receive deposits from the public and hence are relatively conservative towards their lending policy. Conservative lending practices by banks during recessions typically impose a sharp credit squeeze on enterprises, and SMEs are the first to bear the brunt. Berger and Udell (2006) also pointed out that lending behaviors change with the business cycle, mainly because banks use previous loan default probabilities to decide whether it is safe to provide loans. Thus, during a recession, lending personnel are more conservative and tend to raise standards due to their concerns on the high probability of default, which results in a decrease in the total amount of business loans.

Numerous factors could affect a bank's SME financing business, many of which the literature has identified. Berger et al. (2001) noted that there is a significant negative relationship between a bank's scale and SME financing; and there is a negative relationship between banks with financial crises and the overall financing business, but one cannot be sure whether it refers to SME financing. Berger and Udell (2006) found that the financial institution structure affects the use of technologies, because the institution types have comparative advantages under different lending technologies. The lending infrastructures have important effects on SME credit availability, with better lending infrastructures likely to significantly improve SME credit availability by facilitating the use of various lending technologies.

Beck et al. (2008) conducted an investigation of 91 banks from 45 countries, offering key findings from their study's results. First, lending technologies are highly correlated to government policies, financial structures, and SME lending. Second,

⁴ We use stochastic frontier analysis (SFA) rather than data envelopment analysis (DEA). The main advantage of SFA over DEA is that it allows us to distinguish

between inefficiency and other stochastic shocks in the estimation of efficiency scores (Yildirim and Philippatos, 2007).

Table 1
Variable definitions and descriptions of cost function.

Variable	Description	Mean	Std. dev.	Max.	Min
Total cost (TC) US\$1,000	Labor cost + capital cost + funding cost	2,952,942	2,891,896	13,770,205	98,077
Fund (X_1) US\$1,000	Deposits + borrowing	44,569,555	41,870,749	158,600,919	1,518,426
Labor (X_2) people	Total employees	7195	7502	30,932	453
Capital (X_3) US\$1,000	Net fixed assets	857,206	779,739	3,470,147	32,777
Price of funding (P_1) %	Interest payments ÷ deposits + borrowing	0.0412	0.0118	0.1065	0.0248
Price of labor (P_2) US\$1,000	Employee salary ÷ total employees	69.8940	51.9103	333.8767	30.0997
Price of capital (P_3) %	Operating expense ÷ net fixed assets	0.6896	0.6793	5.5442	0.1923
Output (Y_1) US\$1,000	Loans	43,594,819	44,266,196	173,112,479	1,236,997
Output (Y_2) US\$1,000	Investment	14,176,895	11,995,517	42,555,350	355,477
Output (Y_3) US\$1,000	Non-interest income	580,799	982,199	8,245,200	375.0409

among loan condition, enterprise scale, and ownership structure, loan conditions have the greatest impact on SME lending. Third, banks perceive their SME business line as being very profitable, and their reactions to government programs supporting SME finance are positive.

In terms of credit guarantee, [Craig et al. \(2008\)](#) presented that the purpose of the credit guarantee scheme is to reduce the expected loss generated from bad debts and increase the expected return derived from lending. From this scheme, problems generated from adverse selection are expected to be solved, and banks can set the lending interest rate based on the average risk level of all borrowers. Once the lending case is approved by the credit guarantee scheme, the loss could still be reduced significantly even if a default occurs. Conversely, one may refer to the reduced loss as an increase in the expected return of lending. The minimum acceptable interest rates required by the credit guarantee scheme for banks help suppress interest rates, meaning to some extent the credit guarantee can diminish the moral hazard.

[Green \(2003\)](#) also showed that the credit guarantee scheme is effective, regarding the problems of relatively high risks and the lack of collateral for small-scale loans. It was proven to be beneficial through a mutually cooperative banking network as opposed to a single bank creating loans for SMEs within asymmetric information in the banking industry. However, [Levitsky \(1997\)](#) argued that credit guarantee schemes designed for SMEs should take externalities and sustainability into account at the same time. This study refers to whether the SME credit guarantee scheme leads to excessive subsidies and causes moral hazard, thus further affecting the sustainability and development of the scheme. [Honohan \(2008\)](#) had the same opinion as [Levitsky \(1997\)](#) in that most credit guarantee institutions are overly optimistic about the estimated loss. Therefore, we need to keep an eye on the sustainability of a credit guarantee scheme.

[Uesugi et al. \(2010\)](#) pointed out that in the beginning, a credit guarantee scheme can indeed encourage banks lacking adequacy to engage in short-term loans. These banks then apply to the credit guarantee scheme to replace non-guaranteed loans by guaranteed loans in order to reduce risk probabilities, which at the same time helps maintain the business and ease their willingness to engage in long-term loans. In addition to high net worth enterprises, the industrial moral hazard may be more severe, because by encouraging banks to engage in high-risk

investments, the probability of a financial crisis erupting will be higher, which will lead to a decrease in their profitability.

There are numerous studies and literature regarding banks' efficiency in recent years, but their focuses mainly lie in ownership structure ([Bonin et al., 2005](#); [Lensink et al., 2008](#); [Berger et al., 2009](#)), mergers and acquisitions ([Lee et al., 2013](#); [Montgomery et al., 2014](#)), supervisory measures ([Chortareas et al., 2012](#)) and corporate governance ([Aebi et al., 2012](#)). However, there is still a gap of any strict research on how to analyze the effects of SME lending and credit guarantee on bank efficiency. Therefore, we look to fill this gap in the literature by investigating whether SME lending and credit guarantee influence the cost efficiency of Korean banks.

3. Model specification

We use the [Battese and Coelli \(1995\)](#) model that provides estimates of efficiency in a single step in which firm effects are directly influenced by a number of variables. This study specifies the following stochastic translog cost function with three inputs and three outputs ([Christensen et al., 1973](#)):

$$\begin{aligned}
 \ln TC = & \alpha_0 + \sum_{i=1}^m \alpha_i \ln Y_i + \sum_{j=1}^n \beta_j \ln P_j \\
 & + \frac{1}{2} \sum_{i=1}^m \sum_{j=1}^m \delta_{ij} \ln Y_i \ln Y_j + \frac{1}{2} \sum_{i=1}^m \sum_{j=1}^n \rho_{ij} \ln P_i \ln P_j \\
 & + \sum_{i=1}^m \sum_{j=1}^n \tau_{ij} \ln Y_i \ln P_j + v + u,
 \end{aligned} \quad (1)$$

where TC represents the total cost of the Decision Making Unit (DMU), Y_i is the i th output (loans, investment, and non-interest income, respectively), P_j is the j th input price (price of funding, labor, and capital, respectively); α , β , δ , ρ , τ are the parameters to be estimated, whereby v and u are random error terms assumed to be mutually independent, and is a function of firm-specific factors that affect cost inefficiency. Specifically, u belongs to a truncated normal distribution given that $u \sim N^+ (m, \sigma_u^2)$.

In estimation, the translog cost function should satisfy the regularity condition⁵ that an input share equals the derivative of the log cost function with respect to the corresponding log input price (Allen and Rai, 1996). We impose linear homogeneity restrictions by normalizing the dependent variables and all input prices by the second input price P_{2it} .

$$\begin{aligned} \ln \left(\frac{TC_{it}}{P_{2it}} \right) &= \alpha_0 + \alpha_1 \ln Y_{1it} + \alpha_2 \ln Y_{2it} + \alpha_3 \\ &\ln Y_{3it} + \beta_1 \ln \left(\frac{P_{1it}}{P_{2it}} \right) + \beta_3 \ln \left(\frac{P_{3it}}{P_{2it}} \right) + \frac{1}{2} \alpha_{11} (\ln Y_{1it})^2 \\ &+ \frac{1}{2} \alpha_{22} (\ln Y_{2it})^2 + \frac{1}{2} \alpha_{33} (\ln Y_{3it})^2 + \alpha_{12} \ln Y_{1it} \ln Y_{2it} \\ &+ \alpha_{13} \ln Y_{1it} \ln Y_{3it} + \alpha_{23} \ln Y_{2it} \ln Y_{3it} \\ &+ \frac{1}{2} \gamma_{11} \left(\ln \frac{P_{1it}}{P_{2it}} \right)^2 + \frac{1}{2} \gamma_{33} \left(\ln \frac{P_{3it}}{P_{2it}} \right)^2 + \gamma_{13} \ln \left(\frac{P_{1it}}{P_{2it}} \right) \\ &\ln \left(\frac{P_{3it}}{P_{2it}} \right) + \rho_{11} \ln Y_{1it} \ln \left(\frac{P_{1it}}{P_{2it}} \right) + \rho_{13} \ln Y_{1it} \\ &\ln \left(\frac{P_{3it}}{P_{2it}} \right) + \rho_{21} \ln Y_{2it} \ln \left(\frac{P_{1it}}{P_{2it}} \right) + \rho_{23} \ln Y_{2it} \\ &\ln \left(\frac{P_{3it}}{P_{2it}} \right) + \rho_{31} \ln Y_{3it} \ln \left(\frac{P_{1it}}{P_{2it}} \right) + \rho_{33} \ln Y_{3it} \\ &\ln \left(\frac{P_{3it}}{P_{2it}} \right) + \omega T_{it} + \lambda T_{it}^2 + v_{it} + u_{it} \end{aligned} \quad (2)$$

where Y_{1it} is loans of bank i at time t , Y_{2it} is investment of bank i at time t , Y_{3it} is non-interest income of bank i at time t , P_{1it} is price of funding of bank i at time t , P_{2it} is price of funding of bank i at time t , P_{3it} is price of capital of bank i at time t .

We also specify the following regression model to capture the main determinants of X-inefficiency of banks in South Korea:

$$\begin{aligned} u_{it} &\sim N^+ (M_{it} = \delta' z_{it}, \sigma^2) \\ M_{it} &= \delta_0 + \delta_1 z_{1it} + \delta_2 z_{2it} + \delta_3 z_{3it} + \delta_4 z_{4it} \\ &+ \delta_5 z_{5it} + \delta_6 z_{6it} + \delta_7 z_{7it} \end{aligned} \quad (3)$$

where z_{it} is inefficiency variables to bank i at time t , z_{1it} is SME lending of bank i at t , z_{2it} is credit guarantee of bank i at t , z_{3it}

is profitability of bank i at t , z_{4it} is the management capability of bank i at t , z_{5it} is capital adequacy of bank i at t , z_{6it} is regional bank i at t , z_{7it} is the financial crisis, and δ is a vector of parameters to be estimated. After the normalizing process, the parameters of Eqs. (2) and (3) are estimated in one step using the maximum likelihood (Battese and Coelli, 1995; Coelli et al., 2005). We calculate the cost efficiency of each bank by defining the cost efficiency function as $CE_{it} = e^{-u_{it}}$, with $0 < CE_{it} < 1$, and show efficiency scores will be between 0 and 1 with values closer to 1 indicating a higher level of efficiency.

4. Empirical results

4.1. Data sources and variables

This study uses commercial banks in South Korea as the research subject. Sources of data are mainly from Bankscope, a database of banks and financial institutions worldwide. Fourteen banks are selected and divided into national and regional banks based on the official financial system; data used are from the period of 2001–2010. Because earlier information is not completely recorded in South Korea, the shortest sample is 7 years and the longest sample is 10 years. Therefore, this study employs a total of 131 records gathered from unbalanced panel data. Data are mostly nominal accounts, and so this study also refers to the consumer price index (CPI) provided by IMF with the year 2005 as the base date for deflating.

We adopt an intermediation approach (Berger and Humphrey, 1991; Ellinger and Neff, 1993; Altunbas et al., 2000; Rezvanian and Mehdiian, 2002) to define the factor input and output of banks; output variables include lending, investment, and non-interest income, and input variables include funds, labor, and capital. Table 1 defines and describes the variables. Table 2 shows the variable definitions and descriptions on inefficiency model.

4.2. Cost functions

This study uses Frontier 4.1 to carry out modeling estimation based on the maximum likelihood method. Table 3 shows the result of Stochastic Frontier Estimation, and more than half of the variables are statistically significant. We use the likelihood ratio test (LR test)⁶ to determine if the proposed inefficiency model is acceptable or not. Our LR test statistic is 24.945 (greater than $\chi^2_{0.01}(8) = 20.090$), which soundly rejects H_0 at the significance level of 1% and implies suitability of the proposed inefficiency model.

The Wald test results show that the majority of the marginal effects of output are consistent with the condition of monotonic-

⁵ Since the duality theorem requires that the cost function must be linearly homogeneous in input prices, we impose the following restrictions on the parameters in Eq. (1): homogeneity restrictions, $\sum_{j=1}^m \beta_j = 1$, $\sum_{j=1}^m \beta_{ij} = 0$, $\sum_{j=1}^m \gamma_{ij} = 0$, and $i = 1, 2, \dots, m$. Furthermore, the second-order parameters of the cost function in Eq. (1) must be symmetric—that is: $\delta_{nj} = \delta_{jn}$, $n, j = 1, 2, 3$, $\gamma_{km} = \gamma_{mk}$, $m, k = 1, 2, 3$. According to Shephard's Lemma, an input share is equal to the derivative of the log cost function with respect to the corresponding log input price. Each input share should lie between zero and unity, and input shares should sum up to 1. We define cost shares as follows: $S_i = \frac{\partial \ln TC}{\partial \ln P_m} =$

$$\beta_i + \sum_{j=1}^3 \gamma_{ij} \ln P_j + \sum_{n=1}^3 \rho_{ij} \ln Y_n + \eta_i, \quad i = 1, 2, 3.$$

⁶ To test whether the inefficiency model should be added to the stochastic frontier cost function, the likelihood ratio (LR) test is used in the following way: Null hypothesis H_0 : inefficiency model does not exist; Alternative hypothesis H_1 : inefficiency model exists; $LR = -2 \{ \ln [L(H_0)] - \ln [L(H_1)] \}$. Here, $\ln [L(H_0)]$ is the translog cost function that does not include the inefficiency model, and $\ln [L(H_1)]$ is the translog cost function that includes the inefficiency model.

Table 2
Variable definitions and descriptions on inefficiency model.

Variable	Description	Mean	Std. dev.	Max.	Min
SME lending	The proportion of SME lending in the ratio of total lending balance.	50.38	16.57	83.92	18.42
Credit guarantee	The proportion of credit-guaranteed amount to the total lending amount.	7.11	2.22	12.01	3.67
Profitability	Profitability uses return on assets (ROA), which refers to the proportion of net profit in average assets before taxes.	0.76	0.45	3.10	−1.15
Management capability	The management capability uses the cost to income ratio (CI) of banks as the empirical indicator, with operating income divided by operating expense.	52.34	9.63	84.14	34.46
Capital adequacy	The capital adequacy ratio (CAR) is risk assets divided by capital.	12.19	1.53	17.22	9.31
Regional banks	The regional banks have geographical constraints and mainly provide services to SMEs.	0.59	0.49	1.00	0.00
Financial crisis	The dummy variable of a financial crisis; up to the end of 2007 it is set at 0; since 2007 it is set at 1.	0.32	0.47	1.00	0.00

Table 3
Empirical Results of the Stochastic Cost Frontier Model.

Variables	Coefficient	SE	t-Value
Constant	5.4401**	2.5163	2.1619
lnY1	0.1954	1.0514	0.1859
lnY2	−0.3377	1.0681	−0.3162
lnY3	0.4055	0.4494	0.9023
ln(P1/P2)	1.7837**	0.8652	2.0616
ln(P3/P2)	−1.8259***	0.5993	−3.0468
1/2(lnY1) ²	−0.2292	0.1857	−1.2342
1/2(lnY2) ²	−0.6253***	0.2067	−3.0258
1/2(lnY3) ²	0.0481*	0.0281	1.7132
1/2(ln(P1/P2)) ²	0.4738***	0.1663	2.8486
1/2(ln(P3/P2)) ²	−0.0678	0.0787	−0.8617
lnY1 × lnY2	0.0184	0.0772	0.2384
lnY1 × lnY3	0.5682***	0.1640	3.4651
lnY2 × lnY3	−0.2851***	0.0763	−3.7344
ln(P1/P2) × ln(P3/P2)	−0.2662***	0.0801	−3.3213
lnY1 × ln(P1/P2)	0.2345**	0.1048	2.2377
lnY1 × ln(P3/P2)	0.1727**	0.0859	2.0100
lnY2 × ln(P1/P2)	−0.1483	0.1232	−1.2037
lnY2 × ln(P3/P2)	−0.2749***	0.0901	−3.0500
lnY3 × ln(P1/P2)	−0.0002	0.0533	−0.0043
lnY3 × ln(P3/P2)	0.0039	0.0410	0.0940
t × lnY1	−0.0064	0.0194	−0.3303
t × lnY2	0.0021	0.0216	0.0973
t × lnY3	−0.0051	0.0120	−0.4283
t × ln(P1/P2)	0.0168	0.0206	0.8171
t × ln(P3/P2)	0.0338**	0.0146	2.3199
t	0.3595**	0.1504	2.3905
t2	0.0029	0.0030	0.9768
$\sigma_u^2 + \sigma_v^2$	0.0123***	0.0017	7.3350
$\gamma = \sigma_u^2 / (\sigma_u^2 + \sigma_v^2)$	0.5105***	0.1513	3.3746
Log likelihood function	138.9414		

*** Represent statistical significance at the 1% levels.

** Represent statistical significance at the 5% levels.

* Represent statistical significance at the 10% levels, respectively.

Table 4
Empirical results of inefficiency model.

Variables	Coefficient	SE	t-Value
SME lending	0.0050*	0.0030	1.6556
Credit guarantee	−0.0570***	0.0195	−2.9284
Profitability	0.0339	0.0594	0.5704
Management capability	0.0221***	0.0062	3.5871
Capital adequacy	−0.0464*	0.0235	−1.9729
Regional banks	−0.2072**	0.0874	−2.3706
Financial crisis	0.1149	0.0910	1.2628

*** Represent statistical significance at the 1% levels.

** Represent statistical significance at the 5% levels.

* Represent statistical significance at the 10% levels, respectively.

ity for the cost function.⁷ All marginal effects of inputs satisfy the condition of non-decreasing in input prices. Using the homogeneous of degree one,⁸ the input shares also sum up to 1. In addition, the Hessian matrix is used to examine whether the cost function is a concave function of factor prices, meaning the second-order partial differential equation of factor prices forms a negative semi-definite matrix.⁹ The cost function is the concave function of factor prices that is required to satisfy $H_1 \leq 0$, $H_2 \geq 0$, and $H_3 \leq 0$, but the results turn out to be $H_1 > 0$, $H_2 < 0$, and $H_3 < 0$. Although the results do not comply with the requirement, according to Greene and Segal (2004), the main reason some cost functions do not meet the formal criteria is due to the lack of a simultaneous estimation of cost functions and factor share functions.

4.3. Inefficiency model

Table 4 presents the results estimating how the inefficiency variables impact the bank's efficiency, described in the following.

1 SME lending

A significant positive relation is found between the SME lending ratio and cost inefficiency of a bank, meaning if there

is an increase in the SME financing ratio, then the cost efficiency will decrease. This explains that information asymmetry is more severe in SMEs compared to large enterprises (Ang, 1991); therefore, adverse selection or moral hazard will likely occur in SMEs, and banks will face higher credit risk lending to them. An attempt to ease the information asymmetry problem leads to a rise in cost inefficiency.

2 Credit guarantee

A significant negative relationship is found between credit guarantee and a bank's cost inefficiency, meaning as the proportion of credit-guaranteed amount to the total lending amount increases, cost efficiency increases. The empirical results of this study support the proposal addressed by Craig et al. (2008). First, the credit guarantee scheme can reduce the expected loss generated from bad debts and increase expected return derived from lending, thus very likely removing adverse selection. Second, if there is a bad debt, then a bank's actual loss will indeed be reduced enormously due to the effect of risk sharing through the credit guarantee. Therefore, this study assumes that an increase in the expected returns generated from lending will occur in a bank engaging in credit guaranteed loans. Even if there is a bad debt, the actual loss will indeed drop; hence, the cost efficiency will be enhanced.

3 Profitability

According to most studies, the higher banks' profits are, the more efficient their performances are (Pilloff and Rhoades, 2002). The empirical result of this study shows that the effect is statistically non-significant.

4 Management capability

A significant positive relationship is found between the cost-income ratio, which represents management capability and cost inefficiency. As a bank's cost-income ratio becomes too high, its risk turns higher, because the bank's income is unable to cover its expenses and there is excess waste in terms of control of operational expense (Hesse and Cihak, 2007). The empirical results are consistent with Pasiouras and Kosmidou (2007), whereby the higher the cost is, the poorer the bank's cost efficiency is.

5 Capital adequacy

A significant negative relationship is found between capital adequacy and cost inefficiency. In terms of moral hazard, an increase in capital adequacy means the quality of assets is fully controlled by the bank. Moral hazard occurs if a bank encounters a loss generated from poor operations; while when it fulfills the capital adequacy requirement at the same time, it will then have to be fully responsible for the loss and provide an incentive for it to avoid the moral hazard. The higher the capital adequacy is, the better is the quality of a bank's assets, which will lead to an increase in operational efficiency. According to empirical

⁷ The Wald test looks at whether output is consistent with monotonicity and examines if the cost function is non-decreasing with respect to input prices: (A). Output consistency with monotonicity: Null hypothesis $H_0 : \frac{\partial TC}{\partial Y_n} = 0$; Alternative hypothesis $H_1 : \frac{\partial TC}{\partial Y_n} > 0$, $n = 1, 2$. (B). Non-decreasing in input prices: Null hypothesis $H_0 : \frac{\partial TC}{\partial P_m} = 0$; Alternative hypothesis $H_1 : \frac{\partial TC}{\partial P_m} > 0$, $m = 1, 2, 3$.

⁸ We examine the factor share function to obtain the cost function and the factor price's first derivative, as expressed below: $S_j^* = \frac{\partial \ln TC}{\partial \ln P_j} = \beta_j +$

$\frac{1}{2} \sum_{i=1}^3 \rho_{ij} \ln P_i + \sum_{i=1}^3 \gamma_{ij} \ln Y_i$. The homogeneous first-order conditions are: $\sum_{j=1}^3 \beta_j = 1$, $\sum_{i=1}^3 \rho_{ij} = 0$, $\sum_{i=1}^3 \gamma_{ij} = 0$.

⁹ The third-order of the Hessian matrix is defined as: $H_1 = |C_{11}^*| \leq 0$, $H_2 = \begin{vmatrix} C_{11}^* & C_{12}^* & C_{13}^* \\ C_{21}^* & C_{22}^* & C_{23}^* \\ C_{31}^* & C_{32}^* & C_{33}^* \end{vmatrix} \geq 0$, $H_3 = |C_{ij}^*| \leq 0$, where $C_{ij}^* = \partial^2 TC^* / \partial P_i \partial P_j$, $i, j = 1, 2, 3$.

results, an increase in capital adequacy helps regulate incentives of moral hazard, thus reducing risk and enhancing cost efficiency (Das and Ghosh, 2006; Kumbhakar and Wang, 2007; Pasiouras, 2008).

6 Regional banks

A significant negative relationship is found between regional banks and a bank's cost inefficiency, meaning it is easier for a regional bank to establish financial relationships with its customers due to its characteristics. The financial relationship can improve the quality of information exchange between borrower and lender, which further reduces the SME financing cost (Berger and Udell, 1995). As a result, a regional bank can help enhance the bank's efficiency.

7 Financial crisis

We find that the financial crisis displays a positive but not significant relation with cost inefficiency for Korean banks. Generally, after the financial crisis, banks are likely to reduce lending, raise the lending standard, and apply to credit squeeze. The anti-leverage process will deny enterprises funds, which will then lead to the occurrence of bad debt and furthermore will affect a bank's cost efficiency (Ivashina and Scharfstein, 2010). However, during the financial crisis, the South Korea government invested one trillion Korean won (approximately US\$750 million) in the Industrial Bank of Korea to expand that bank's investment foundation and increase the amount of SME lending up to 12 trillion Korean won (approximately US\$9 billion). Stabilizing measures such as providing deposit guarantees, giving funds to banks, and promoting SME loans, helped shift the financial market back to normal. Therefore, statistical non-significance is found between the financial crisis and banks' cost efficiency.

4.4. Cost efficiency

The closer the cost efficiency rate is to 1, the better the cost efficiency is. The average cost efficiency value of the 14 banks in South Korea sampled is 0.9498, meaning there is still room for improvement. Second, the cost efficiency value of national banks is 0.9412 compared to regional banks (0.9598). Since 2004, the cost efficiency value of banks in South Korea began to decline and hit bottom in 2007. In 2008, the cost efficiency value of regional banks began to recover, but the cost efficiency value of national banks continued to decline. It is obvious that impacts on national banks caused by the financial crisis were relatively larger.

5. Conclusion

SMEs are the backbone of economic development among many countries. According to the World Economic Forum (WEF) and the Swiss-based International Institute for Management Development (IMD), SMEs account for 97–99% of the aggregate enterprises in the ten most competitive countries

throughout the world where SMEs play an important role of economic development. Given that SMEs depend highly on the banking system to ease their lending gaps, governments worldwide have established incentive mechanisms to encourage banks to engage more actively in SME financing. This study aims to investigate impact on banks' cost efficiency caused by SME financing and credit guarantee using South Korea as its study subject—a country with one of the fastest growing economies in recent years and which has an enormous amount of SME.

According to empirical results, the higher SME lending ratio reduces bank's cost efficiency. There are two likely explanations deriving from the fact that the information asymmetry problem is more severe in SMEs. First, it leads to adverse selection or moral hazard, and banks will have to endure higher credit risk. Alternatively, the cost of adjusting information asymmetry is higher; therefore, an increase in a bank's inefficiency occurs.

South Korea's credit guarantee schemes help enhance bank efficiency, because it assures the security of loans and shares the credit risk with the bank. As a result, bank efficiency is enhanced. The country's credit guarantee system is comprehensive; not only does it help the lack of collateral of SMEs in order to obtain loans, but also increases the recovery rate of loans and effectively reduces a bank's cost inefficiency.

In terms of profitability, so far there is no proof of a significant relationship between profitability and cost efficiency. For management capability, the results show that the higher the cost–benefit ratio is, the poorer is a bank's operational efficiency. According to the results, the higher the capital adequacy is, the lower the risk the bank encounters, which helps increase its cost efficiency.

As for environment variables, according to the study's findings, regional banks are more capable of establishing relationship banking, which helps increase bank efficiency. In short, regional banks indeed can enhance bank efficiency. Although the global financial crisis did crush Korean banks to a certain degree, measures the government adopted to stabilize the financial market, such as providing deposit guarantees, giving funds to banks, and promoting SME lending, helped rapidly shift the financial market back to normal. Therefore, impacts from the recent financial crisis were not that significant.

Of final note is that the average cost efficiency value of the 14 banks in South Korea is 0.9498, implying there is still room for improvement. The average cost efficiency of national banks is 0.9412 compared to 0.9598 for regional banks. This means regional banks have better performances than national banks and have more advantages than large banks.

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