

The Application of Generalized Additive Model in the Effectiveness of Scale in Funding Policy on SMEs Overall Performance

by SeungYin Ha^{*}, Myoung Gyun Jang^{**}, and GunHee Lee^{***}

The aims of this study is to analyze the effectiveness of firms financial status quo and the scale of financial support on SMEs overall performance. We have gathered the financial guarantee data from 1998 to 2013, provided by Korea Credit Guarantee Fund (KODIT), to analyze the effectiveness of Financial policy. To classify both financial status quo and scale of financial support, we utilized the following variables; Interest Coverage Ratio (ICR) and newly guaranteed amount ratio. To take the measurement of the overall performance, we employed profitability, growth ratio and activity index. To minimize the effect of repeated financial support (redundancy benefits), firms were selected based on the following criteria: firms that receive no financial support prior to implementing such policy over the last 3 years and no new financial support over the last 2 years. Results suggest that firms with higher ICR and large newly guaranteed amount influence on financial performance in terms of profitability index. Firms with lower ICR and large scale financial support showed a better performance compare to firms with small-scale financial support. Firms with large-scale financial support, irrespective of ICR inclined to have better performance to those of small-scale financial support in terms of growth index. For activity index, however, firms with large scale support led to higher performance in the short term.

In turn, our analysis presents objective perspective with respect to the effectiveness of financial policy through credit guarantee on overall performance of SMEs. This study, therefore, implies that well-balanced SMEs supporting policy may lead to better directions.

Keywords : *SME, Policy Loans, Credit Guarantee, Interest Coverage Ratio*

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I. Introduction

Small and Medium sized enterprises (SMEs) takes up higher proportion of the total industries influencing large portion of employments as compared to large conglomerate. In fact, the actual range of local SMEs can be divided into; less than 50 full time employees or less than 300 full time employees, total capital of 3 million up to 8 million dollars, total annual sales of 5 million or 30million dollars. According to 「2015 Census on Establishments」 of KOSTAT, The number of entities that operates with 1~4 permanent employees in year 2014 has increased to 3.2% (approximately 3.1 million entities) overall, 5~99 permanent employees in year 2014 has increased up to 6.6%. The number of entities under 100 employees account for 99% (approximately 700,000 entities) of total industry. Employee contribution rate is 26.4% for firms with 1~4 employees, 59.9% for 5~99 employees consisting more than 86% of overall industry.

As the stagnant national economic growth continued to have negative influence on SMEs overall performance that acts as the foundation of the domestic industries, maintaining status-quo seems to be out of place. Nevertheless, companies, even under continued recession, need to have necessary funds to facilitate business activities. The majority of financial institutions, loan-out with conservative perspective in mind, set a certain criteria when lending loans to SMEs compare to conglomerate. Most financial institutions are likely to reduce the amount of loans to SMEs in recessionary period. Because of insufficient information on SMEs financial status, financial institutions would rather loan out to those firms with less risks.

According to Williamson (1994) and Kim (2005), SMEs that lacks security solvency or the reliability of financial statement is prone to receiving limited amount of loans may lead to market failure. To resolve the credit allocation issue cause by information asymmetry between companies, government further requires to support those SMEs that is in need of desperate financial supports

(Kim, 2005; Jung and Lim, 2014). Financial policies for SMEs has been expanded significantly through the credit guarantee expansion after 2008 global financial crisis. The government had to alleviate the SMEs financial problems through these supporting policies.

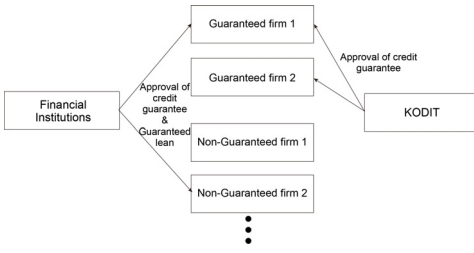
However, extension of financial SMEs supporting programs in terms of funding policy have attributed to delaying the process of restructuring and it leads to impede entire industry productivities (Jeong, 2014). The problem of government financial support is that funds may be distributed to larger size SMEs or to insolvent borrowers (which we call zombie firms), otherwise would have been used to support start-up firms and firms with highly advanced technology. To sum up, policy lending programs for SMEs seems not to contribute in equal distribution among SMEs that face financial predicament. Due to the above mention that, Korean government recently announced to launch a new program called “SMEs efficient financial supporting policy” asserting that existing supporting method is no longer valid. Thus, the new program enhances financial support more rigidly by providing portfolio guarantee to decide loan limitations (see Figure 1).

Government defined zombie firms as Interest Coverage Ratio (ICR) is below 1 and targeted to restructure. In detail, government authorities have strengthened zombie companies’ standards as they change the restructuring standards. It was reinforced by changing the standard for ICR of below 1 for three consecutive years to the standard for the second consecutive year. Government authorities believe that firms with ICR of below 1 for second consecutive year is not an economically viable firms and they prevent more productive companies from gaining market share, strangling a potentially important source of productivity gains for the overall economy.

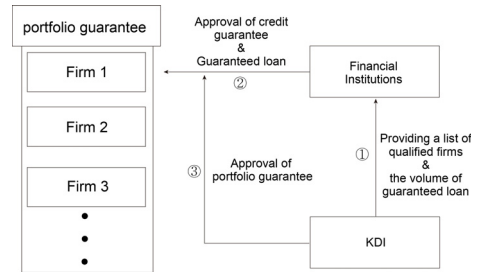
ICR is considered as a major assessment of index (e.g. evaluation between zombie or not) in which target restructuring firms can be selected. Selected firms may include

Figure 1
Comparing of between Traditional and Portfolio Financial Supporting Policy

Panel A: Traditional method of Credit Guarantee scheme



Panel B: Portfolio Credit Guarantee scheme



Source: Ministry of Strategy and Finance (2015).

firms with technological competencies or potential growth capabilities. The financial policy makers consider that restructuring of enterprise should be implemented through and yet temporary risk management problems may cause the entire company to fall into the zombie company category. To strengthen the viability of company for continued growth and development, efficiency of financial policies should be carried out.

SMEs financial policy can be classified as direct financing, credit guarantee and Credit Insurance. The size of government financial supporting and types of financial support be determined in accordance with the government financial supporting scheme. To achieve the objectivity of financial support policies effectively, performance analysis is required. A variety of empirical results both positive and negative have been reported depend upon the research analyze method. Jang and Yoon (2007) and Woo and Bihn (2014) emphasis which plays a vital role in supporting policy. Existing studies on the effect of government financial support on overall performance of SMEs are positive (Yoo, Kim, and Huh, 2005; Song, Kim, and O., 2006; Yang, Cho, and Hong, 2007; Noh, 2010; Kim et al., 2012; Kim and Kim, 2013). Other studies concluded that the results were varied since each firms has different characteristics. And some studies, further, concluded that the results were not positively correlated with overall performances (Kwak

and Song, 2003; Kim, 2005; Roh and Kim, 2007; Kwon, 2012; Woo and Bihn, 2014).

Existing empirical studies only implemented empirical analysis regarding whether to support or not and the directions of policy. However, this study aims to analyze the following; overall performance of firms that received credit guarantee according to the scale of credit guarantee, through that finding the effectiveness of credit guarantee.

We utilized both the firms' financial status at the time receiving financial support and the scale of credit guarantee to find out their effectiveness on SMEs performances by specific industries; financial profitability and growth changed by ICR and guaranteed amount. We have concluded that the firms that received credit guarantee are likely to have different performance in accordance with financial status and scale of credit guarantee.

II. Literature Review

2.1 Financial Policy in Korea

Financial support for SMEs scheme was supported in various ways. In 1960, Industrial Bank of Korea (IBK) was established for SMEs as a part of an economic development plan and support SMEs that lacks security. In the 1970s and 1980s, Korea Credit Guarantee Fund (KODIT) and Korea Technology Finance Corporation (KIBO) was es-

established to enhance the competitiveness of overall SMEs. In the 1990s, the Small and Medium Business Corporation (SBC) was heavily focus on supporting venture companies to overcome the financial crisis. Such policies, financial support scheme are classified in accordance with the following methods; direct loans, loan through a financial institution, investment and Credit Guarantee.

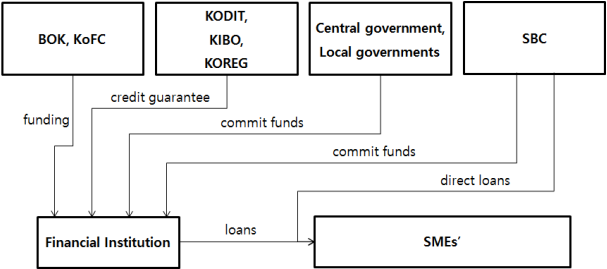
Direct and indirect loans that exist for SMEs including; SMEs loans available from Small and Medium Business Corporation (SBC), loan from Small and Medium Business Administration (SMBA) and local governments, financial intermediary support loan from Bank of Korea (BOK), and On-Landing loan from Korea Finance Corporation (KoFC). The policy funding program, run by Small Medium Business Corporation (SBC), allocates its loan by selecting strategically competent industries. By classifying supporting industries in accordance with different phases; start-up phase and growth phase, they grant loans for SMEs. In particular, it supports many owners of SMEs who are vulnerable to external uncertainties and number of employees fewer than 50 employees. The BOK offers low interest rate funding which consists of 6 different types of loan. Loan Finance Corporation’s ‘On-landing’ supports a company with more than 1 billion won

in annual sales and corresponding companies may be evaluated by government. In addition, local governments raises funds to support local SMEs or operates local programs to achieve local policies.

KODIT’s guarantees are providing of classified into the scope of guarantee including bill guarantees, facility lease guarantees, guarantees for loans by second-tier financial institutions, performance guarantees, trade-bill acceptance guarantee and, commercial transaction collateral guarantees, KIBO was established to support SMEs that equipped with technological competencies including Technology Start-Up Guarantee, Technology Innovation Guarantee, and Technology Evaluation Assurance Guarantee. A guarantee from KOREG ensures the liabilities of small business owners who lack sufficient collaterals by implementing easier fund circulation. Financial supporting structure is as shown in Figure 2.

Thus, this form of policy financing for SMEs can be categorized as policy fund and Credit Guarantee fund (see Table 1). This policy was further expanded to solve financial difficulties for SMEs and diversity in target firms become increasing especially, supporting small business owners in a separate manner since 2015. To improve the qualitative impact of policy funding, government

Figure 2
Framework of Policy Financing for SMEs



- 1) BOK: The Bank of Korea
- 2) KoFC: Korea Finance Corporation
- 3) KODIT: Korea Credit Guarantee Fund
- 4) KIBO: Korea Technology Finance Corporation
- 5) KOREG: Korea Federation of Credit Guarantee Foundations
- 6) SBC: Small and medium Business Corporation

Table 1
SMEs Financial Policy Status

Classify	Year	2009	2010	2011	2012	2013	2014	2015
Policy Funds		5.8	3.3	3.4	3.6	4.9	4.4	3.9
Credit	KODIT	39	39	38	39	41	41	41
Guarantee	KIBO	17.1	17.4	17.0	17.7	18.9	19.2	19.8
	KOREG	11.2	14.3	14.5	14.3	16.0	16.7	18.9

1) policy fund is run by Small Medium Business Administration.

2) the unit of supporting amount of money is trillion dollar.

3) data is based on KOSTAT.

strengthen support by expanding the scale of direct/indirect credit loan as well as increasing funds for Start-up Funding and Technology Development Funding. Credit Guarantee also significantly increased in 1997 in terms of its scale to facilitate financing to SMEs in 1997 financial crisis. The scale of Credit Guarantee was normalized in 2010 by increasing the scale of Credit Guarantee in 2009 to overcome financial crisis.

Financial policy for SMEs supports in various ways including, but are not limited to, the following; direct lending agency loans, investment and credit guarantee support. Most financial policy is being made through the credit guarantee.

2.2 Literature Review on Korean Financial Policy

There are number of studies on effects of financial support and overall performance of SMEs. Jang and Yoon (2007) imply that supporting SMEs which is vulnerable to security solvency, improving in business environments core competencies. They find out that financial policy, though its nature of risk, can be a powerful weapon to support SMEs with articulate objectives to grow as multinational companies and prevent market failure in some degree. Kim and Yi (2011) asserts the existence of institutions for credit guarantee such as KODIT or KIBO is helpful for SMEs or start-up which faces difficulty in demanding the necessary funds for company operation due to lack of information asymmetry. Policy indeed played a pivotal role to solve the problems by acting as a mediator to minimize information asymme-

try among SMEs and bank (Woo and Bihn, 2014). Jung and Lim (2014) claimed the effectiveness of policy support on SMEs by utilizing panel data to analyze mitigating information asymmetry between banks and firms in initial phase of start-up. Especially, this tendency of behavior appears more in middle credit worthy.

Most studies mentioned the necessity of financial supporting purpose yet effectiveness of support is contradict in some studies. Two different perspectives on effectiveness of support for performance of SMEs has been existed; one theory is positively correlated and the other is negatively correlated. According to Song et al. (2006), since SMEs has difficulties in procuring efficient financial resources from financial institutions, financial policy supporting solved that problems and enhanced the overall performance as well as improved competencies. He then analyzed the effectiveness in enhancing overall performance showing that higher net profit could be expected after financial support and maximize the efficiency of financial support in firms with higher debt ratio. Lee, Kim, Lee, Jang, and Lee (2008) implies that SMEs receiving financial supports improved profitability, stability, strengthened activity. Kim and Kim (2013) estimated the effect of the credit guarantee on financial policy proving that guaranteed companies have substantial effects in terms of overall growth, profitability, mobility, productivity and reliability. Noh (2010) carried out an empirical study between 2002 to 2008 that received financial support and draw following conclusions; short-term improvement in growth and profit-

ability, smaller the size of SMEs, the better the performance of firm. Moreover, direct loan from government financial institution led to better profits as compared to private financial institution loan out.

A number of studies that differentiate the effects of financial policy based on size, financial status of firms implies that supporting firms that falls into the following criteria may result in better effectiveness and allocation of limited resources: start-up firms as well as firms with short establishment period. Yoo et al. (2005) classified SMEs that received financial support based on the number of permanent employers and the size of asset to verify the overall performance. Firms with the large number of permanent employees and asset are inclined to grow. Yang et al. (2007) verified that the firms with employers less than 19 enable to achieve the highest overall performance. Chang, Yang, and Woo (2013) found out that effect of financial support by comparing based on firms' operating year between general entities and start-up.

The results shows that general entities with shorter operating years have better financial performance than start-up. General entities with longer operating years, compared to start-up, have not shown the overall improvement in performance. Woo and Bihn (2014) examined the Technology Guarantee from KIBO can effect on supporting corporate's profitability and stability of their financial condition and the effects of guarantee are greater on poor financial state than are relatively good financial state.

Lee (2008) determined the effect of financial support on SMEs overall performance concluding that firms receiving overlapping financial support to a greater extents led to negative results. Firms receiving less additional support resulted in an improvement in annual sales. Nam (2014) set targeting firms that received credit guarantee from KODIT from the year 2008 to the year 2011. The results of firms' performance varied depend on the level of credit guarantee ratio, especially credit guarantee rate between 50~65% shows statistically significant.

Meanwhile, prior studies on negative effects or slightly significant of financial support claimed that the financial support is utilized to protect themselves from the burden of operating expenses and heavily depends on financial policy which aggravates competencies and informativeness. Kwak and Song (2003) analyzed the overall performance of SMEs in accordance with financial support they received, firms that received financial support did not show any significant improvement in overall performance. The result turned out to be statistically significant between financial support and overall performance. Kim (2005) tried to analyzed using data (1998~2003) from The Small and Medium Business Corporation (SBC) empirically and analyzed firm's profitability by classifying into supporting and non-supporting group.

The results show that there is no significant difference between two groups. Firms with shorter operating period, however, confirmed that it had positive effect on Operating Profit to Sales Ratio as compared to firms with longer operating period. Roh and Kim (2007) analyzed the difference between a year before and after receiving support. They have concluded that firms receiving supports that following year displayed a propensity to decrease in growth potential and profitability ratio. Kwon (2012) empirically tested using data (1999~2010) from KIBO, to see the relationship between SMEs that received support and not supported. The results proved that there is no significant effect between two groups. Jeong (2014) implied that financial support, indeed, results in declining of economic flow, increasing number of Zombie firms. Increasing number of Zombie firms, take matters even more seriously, impede the overall production activities of other firms.

III. Empirical Test

3.1 Generalized Additive Model

The generalized additive model (GAM) is a statistical model that combines the prop-

erties of a generalized linear model (GLM) with additive models. These generalized additive models are shown in the form of regression equations as follows.

$$Y = \alpha + \sum_{j=1}^p f_j(X_j) + \varepsilon$$

The dependent variable is Y , the independent variable is X_j and $f_i(\cdot)$ is a smoothing function that performs a smooth nonlinear transform with an arbitrary function for each independent variable X_j . Each independent variable X_j is estimated by the Backfitting Algorithm with the following conditional expectation value through a link function $f_i(\cdot)$ (Hastie and Tibshirani, 1990) is as shown in Figure 3.

Figure 3 The Backfitting Algorithm

- step 1) Initialize: $\alpha = E(Y)$,
 $f_i = f_j^0, j = 1, \dots, p$
 step 2) Cycle: $j = 1, \dots, p, 1, \dots, p, \dots$
 $f_i = S_j(y - \alpha - \sum_{k \neq j} f_k(x_k))$
 step 3) Continue step 2) until the individual functions don't change

In other words, the generalized additive model can confirm the nonlinear relation which is difficult to confirm linearly, and it is advantageous to confirm the nonlinear relation among each variable by fixing the influence of each on other variables. That is, the total effect can be confirmed as the sum of individual variable effects.

3.2 Test Design

This study is intended to find out the effects of financial policy on business performance in accordance with SMEs financial status. We then used as independent variables in terms of ICR and scale of guarantee financial support. For analysis, GAM was implemented to evaluate dependent variables such as index of profitability (including Return on Assets (ROA) and Return on Equity (ROE)), index of growth as a Growth Rate of Total

Assets (GRTA).

Most existing studies analyzed only the effects of the policy according to with or without financial supports. This study, however, primarily distinguish the company's financial status quo at the time of financial supporting and additionally total assets to newly guaranteed amount ratio to analyze the overall performance depending on the scale of financial supporting. Overall performance may vary depending upon the financial status quo each company receive and even with similarity in financial condition the scale of support may vary.

Financial institutions utilize several variables in determining the financially distressed company, ICR is used as rudimentary tool. This earning also known as ICR is calculated by dividing the profit gained from operating activities into financial cost indicating whether companies are able to repay the money with interest earned from normal business activities. Over 1 means firms are able to afford financial cost, less than 1 means firms are unable to repay the interest from operating earnings. Such firms trapped in a vicious circle of paying off existing debts with other debts. According to the "Guidelines for insolvent company" by Financial Supervisory Service (FSS), firms with ICR less than 1 over the last 3 years considered as financially unhealthy.

If the firm's financial condition is insufficient therefore may expect to have lower business performance. We set up firms with ICR and guaranteed amount as a new credit guarantee to total assets ratio (NCGTAR) is independent variables. By doing so, we can check the effects of financial policies on scale of financial supports. The performance of each SMEs may vary depending on a scale of financial support so we set up variables that present profitability and growth.

We utilized economical performance index such as ROA (Kwak and Song, 2003; Kim, 2005; Lee, 2008; Kwon, 2012; Kim et al., 2012; Chang et al., 2013; Kim and Kim, 2013; Nam, 2014) and ROE (Lee, 2008; Noh, 2010; Kim et al., 2012; Chang et al.,

2013) to measure total business profits. ROA is the ratio of net income to total assets which grant us to measure the effectiveness of business operation and ROE estimates the overall performance of ability to make profit after receiving credit guarantee. To measure a increase in size and overall performance of firms. We also utilized Growth Rate of Total Assets (GRTA) as growth index measurement (Kwon, 2012; Kim et al., 2012). GRTA accurately measures the growth of firms' total assets.

We have used following criteria to analyze the effectiveness of supporting scale on overall performance of SMEs; ICR and NCGTAR for independent variables. As for control variables, we utilized existing variables based on previous researches that affect on overall performance of SMEs (Kim and Yi, 2011; Kim, 2005; Kwak et al., 2003; Kwon, 2012; Lee, 2008; Min, Ha, and Kim, 2015; Nam, 2014; Noh, 2010). At first, the larger the size of firms, the higher the capacity for generating higher profits compare to smaller firms. We used establishment period as a control variable since firms with longer establishment period tend to generate higher profits. We have utilized Borrowings and bonds payable ratio since using debt ratio may not be taken into account factors that can fluctuate greatly in accordance with changes in business operation and so on. We divided sum of Short term borrowing, Current portion of long term debts and long

term borrowing by total asset. Borrowings and bonds payable ratio contains critical information of firms so that it was used as a control variable. To control the effects of business fluctuation, and year dummy we used. We have divided samples of analysis into wholesale and retail, manufacturing, construction since the overall effects of ICR and NCGTAR may vary in accordance with the characteristics of each industry. We draw the following Generalized Additive Model below to find out the correlation between SMEs financial supporting policy and the overall performance. While the firms (SMEs) are motivated to pursue generating profits for ongoing business operations, new credit guarantees should be taken into account for their business. Therefore, we uses two year period average of performance variables to find the effectiveness of credit guarantee at each point in time of receiving new credit guarantees.

3.3 Sample Selection

Table 2
Sample Size

Business Classification	Total
Wholesale and Retail	2,205(23.36%)
Manufacturing	4,040(42.79%)
Construction	2,184(23.13%)
Other industries	1,012(10.72%)
Total	9,441(100.00%)

1) (): given ratio.

$$Performance\ variables = \beta_0 + f_1(ICR) + f_2(NCGTAR) + \sum_{i=3}^6 \beta_i X_i + \sum_{j=7}^{17} \beta_j X_j + \varepsilon$$

Performance variables:

Return on Assets (ROA): (net income/average of total assets)×100

Return on Equity (ROE): (net income/average of equity)×100

Growth Rate of Total Assets (GRTA): ((total assets-total assets(prior))/total assets(prior))×100

Interest Coverage Ratio (ICR): (EBIT/interest expense)

Guaranteed Amount (NCGTAR): (new Credit Guarantee/total assets)

X_3 : log (firm age)

X_4 : log (sales)

X_5 : Research and Development Expense to Sales
(research and development cost/sales)×100

X_6 : Total Borrowings and Bonds Payable to Total Assets
((short and long term borrowings+bonds)/total assets)

X_j : the year of newly guaranteed amount ($j=2000, \dots, 2010, 2011$: reference group)

ε : error

This study aims to verify the effects of overall performance in accordance with firm's financial status quo and scale of credit guarantee at the time of receiving financial support.

We organized the size of sample that classified into four categories in Table 2. Other industries are excluded from the analysis because they are composed of industries with different characteristics such as service in-

Table 3
Sample Statistic

Panel A: Wholesale and Retail Industry

Variables	avg.	std. dev.	min	median	max
Return on Assets (ROA)	5.14	5.90	-57.92	4.35	48.32
Return on Equity (ROAE)	17.72	21.23	-171.79	15.46	141.88
Growth rate of total assets (GRTA)	21.78	34.93	-38.39	14.98	912.13
Interest Coverage Ratio (ICR)	19.15	65.10	-607.00	4.45	853.00
Guaranteed Amount (NCGTAR)	0.21	0.18	0.00	0.17	2.79
log (firm age)	1.77	0.75	0.00	1.79	3.97
log (sales)	8.55	0.78	3.71	8.54	10.82
Research and Development Expense to Sales	0.07	0.72	0.00	0.00	17.71
Total Borrowings and Bonds Payable to Total Assets	25.44	22.84	0.00	20.53	93.66

Panel B: Manufacturing Industry

Variables	avg.	std. dev.	min	median	max
Return on Assets (ROA)	4.60	6.21	-32.91	3.87	62.33
Return on Equity (ROAE)	16.16	24.18	-208.43	13.92	607.66
Growth rate of total assets (GRTA)	24.00	31.40	-42.85	16.04	364.94
Interest Coverage Ratio (ICR)	11.42	67.69	-413.50	2.89	2233.00
Guaranteed Amount (NCGTAR)	0.18	0.25	0.00	0.12	4.74
log (firm age)	1.81	0.79	0.00	1.79	4.01
log (sales)	8.21	0.87	1.61	8.15	10.91
Research and Development Expense to Sales	0.37	2.05	0.00	0.00	72.68
Total Borrowings and Bonds Payable to Total Assets	37.14	21.15	0.00	38.41	97.26

Panel C: Construction Industry

Variables	avg.	std. dev.	min	median	max
Return on Assets (ROA)	6.60	6.61	-41.17	5.64	52.27
Return on Equity (ROAE)	11.26	11.85	-65.43	9.43	83.47
Growth rate of total assets (GRTA)	19.34	28.22	-40.24	13.84	322.96
Interest Coverage Ratio (ICR)	30.06	82.28	-258.00	8.13	1656.00
Guaranteed Amount (NCGTAR)	0.18	0.21	0.00	0.14	4.75
log (firm age)	2.00	0.68	0.00	2.08	4.13
log (sales)	8.26	0.86	5.07	8.27	10.90
Research and Development Expense to Sales	0.17	0.85	0.00	0.00	11.73
Total Borrowings and Bonds Payable to Total Assets	14.50	13.02	0.00	11.21	82.77

Panel D: Other Industries

Variables	avg.	std. dev.	min	median	max
Return on Assets (ROA)	3.73	8.47	-41.74	3.18	50.43
Return on Equity (ROAE)	13.57	45.88	-254.41	10.06	1069.30
Growth rate of total assets (GRTA)	22.27	34.25	-39.21	13.74	287.16
Interest Coverage Ratio (ICR)	8.38	85.16	-1583.0	3.04	641.00
Guaranteed Amount (NCGTAR)	0.19	0.28	0.00	0.12	3.82
log (firm age)	1.99	0.76	0.00	1.95	4.08
log (sales)	8.30	0.96	1.79	8.29	10.93
Research and Development Expense to Sales	0.63	3.99	0.00	0.00	94.57
Total Borrowings and Bonds Payable to Total Assets	28.72	22.94	0.00	25.21	98.77

1) formula for each variable is same as (1).

dustry, agriculture and mining.

Table 3 is basic statistics displaying variables used in the analysis of each sample; Construction Industry is significantly higher in its ROA. Wholesale and Retail industry displays that ROE is higher than other industry. The average ICR is approximately 30 that is the highest in construction industry and the standard deviation is 82.28. and the average ICR of wholesale and retail is approximately 19.15 and the standard deviation is 65.10 which is lowest at those of analysis. It means that wholesale and retail is stable

financial status at the time of receiving credit guarantee. However, the average NCGTAR is about 0.2 in all industries, but there are some firms with a larger guarantee in manufacturing and construction than other industries.

IV. Results

4.1 Effectiveness of Profitability Index

4.1.1 Wholesale and Retail Industry

we have carried out set of non-linear model analysis as shown in Table 4 and Figure 4.

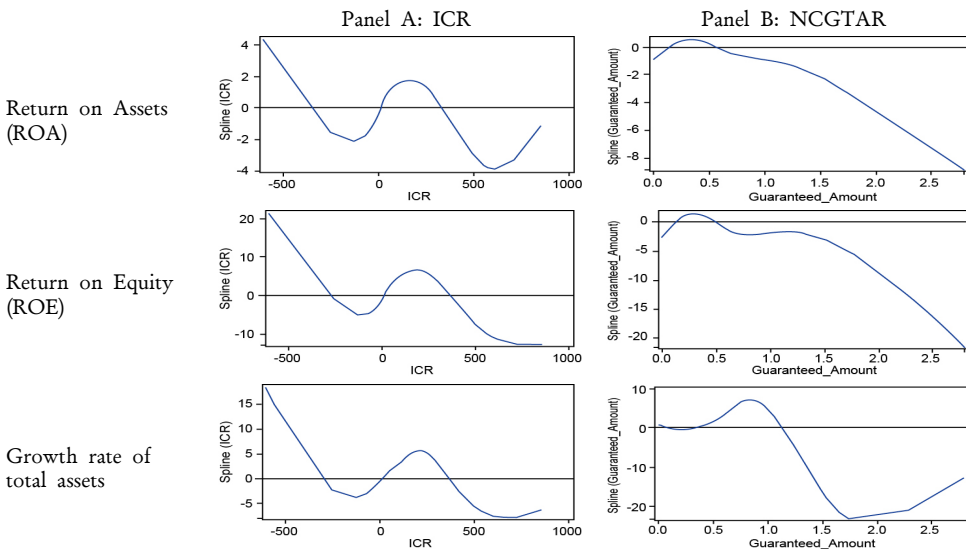
Table 4
Smoothing Model Analysis Result for Business Performance Index

variables	Return on Assets (ROA)	Return on Equity (ROE)	Growth rate of total assets
Intercept	-419.5051(-4.96) ^{***}	-912.8101(-2.95) ^{***}	381.3220(0.95)
Interest Coverage Ratio (ICR)	0.0150(7.29) ^{***}	0.0295(3.93) ^{***}	0.0345(3.54) ^{***}
Guaranteed Amount (NCGTAR)	2.8330(3.90) ^{***}	5.6134(2.11) ^{**}	54.5806(15.84) ^{***}
log (firm age)	-0.3739(-2.11) ^{**}	-5.2888(-8.19) ^{***}	-4.2989(-5.13) ^{***}
log (sales)	0.1274(0.76)	-0.3091(-0.50)	0.2620(0.33)
Research and Development Expense to Sales	-0.7150(-4.28) ^{***}	-1.6409(-2.69) ^{***}	0.3521(0.44)
Total Borrowings and Bonds Payable to Total Assets	-0.0142(-2.32) ^{**}	0.0476(2.14) ^{**}	-0.0710(-2.46) ^{**}
year dummy	included	included	included

1) figures in parentheses (t-values).

2) ^{***}, ^{**}, ^{*} is significance level 1%, 5%, 10%.

Figure 4
Smoothing Components for Performance Variables



For wholesale and retail trade, firms with ICR ranging from 0 to 400 produces high profitability and growth, and shows a sharp increase up to 200. Also, firms with a NCGTAR of 0.2 to 0.5 shows high profitability and shows a sharp increase from 0.2 to about 0.3. The growth rate increase from 0 to 1.2, and shows sharp increase from 0.2 to 0.9. It turns out that the profitability and growth rate after receiving credit guarantee is higher than that of firms with a minimum ICR of 0 to 400 at the time of receiving

credit guarantee. The NCGTAR shows that the growth rate of a firm larger than 0.5 shows a rather low growth and the profitability is lower when the NCGTAR is larger than 1.2. Firms with low ICR at the time of receiving credit guarantee have a high profitability and growth after receiving credit guarantee.

4.1.2 Manufacturing Industry

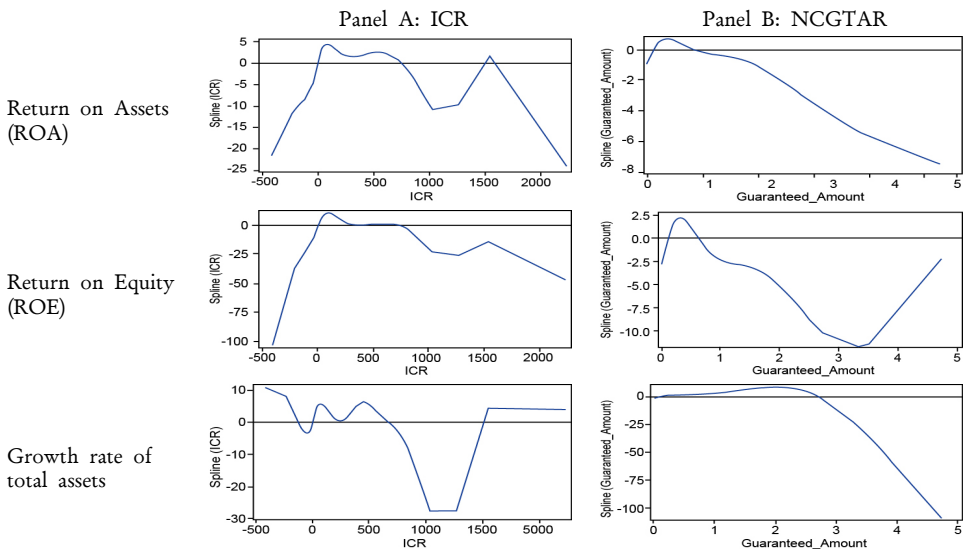
Table 5 shows the influence of both ICR and the NCGTAR support on SME per-

Table 5
Smoothing Model Analysis Result for Business Performance Index

variables	Return on Assets (ROA)	Return on Equity (ROE)	Growth rate of total assets
Intercept	-218.9284(-3.50)***	-613.6807(-2.39)**	350.5697(1.26)
Interest Coverage Ratio (ICR)	0.0164(11.70)***	0.0301(5.23)***	0.0163(2.60)**
Guaranteed Amount (NCGTAR)	0.6473(1.61)*	2.0547(1.24)	55.9963(31.22)***
log (firm age)	-0.1946(-1.56)	-3.2505(-6.33)***	-6.6963(-12.02)***
log (sales)	-0.3358(-2.96)***	-1.2405(-2.67)***	0.1236(0.24)
Research and Development Expense to Sales	-0.0509(-1.09)	-0.4071(-2.13)**	0.4906(2.36)**
Total Borrowings and Bonds Payable to Total Assets	-0.0077(-1.59)*	0.1049(5.30)***	-0.1262(-5.87)***
year dummy	included	included	included

- 1) figures in parentheses (t-values)
- 2) ***, **, * is significance level 1%, 5%, 10%.

Figure 5
Smoothing Components for Performance Variables



formance. Also, the graph provides the ICR and NCGTAR by using the nonparametric smoothing for the performance index.

For manufacturing industry, the total assets ratio and the net capital ratio of firms with the ICR of 0 to 750 is significant, and the total asset growth rate is high in the range between 0 and 750. Firms with NCGTAR range between 0.1 and 0.8 shows higher total assets and equity capital ratios, while the total assets growth rate is high in the range between 0 and 2.8. Firms with an ICR less

than 1 and less than 750, are likely to have higher profitability and growth rate after receiving the credit guarantee. If the profitability of firms with the NCGTAR is larger than 0.8 and the growth rate is larger than 2.8 shows low overall performance after receiving credit guarantee.

4.1.3 Construction Industry

Table 6 shows the influence of ICR and NCGTAR support on the performance of SMEs in the construction industry. For con-

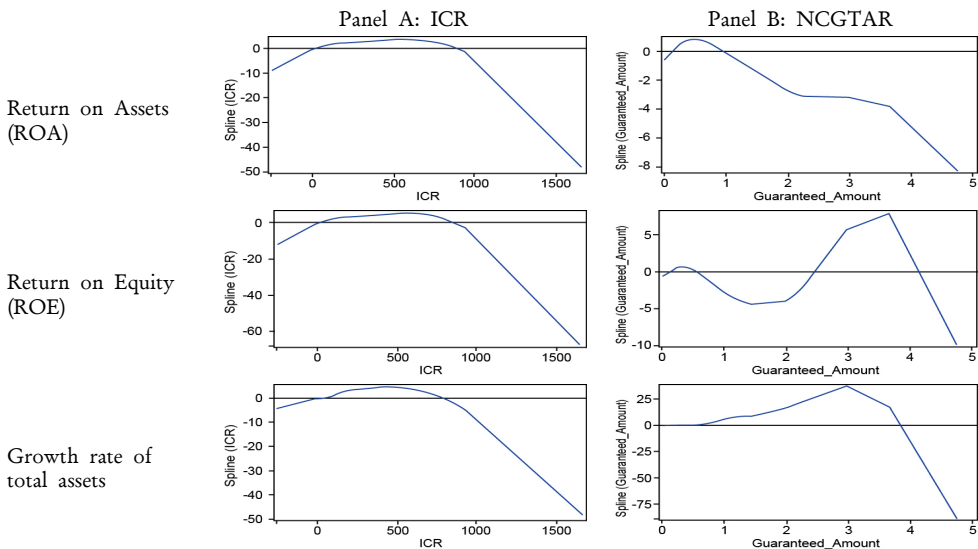
Table 6
Smoothing Model Analysis Result for Business Performance Index

variables	Return on Assets (ROA)	Return on Equity (ROE)	Growth rate of total assets
Intercept	-230.9870(-2.46)**	-251.2861(-1.50)	294.8880(0.79)
Interest Coverage Ratio (ICR)	0.0032(1.84)*	0.0032(1.00)	-0.0012(-0.18)
Guaranteed Amount (NCGTAR)	1.6806(2.54)**	5.3112(4.48)**	47.1862(17.95)***
log (firm age)	-0.6192(-2.82)**	-2.6355(-6.70)**	-6.0089(-6.88)***
log (sales)	0.4920(2.91)**	1.9475(6.44)**	1.8445(2.75)**
Research and Development Expense to Sales	0.3945(2.33)**	0.0121(0.04)*	-0.3430(-.051)
Total Borrowings and Bonds Payable to Total Assets	-0.0365(-3.31)**	0.0510(2.59)**	0.0244(0.56)
year dummy	included	included	included

1) figures in parentheses (t-values).

2) ***, **, * is significance level 1%, 5%, 10%.

Figure 6
Smoothing Components for Performance variables



struction industry, firms with ICR between 0 and 900 shows higher ROA and ROE. The growth rate of total assets increased from 0 up to 750. Firms with between 0.1 and 1 shows high ROA. ROE is NCGTAR high when the range is between 0.1 and 0.5. The growth rate of total assets increased from 0 to 3.9, and shows sharp increase up to 3. Firms with an ICR less than 1 and less than 900 shows higher profitability after receiving credit guarantee compare to those firms with no credit guarantee. If ROE of firms with NCGTAR larger than 1 and ROA larger than 0.5 and the growth rate of total asset larger than 3.9 shows low overall performance after receiving credit guarantee.

The results are summarized as follows. First, the firms whose ICR is approximately 1 have higher performance after receiving credit guarantee than those with higher ICR which has stable financial status quo. In other words, firms with higher ICR does not indicate the higher level of financial performance after receiving credit guarantee compare to the firms with lower ICR which in turn, has higher level of financial performance after receiving credit guarantee. Also, the relationship between guarantee scale to total assets ratio and financial performance shows similar result to that of the relationship between the ICR and financial performance. All of above results draw a similar conclusion as previous studies (Noh, 2010; Kim et al., 2012; Kim et al., 2013; Nam, 2014; Woo et al., 2014) that show a positive effect on firms' profitability by providing credit guarantee support and the scale of credit guarantee.

Second, firms with credit guarantee support displayed better growth regardless of financial stability. This may have resulted from positive effectiveness of credit guarantee support (Kim et al., 2012; Kim and Kim, 2013).

As a result, regression results above may have contributed to the following claims; SMEs financial support in the form of credit guarantee may derive positive conclusions including enhancement of business perform-

ance as well as imprinting the preconception of credit guarantee support in a positive way. It also substantiated that financial support policy enhanced the overall performance of firms. Restructuring of zombie firms is necessary procedure, however, becoming a target of potential restructuring firm depending solely on temporary management risk is not fair treatment instead continuing financial support is necessary for SMEs steady growth and overall performance.

Our study suggests a necessity of reevaluate the current governments financial policy scheme which contends the zombie needs to restructured. However, measuring ICR alone therefore may take away the opportunity of SMEs. In other words, considering ICR only as a restructuring standard precludes the possibility of including SMEs with good growth potential or technology.

V. Conclusion and Limitation

Concerns over declining in overall productivity of economies have been increasing since financial support for SMEs may lead to delay in restructuring of organization. Prior studies on effectiveness of supporting policy had assessed whether support has been made or not. This led to inconclusive results. Further study should analyze the effectiveness according to the size of Policy Guarantee so that fair allocation of resources can be maximized.

This study is intended to measure the positive effects of financial support on SMEs overall performance. We have utilized the following variables to measure the degree of supportiveness in financial support using Interest Coverage Ratio (ICR) and new credit guarantee to total assets ratio (NCGTAR) to classify the financially stable firms and unstable ones as well as firms receiving large scale credit guarantee support or vice versa. We have analyzed whether there is over performance between firms.

For empirical analysis, we have chosen the target firms that falls into a following category; firms that received credit guarantee over the last 16 years, variables represent

ICR and NCGTAR as independent variables, performance variables represent profitability and growth as dependent variables.

Analysis results show that firms with debt compensation rate is over 1 and the size of credit guarantee is large, the firms are statistically significant as compared to firms with debt ratio compensation is below 1. Performance growth rate with large scale credit guarantee support had statistically significant irrespective of ICR. In case of firm activity, firms with ICR more than 1 and large scale financial support seemed to have higher total asset turnover ratio. Firms with ICR more than 1 and small scale financial support seemed to be lower than that of ICR less than 1. Depending on the scale of credit guarantee support that firms receive, SMEs may enhance its overall performance and draw positive judgement relative to financial support. Furthermore, judging solely on ICR to determine zombie company is not recommended rather supporting through accurate assessment in terms of technological prowess and potential of growth may lead to enhancement in firms' value the long run.

The nonlinear relationship of the variable (ICR, NCGTAR) as much as using the GAM can be described through the graph, but there may be a limitation that the specific co-efficient can not be presented for the non-first term. Although it includes a year dummy in relation to the period, it seems to be limited due to the inability to fully absorb the effects of the foreign exchange crisis or the global financial crisis

However, If we can obtain the assurance data of other institutions and the financial information of SMEs' quarterly and semi-annually, we can suggest various implications for SME policy finance.

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일반화 가법 모형을 이용한 정책금융 수혜규모가 중소기업 경영성과에 미치는 효과성 연구

하승인*, 장명균**, 이근희***

본 연구는 기업의 재무상태 및 지원규모에 따른 정책금융지원의 효과를 파악하기 위하여 일반화가법모형을 적용하여 실증분석 하였다. 이를 위해 이자보상배율과 총자산 대비 신규보증금액 비율을 이용하여 업종별로 분석대상을 구분하였으며, 수익성, 성장성지표를 사용하여 경영성과를 측정하였다. 또한 분석기간에 여러 번의 정책금융을 지원받은 기업의 경우 표본선택편의로 인한 결과의 왜곡이 발생할 수 있으므로 중복지원 효과를 최소화하기 위해 지원연도를 기준으로 이전 3년 동안 보증잔액 및 신규보증액이 없으며, 이후 2년 동안 신규보증액이 없는 기업을 선정하였다.

분석 결과, 보증시점의 이자보상배율이 1 미만이라 하더라도 지원규모에 따라 성과는 차별화되는 것을 확인할 수 있었다. 또한 한계기업의 기준으로 사용되는 이자보상배율이 0에 근사한 기업이라도 경영성과는 향상될 수 있음을 확인할 수 있다. 결국 본 연구에서는 정책금융 지원정도에 따른 차별적인 경영성과를 확인함으로써 기술력이나 성장 잠재력을 고려한 평가가 요구되며 이를 통해 정책금융을 지원하는 담보가 부족한 중소기업의 자금조달 문제를 완화할 수 있는 유인책으로서의 작용할 수 있음을 시사하고 있다.

주제어 : 중소기업, 정책금융, 신용보증, 이자보상배율

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