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Effect of credit guarantee policy on survival and performance of SMEs in Republic of Korea

Jae Won Kang · Almas Heshmati

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Abstract This study evaluates the effect of credit guarantee on SMEs at the firm level. To estimate the effect of credit guarantee, we analyze relations between credit guarantee, the survival of guaranteed firms, and their productive performance. The result indicates that credit guarantee frequency enabled guaranteed firms to achieve good performances in general. On the contrary, the effect of guarantee amounts is ambiguous in that there is difference between the contemporary effect and the lagged effect. Therefore, we conclude that credit guarantee satisfied partially its goal to alleviate SMEs' difficulty in acquiring finance and to stabilize employment.

JEL Classification G28 · L26

Keywords Credit guarantee · SMEs · Pseudo panel data · Survival · Performance

J. W. Kang (✉)
Technology Strategy and Planning Division, Korea Institute of Industrial Technology Evaluation & Planning, 13F KOTECH Bldg. 701-7, Yeoksam-Dong, Gangnam-Gu, Seoul 135-080, Rebublic of Korea
e-mail: pang77@snu.ac.kr; jkang@itep.re.kr

A. Heshmati
Economics & Finance, University of Kurdistan Hawler, Hawler, Federal Region of Kurdistan, Iraq
e-mail: heshmati@snu.ac.kr; almas.heshmati@ukh.ac

1 Introduction

For policy makers and academic researchers, the survival and growth of small and medium-sized enterprises (SMEs) is a matter of primary concern. The dynamic characteristic of SMEs is an interesting topic since SMEs invigorate the stagnant economy and are necessary as an infrastructure for large corporations. Generally, the major advantage of SMEs is that they are flexible in organization and production structure allowing them to seize new business opportunities quickly. In addition, they tend to contribute to the welfare and stability of society by accounting for a relatively larger share of total employment. However, SMEs in common face great difficulties to finance investment due to credit rationing in which they face restriction or refusal in credit acquisition even though, at times, they could be willing to pay more than identical but competitive borrowers. This is why most governments tend to intervene establishing and enhancing collaboration between financial institutions and SMEs through a credit guarantee system in many countries.

The Korean government has encouraged new businesses and has supported SMEs to help accelerate economic growth and to decrease unemployment especially during the depression periods. Among many direct and indirect support measures, the credit guarantee system is seen as one of the most important instruments to achieve national economic policy goals. For example, the credit guarantee system has

played an important role in assisting SMEs to raise necessary investment funds from the capital market throughout the economic crisis in the late 1990s and in particular after the collapse of venture businesses in the early 2000s. Since banks were reluctant to lend to SMEs in the absence of reliable risk measures, the amount of credit guarantee increased rapidly as an important supportive measure. Part of the reason for such a trend is due to the SMEs' inherent high risks such as their high failure rates and lack of collateral, especially for venture businesses and new technology based firms (NBTFs). With credit guarantee, many SMEs are able to overcome financial distress and achieve their transformation into competitive entities. However, it has been criticized that credit guarantees by being favorable to SMEs encourages moral hazard and mitigates the exit of inefficient firms, thereby disturbing the market mechanism as a result.

In spite of its economic and social impacts, the evaluation of the performance of credit guarantee, for reasons of lack of data, has not been a popular research area in Korea. A few studies investigate the impact of credit guarantee on the economy, for example, in an inter-industry analysis approach (Hong, Park, & Jeon, 2003) and by applying a modified national income distribution model (Lim, Park, & Han, 2003). However, the performance of credit guarantees has not yet been evaluated at the firm level, and analysis remains limited to a macroscopic viewpoint so far. Recently, using aggregate data from the Small and Medium Business Administration (SMBA) and D&B Korea, Kim (2004) analyzes the impacts of credit guarantee and suggests that the relationship between policy loans.[1] and the performance of SMEs is statistically insignificant in general.

We evaluate the effect of credit guarantee on the survival and the performance of SMEs using a large dataset in this study. Our study is distinguished from existing papers in that we treat firm level data. Results of this paper shed light on credit guarantee policy which is differentiated by the types of firms such as their size and the industrial sector the firms participate in. This research should be useful not only in identifying the strengths and weaknesses of current policies, but also in designing new policy programs to take important issues into account.

The remainder of this study is organized as follows. Section 2 reviews studies on the determinants of the survival and growth of SMEs. Section 3 describes the original data and presents the constructed pseudo panel data. We describe how the pseudo panel was constructed and quantify discrepancy between the original data and pseudo data in relation to the size of the original data. In Sect. 4, models are presented that are used for analysis concerning survival and performance of SMEs. Based on the empirical findings, possible improvements in government policies for SMEs finances are proposed in Sect. 5. Finally, we discuss the limitations of this study and suggest directions for the future research.

2 Theoretical development

To analyze the survival and performance of firms, let us consider their size first. Since Gibrat presented the dynamic model of firms in 1931, the so-called Gibrat's Law, many researchers have analyzed the relationship between firm growth and size. According to Gibrat's Law, the growth of a firm is proportional not to its initial size but to its current size over a specified period in a given industry. This, however, has been rejected in many empirical studies, which find that, generally, smaller firms tend to have higher and more variable growth rates than larger firms (Almus & Nerlinger, 1999; Audretsch, Santarelli, & Vivarelli, 1999; Becchetti & Trovato, 2002; Dunne & Hughes, 1994; Evans, 1987; Hall, 1987; Lotti, Santarelli, & Vivarelli, 2003; Mansfield, 1962).

The failure of Gibrat's law could, on the other hand, originate in biased samples and heteroscedasticity with the exit of slow-growing small firms from the sample. Small firms exhibit lower survival probability, while a high growth rate is mainly registered by those firms which survive (Dhawan, 2001; Honjo, 2000; Mata, Portugal, & Guimaraes, 1995; Taymaz & Köksal, 2006). However, Hall (1987) and Dunne and Hughes (1994) claim that the negative relationship between the size and growth of small firms is robust to their correction for selection bias due to sample attrition. To explain the discrepancy between Gibrat's Law and empirical evidence,

[1] Policy loans include not only credit guarantees but also all other funds provided by the government or public institutions.

Jovanovic (1982) proposed the theory of noisy selection, which asserts that efficient firms grow and survive. New firms do not achieve efficiency without difficulties. At the beginning, many firms are vulnerable and are unable to overcome failure. Only those surviving eventually have opportunity to utilize the experience of failed firms as part of their knowledge set. Consequently, the survival rate decreases dramatically over time for a maturing industry. Therefore, firm age is considered as a proxy of efficiency since survival itself improves management competence (Audretsch, 1991; Audretsch & Mahmood, 1995; Audretsch et al., 1999; Bartelsman, Scarpetta, & Schivardi, 2005; Lee, 2003; Mata et al., 1995). There is an auxiliary advantage in that the addition of age in regression reduces heteroscedasticity (Dunne &Hughes, 1994).

Even though Gibrat's law fails in many cases, it is quite obvious that size plays an important role in the dynamics of the firm, especially, its survival. If size is the key factor of survival, two questions arise: (1) why are there inaugurations of initially small-sized firms? (2) How do some small firms, to some extent in size, exist over a long period? One of the main reasons is that the survival and growth of firms depends on the industry to which they belong. Since the minimum efficient scale (MES) level often varies according to industry, survival rates are considerably different across industries as well[2] (Audretsch, 1991, 1995; Audretsch et al., 1999). Once firms achieve MES immediately, they tend to have a high survival likelihood and stable basis for growth. As the structure of industry transforms from capital-intensive to technology-intensive organization, technology acquisition licensing, R&D and innovative activity of firms become important for the survival and growth of firms (Agarwal, 1996; Arrighetti & Vivarelli, 1999; Audretsch, 1991, 1995; Calvo, 2006; Colombo & Grilli, 2005; Colombo, Delmastro, & Grilli, 2004; Kiyota & Okazaki, 2005). Almus and Nerlinger (1999) claim that NTBFs achieve on average higher growth rates than non-innovative firms. In addition, the initial firm size and post-entry performance of new small firms are determined by various factors such as human capital and entrepreneurship (Colombo et al., 2004; Colombo & Grilli, 2005; Cressy, 2006), entrance time (Honjo, 2000), location (Scott, 2006; Stearns, Carter, Reynolds, & Williams, 1995), and labor market and regional support (Heshmati, 2001), amongst others.

The financial constraint that firms face is one of the most important factors which affect their survival and growth. In the loan market, credit rationing has been found to be important (Stiglitz & Weiss, 1981). Due to residual imperfect information after the evaluation of loan applications and adverse selection of riskier borrowers, it gets more and more difficult in general for firms to borrow at higher interest rates. Especially, credit rationing has serious effects on new firms, which have neither experience nor collateral (Hanley & Girma, 2006). SMEs suffer from credit rationing since there lack somewhat sufficient financial information and standardized financial statements. While small surviving firms have higher growth potential than the average, this potential could be limited by the availability of external finance (Baas & Schrooten, 2006; Becchetti & Trovato, 2002; Hyytinen & Väänänen, 2006; Oliveira & Fortunato, 2006).

The belief that capital markets do not provide adequate funds for new business is the rationale for public loan assistance programs such as credit guarantee to small business (Evans & Jovanovic, 1989). If credit guarantee institutions inform lenders of the risk associated with the loan properly or help manage risk better than lenders, then they can help SMEs to overcome collateral constraints. Credit guarantees could relieve the risks of lending to SMEs, as well as provide compensation for low profit margins and produce additionality[3] (Gudger, 1998). In other words, credit guarantees warrant firms to private investors and help reduce information asymmetry that might have otherwise precluded investments. Hancock and Wilcox (1998) find that the volume of loans made under Small Business Admin-

[2] Analysis across countries as well as industries is conducted for Portugal (Mata et al., 1995), for Italy (Audretsch et al., 1999), for Sweden (Heshmati, 2001), for Japan (Honjo, 2000), for Korea (Lee, 2003), and for OECD countries (Bartelsman et al., 2005).

[3] According to Gudger (1998), additionality means that ''a small investment in a guarantee institution's capital and/or ongoing administrative support to guarantee institutions can produce a significantly larger volume of lending to a credit constrained sector than would have been achieved without such guarantees''.

istration (SBA) loan guarantee programs shrank less than that not made under SBA programs in the decline of banks' capital. Loan guarantee programs can be an effective mean of supporting the start-up, growth, and survival of new and risky enterprises (Riding & Haines Jr., 2001). Hong et al. (2003) provide empirically evidence of employment-inducing effect of credit guarantees in an input–output analysis.[4]

However, there is concern that indiscriminate public supports distort and delay the competitive selection process, thereby impairing efficiency. Santarelli and Vivarelli (2002) claim that the failure rate is especially high among new firms that have received public support. Kiyota and Okazaki (2005) indicate that policy funds might be used in the adjustment of declining industries, rather than for supporting technology acquisition, even though firms with acquired technologies do achieve faster growth in performance. On the other hand, firms founded by entrepreneurs with industry-specific professional knowledge, entrepreneurial talent and confidence are less constrained in the capital market and begin business at a greater scale or nearer the optimal size (Colombo et al., 2004). Nevertheless, this does not mean that there is no need of public support. Rather such arguments call for public intervention to stimulate the establishment and growth of small firms which have high levels of human resources in specific knowledge and experience.

3 Data description

The original data consist of 200,702 applicants which requested credit guarantees from either or both of two credit guarantee funds, Korea Credit Guarantee fund (KCGF) and Korea Technology Credit Guarantee Fund (KOTEC), during the period 2001 to 2004. All applicants provided basic information such as age, location, Korea Standard Industry Code (KSIC), in addition to financial data in previous years. However, these panel data are highly unbalanced since they include information on accepted applications rather than on all applicants in most cases. In addition, necessary information identifying firms and tracing them over time was not provided for confidentiality reason. Since observations are not independent over time, a pseudo panel data analysis applies appropriately compared with the more common panel data analysis which would have been based on the original data.

To transform the original data into pseudo panel, the following steps were performed. First, to trace individual firms and to account for dependency of observations over time, a synthetic identity number was generated using firm characteristics that are likely constant over time (as given in Eq. 1)[5]:

$$\begin{aligned}\text{IDNR} = {} & 100,000 \times \text{KSIC} + 10,000 \times \text{CGI} \\ & + 1,000 \times \text{LOCATION} + 10 \times \text{SIZE} \\ & + \text{BANKRUPTCY} \end{aligned} \quad (1)$$

For example, an IDNR of 4,511,021 indicates that the firm belongs to industrial sector 45, applies for credit guarantee to KOTEC, is located in Seoul, is small sized, and is bankrupt. Thus, with the new identification number, basic information on the object is easily derived, such as its size, geographic location, industrial sector, and other firm characteristics.

The next step involved the calculation of the means of the variables according to the identification number and year. Through this procedure, the large original data set was reduced to 20,165 cohorts that could be traced over time.

Table 1 summarizes the main differences between the pseudo panel and the original data of guaranteed SMEs according to two credit guarantee funds. The non-ratio variables are defined as the cell mean representing the average firm belonging to a cohort, while the ratio variables are defined as the ratio of the cell means. The growth variables are defined as percentage growth in the respective

[4] Hong et al. (2003) indicated that only indirect effect is considered in input-output analysis, which might underestimate the outcomes. On the other side, fixed prices enable to overestimate the effects.

[5] Credit Guarantee Identification (CGI) is 0 if a firm receives credit guarantee from KCGF, 1 if a firm receives credit guarantee from KOTEC. KSIC is two digits. When location is considered, firms are divided into 5 categories. Seoul, Gyunggi, Inchon constitute first, Gangwon is second, Daejeon, Chungnam, and Chungbuk are third, fourth is consist of Busan, Daegu, Ulsan, Gyungnam, and Gyungbuk, Gwangju, Jeonnam, and Jeonbuk are fifth regions. Size number varies from 1 to 15 according to the number of employees. Bankruptcy is 1 if the firm is bankrupt and 0 if not.

Table 1 Characteristics of guaranteed firms

		KCGF		KOTEC		Total	
		Mean	Std	Mean	Std	Mean	Std
Age	Original	5.81	5.20	5.63	5.26	5.77	5.21
	Pseudo	5.75	4.35	5.36	4.26	5.59	4.32
Number of employees	Original	13.59	41.78	21.82	38.34	15.43	41.18
	Pseudo	21.31	111.68	20.94	49.50	21.16	91.38
Amount of credit guarantees	Original	211	623	336	914	239	700
	Pseudo	334	778	339	760	336	771
The number of receiving guarantee	Original	1.50	2.87	1.27	.82	1.45	2.57
	Pseudo	1.62	3.28	1.24	.58	1.46	2.55
Business failure rate	Original	.08	.27	.15	.35	.09	.29
	Pseudo	.28	.45	.28	.22	.28	.45
Sales	Original	3,387	341,658	3,371	10,279	3,384	301,220
	Pseudo	4,580	44,905	3,530	13,805	4,148	35,578
Collateral ratio (fixed asset/total asset)	Original	.37	.26	.43	.26	.38	.26
	Pseudo	.46	.22	.46	.22	.46	.22
Debt ratio (liability/equity)	Original	2.30	30.20	2.80	20.35	2.41	28.33
	Pseudo	2.43	35.87	2.60	15.16	2.50	29.24
Profitability ratio (operating income/sale)	Original	.01	1.28	−.31	6.58	−.06	3.28
	Pseudo	−.03	1.45	−.36	4.85	−.17	3.29
Patent	Original	.07	.25	.29	.46	.12	.32
	Pseudo	.07	.19	.25	.34	.14	.28
KOSDAQ	Original	.03	.16	–	–	.03	.16
	Pseudo	.04	.16	–	–	.04	.16
Number of the firm or cohort	Original	155,986		44716		200,702	
	Pseudo	11,872		8,293		20,165	

Unit: Year, %, '00 mil. Won

Note: Number of original firms is 200,702 and that of pseudo is 20,165

cell mean. In the distribution of firms by individual observations or cohorts, discrepancies between pseudo and original data were observed in some variables. Such discrepancy might be attributed to differences in the cell size. Since cohorts are generated in terms of a new identification number, the bias of time-invariant variables in the original distribution could affect the cell size in the pseudo panel. For example, the share of firms in the manufacturing sector increased while that in whole sales and retail trade sector decreased remarkably (Table A1). The discrepancy in share happens in location as well (Table A2). However, there is a little difference in the distribution in case of size or year (Table A3, Table A4).

4 Modeling and estimation procedure

The estimation based on grouping individual data transformed into cohorts can be conducted using the instrumental variables (IV) method. For empirical analysis, Verbeek and Vella (2005) discuss the implications of conditions in which IV estimators based on OLS using the cohort aggregates is consistent. They indicate that these conditions are not trivially satisfied in applied analysis, however. First, instruments observed for each object in the entire sample should exhibit sufficient (time-varying) correlations with each explanatory variable and should have no correlation with unobservables. Second, cohort effects in the unobservables should be absent

for a simple IV estimator. Finally, an augmented IV estimator, based on the within estimator using cohort aggregates, is significant, if time-invariant cohort effects are allowed.

Hence, pseudo panel analysis is a second best choice in this study, since repeated cross sections do not trace individual firms over time. For this study, as has already been explained, this limitation was due to confidentiality issues at the firm level. With pseudo panels, even though every observation is assembled into separated cohorts, each of the cohort means is well defined by key time invariant firm characteristics. The use of such characteristics has the advantage that firms are classified in the same cohorts over time. This property allows us to study the dynamics of the firms in the credit guarantee system. In addition, Heshmati and Kumbhakar (1997) summarize the advantage of pseudo panels over genuine panels. First, researchers can prolong the time period by using repeated cross section data or rotating short period panel data. The prolonged time periods to some extent are indispensable for testing the constancy of parameter estimates over time, the dynamics of the system, and its impacts. Second, pseudo panel data tend to deal with the attrition problem flexibly compared with original panels. Since cohort means are used as observations, missing units do not result in unbalanced data when dealing with pseudo panels. Rather, it allows for exit and entry but yet maintains the balanced nature of the panel data over time. Finally, the conspicuous decrease in the number of observations mitigates intricate data management and laborious computational problems associated with large micro datasets.

We proceed to estimate the effect of credit guarantee on SMEs in three steps. First, we identify the determinants of the amount of credit guarantee. Second, the effect of credit guarantee on business failure is estimated for firms that received credit guarantee. Finally, the relationship between credit guarantee and the performance of SMEs is investigated conditional on receipt of credit guarantee and survival.

Although the determinants of credit guarantee provision should have been identified, since they are the main focus of our analysis on the survival and performance of guaranteed firms, this was impossible due to the low quality of data about firms, which applied but failed to receive credit guarantee.[6] As an alternative, we introduce the determinants of the amount of credit guarantee as a substitute. Among many factors, which play an important role in the credit provision decision, basic information such as age, size, and KSIC and financial data is preferably considered in this study. This might be due to difficulties in access data and evaluating practical know-how in decision-making. Regarding financial variables, the debt ratio, profitability ratio, and collateral ratio are introduced to identify risk, stability, profitability and liquidity. Traditionally, fixed asset were used as collateral, therefore the ratio of fixed asset to total asset is used here as a collateral ratio. The ratio of operating income to sale is used to estimate profitability. Introduction of financial ratio variables has the advantage in that it can reduce problems associated with high correlation among financial variables (Table A5). The coefficients of correlation between the financial explanatory variables lie in the interval between $-.034$ and .004 suggesting that multi-collinearity is not a major problem. In addition, the KOSDAQ dummy is introduced to analyze the effect of the capital market on the provision of credit guarantees indirectly.[7] Patent dummy represents the applicant's technology ability indirectly, while the KOTEC dummy identifies a firm as guaranteed by KOTEC or not, which allows us to compare the difference between the two credit guarantee institutions.

For the analysis of factors determining the amount of credit guarantee, the following model is specified and estimated by ordinary least squares (OLS):

$$\begin{aligned}\mathrm{Cga} &= \beta_0 + \beta_1 \mathrm{age} + \beta_2 \mathrm{sale} + \beta_3 \mathrm{debt} + \beta_4 \mathrm{collateral} \\ &+ \beta_5 \mathrm{profitability} + \beta_6 \mathrm{fcg} + \beta_7 D^{\mathrm{Patent}} + \beta_8 D^{\mathrm{KOSDAQ}} \\ &+ \beta_9 D^{\mathrm{KOTEC}} + \sum_t \beta_i D_t^{\mathrm{Time}} + \varepsilon \end{aligned} \quad (2)$$

[6] Credit guarantee institutions do not require all detailed information at once in the first part of their application since determination of acceptance or rejection to provide credit guarantee proceeds in a number of steps. The datasets include information only on accepted applications rather than on all applicants.

[7] Korea Securities Dealers association Automated Quotation (KOSDAQ) is an alternative source of finance for SMEs which are not listed on the Korea Securities Exchange (KSE). It is an electronic trading system benchmarking NASDAQ in U.S.

where cga is the logarithm of the amount of credit guarantee, fcg is the frequency of credit guarantee, and D_t^{time} is the dummy variable which indicates when credit is provided.[8]

In the second step, the logarithm of the amount of credit guarantee is introduced to analyze the effect of credit guarantee on survival.[9] In this step, we regress the model twice without and with the lagged credit guarantee variable to identify the lagged credit effect. The following probit model is estimated by maximum likelihood method (MLE):

$$\begin{aligned}\text{survival}_t = {} & \beta_0 + \beta_1 \text{age}_t + \beta_2 \text{employee}_t + \beta_3 \text{debt}_t \\ & + \beta_4 \text{collateral}_t + \beta_5 \text{profitability}_t + \beta_6 \text{fcg}_t \\ & + \beta_7 \text{cga}_{t-1} + \beta_8 \text{cga}_t + \beta_9 D_t^{\text{Patent}} \\ & + \beta_{10} D_t^{\text{KOSDAQ}} + \beta_{11} D_t^{\text{KOTEC}} \\ & + \beta_{12} D_t^{\text{Overlap}} + \varepsilon_t \end{aligned} \quad (3)$$

where D_t^{Overlap} indicates whether firms received guarantee from both or not. Other explanatory variables are the same as those of Eq. 2.[10]

Finally, we estimate the effect of credit guarantee on the performance of SMEs. The performances of SMEs are specified with regard to three aspects: growth of sales, increase of employment, and productivity growth. Since we use only cohorts of firms, which are guaranteed and survive, coefficients are estimated by Heckman's two-step method to resolve sample attrition bias (Heckman, 1979). Therefore, we introduce inversed Mill's ratio calculated from the probit model on survival of firms in the second step. The model specification is shown below and the estimation method is similar with the first step (Eq. 2), i.e. OLS method:

$$\begin{aligned}\text{Performance}_t = {} & \beta_0 + \beta_1 \text{age}_t + \beta_2 \text{employee}_t \\ & + \beta_3 \text{debt}_t + \beta_4 \text{collateral}_t + \beta_5 \text{profitability}_t \\ & + \beta_6 \text{fcg}_t + \beta_7 \text{cga}_{t-1} + \beta_8 \text{cga}_t + \beta_9 D_t^{\text{Patent}} \\ & + \beta_{10} D_t^{\text{KOSDAQ}} + \beta_{11} D_t^{\text{KOTEC}} + \beta_{12} D_t^{\text{Overlap}} \\ & + \beta_{13} \text{millsr} + \varepsilon_t \end{aligned} \quad (4)$$

where millsr is the inversed mills ratio and performance measures are growth of sales, increase of employment and productivity growth, in turn.[11]

Since the amount of credit guarantee is used as an explanatory variable in survival and performance, Wu–Hausman test is introduced to test whether credit guarantee amount is endogenous or not. We regress on survival and performance the residual computed from Eq. 2 then test whether it is significant. If the coefficient of this residual is significant, then predicted value of credit guarantee amount should be used instead to avoid endogeneity (Davidson & MacKinnon, 1990).

5 Analysis of results

Table 2 shows that guarantee frequency plays an important role in decision making. Credit guarantee institutions prefer applicants with past records to new entrants. They are under constant pressure to reduce their dependency on the public by being more and more effective in their operations since credit guarantee funds heavily depend on continued contribution from the government. Therefore, there is strong incentive to select previously approved applicants, even though they are on a decline, rather than new applicants with high growth potential without sufficient background information. This inclination explains that credit guarantee institutions provide more guarantees to firms which are less risky. The amount of credit guarantee is in proportion to firm size and collateral ratio.[12]

[8] The value of financial variables is transformed into constant 2004 prices using yield of treasury-bond (3 years). For the reasons of simplification of the notation, the firm (*f*) subscript is omitted from all equations.

[9] Predicted value of credit guarantee amount is used instead in case that the credit guarantee amount variable is endogenous.

[10] The cohort (firm) subscript is excluded in order to simplify. In model 1, the lagged variable of credit guarantee amount is omitted.

[11] All explanatory variables except millsr are same as those explained in Eq. 3.

[12] Usually, the number of employee is used for firm size. However, we use logarithmic sales as firm size since (1) credit guarantee institutions consider total sales more than the number of employees in actual evaluations and (2) there is high correlation between sales and the number of employees (see Table A5).

Table 2 LS parameter estimate of determinants of amount of credit guarantee

Variable	Definition	Pooled	KSIC1	KSIC2	KSIC3	KSIC4	KSIC5	KSIC6
Age	Logarithmic age of firms	.0022 (.0017)	−.0192b (.0090)	−.0087a (.0019)	.0184b (.0089)	−.0042 (.0087)	.0260a (.0075)	.0129a (.0043)
Sales	Logarithmic Sale	.5748a (.0077)	.7277a (.0570)	.5862a (.0102)	.7057a (.0318)	.7203a (.0180)	.4624a (.0225)	.5289a (.2155)
Debt ratio	Liability/equity	.0011a (.0002)	.0172c (.0102)	.0003 (.0005)	.0079 (.0062)	−.0011c (.0007)	−.0040 (.0030)	.0014a (.0001)
Collateral ratio	Fixed asset/total asset	.4805a (.0309)	.3393 (.2154)	.3602a (.0420)	.3057 (.1934)	.0566 (.0838)	.1595 (.1044)	.4880a (.0693)
Profitability ratio	Operating income/sale	−.0381a (.0069)	−.0963 (.1415)	−.0537a (.0083)	−.2507b (.1002)	−.3041a (.1083)	−.0227a (.0047)	−.0272a (.0059)
Guarantee frequency	The number of receiving guarantee	.0519a (.0085)	.2954a (.0651)	.0648a (.0179)	.0337a (.0069)	.0753a (.0182)	.0467a (.0141)	.0893a (.0197)
Dummy patent	Existence of patent	.3483a (.0117)	−.3946 (.2852)	.3158a (.0146)	.1334a (.0321)	.0904a (.0294)	.5072a (.0506)	.4845a (.0732)
Dummy KOSDAQ	Whether on KOSDAQ or not	.2519a (.0258)	.3128 (.2436)	.2491a (.0317)	.1204a (.0443)	.0482 (.0460)	.3178a (.0940)	.5642a (.1315)
Dummy KOTEC	Guaranteed by KOTEC	.1206a (.0114)	.0373 (.1057)	.1469a (.0138)	−.1599a (.0320)	−.1037a (.0250)	.4525a (.0496)	.1159a (.0392)
Dummy time 1	2002	−.0105 (.0141)	−.1769 (.1334)	−.0121 (.0174)	−.0418 (.0400)	−.0124 (.0289)	−.0253 (.0508)	.0155 (.0474)
Dummy time 2	2003	−.0829a (.0146)	.0229 (.1216)	−.0913a (.0181)	−.1288a (.0384)	−.0627b (.0294)	−.1235b (.0519)	−.0387 (.0489)
Dummy time 3	2004	−.1659a (.0159)	.0403 (.1306)	−.1812a (.0192)	−.3696a (.0461)	−.2308a (.0349)	−.1609a (.0574)	−.0340 (.0542)
Observation number		19,689	168	11,187	1,461	2,253	1,473	3,147
Adjust *R*-squared		.5985	.6580	.6436	.7669	.7307	.5951	.4048

Note: Figures in parenthesis are standard errors; significant at the less than 1% is (a), 5% is (b), and 10% is (c); KSIC1 is mining and quarrying and KSIC2 is manufacturing, KSIC3 is construction, KSIC4 is whole sale and retail trade, KSIC5 is business activities, and KSIC6 is others. Results are corrected for heteroskedasticity

However, there is inconsistency in the risk-averse tendency in the relationship between debt ratio and credit amounts. Since credit rationing happened due to collapse of venture bubble in early 2000s, credit guarantee institutions were confronted with the pressure to soothe stringency in financing. This demonstrates the inherent conflict between incentives and goals in credit guarantee institutions.

Generally, SMEs have incentive to use policy funds, including public credit guarantees, which cost less than private loan. Therefore, even superior firms which can acquire finance on the market tend to apply for credit guarantees and do in fact receive some parts for their financing. In such cases, estimation could become biased. To go around this problem, we should investigate possibilities of internal financing and market financing. However, this is not possible due to the limitation of proper information. There are many missing data in balance sheets and income statements of SMEs. Therefore, profitability and the KOSDAQ dummy are introduced alternatively to identify possibilities of internal financing and private financing via the market. It seems that firms financing internally are guaranteed less while firms financing on market receive more guarantees.

The amount of credit guarantee continuously decreased with the elapse of time. After the decline of venture businesses in early 2000s, the amount of credit guarantee increased rapidly, then declined gradually keeping pace with economic recovery. Technology potential represented by the patent dummy is considered as an important determinant since it helps increase expected profitability in the future.

Even though we find similar trend in general, there are some significant differences across industries with respect to age. In case of mining & quarrying, and manufacturing, the younger has the more credit guarantees while the older has the more in other sectors. This result coincides partly with the expectation that credit guarantees are preferentially distributed to new entrants or growing firms. It is consist partially with the objectives of the credit guarantee system as well. With respect to the KOTEC dummy variable, only increase in manufacturing and business activities relates with the KOTEC's goal that fosters NBTF and promotes technological innovation.

The effect of credit guarantee on the survival of SMEs is positive only if contemporary effects are considered (Model I in Table 3). Considering lagged effect, contemporary effect becomes negative while lagged effect is positive in Model 2. This implies that the amount of credit guarantee tends to affect the survival of guaranteed firms with a lag. More specifically, while lagged guaranteed amount restrain bankruptcy, contemporary amount decreases survival. The guarantee frequency increases survival in some cases. The overlap of guarantee from both institutions is positively correlated with the survival rate.

Age shows a positive correlation with survival. This means that some firms overcome the crisis with management enhanced by experience. Survival rate seems to have negative relationship with size. However, this result originates in excessively biased distribution of pseudo data with respect to size. Bankruptcy rate is only 4.87% in large-sized enterprises while 28.26% in micro enterprises and 23.56% in SMEs.[13] The high collateral ratio decreases risk while the effect of a debt ratio is obscure. Those firms which could acquire finance on the KOSDAQ show high survival likelihood.

Firms guaranteed by KOTEC showed higher survival likelihood than those guaranteed by KCGF. One of the reasons in difference between two groups stems from the technology evaluation process. In the early 2000s, SMEs suffered from credit rationing due to the collapse of the venture. Providers of loans in the private sector became conservative in recognizing the value of technology of SMEs, especially NTBFs. In this respect, KOTEC provided some part of guarantee for NTBF by evaluating technology only, and so helped mitigate credit rationing partially. Utility of technology evaluation is supported by patent dummy as well.

We evaluate performances of SMEs with regards to three aspects: (1) growth of sale, (2) increase of employment, and (3) improvement in labor productivity. Each result was reported in Tables 4– 6. The effect of credit guarantees is different in detail according to aspects and across industries. To sum

[13] In Korea, firms are classified according to the number of regular employees. If the number of employees is less than 50, a firm is classified as a micro enterprise. In general, SMEs have less than 300 employees.

Table 3 Estimation of survival in probit regression

Variable	Pooled		KSIC2		KSIC3		KSIC4		KSIC5		KSIC6	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Age	.0652a (.0043)	.0637a (.0065)	.0713a (.0052)	.0713a (.0078)	.0385b (.0192)	.0578c (.0340)	.1070a (.0175)	.0991a (.0246)	.0635a (.0218)	.0939b (.0388)	.0981a (.0184)	.0855a (.0315)
Employee	−.1598a (.0181)	−.1475a (.0290)	−.3357a (.0265)	−.4177a (.0450)	−.4052a (.1012)	−.8623a (.1977)	.0415 (.0618)	.0452 (.1014)	−.1536b (.0649)	−.1757 (.1137)	−.1596a (.0618)	−.1225 (.1248)
Debt ratio	.0002 (.0004)	−.0009 (.0014)	−.0021 (.0013)	−.0016 (.0015)	−.1866a (.0370)	−.3627a (.0639)	.0004 (.0014)	−.0008 (.8602)	−.0071 (.0077)	−.0172 (.0108)	.0024 (.0023)	.0139b (.0068)
Collateral ratio	1.0001a (.0663)	1.3566a (.1014)	.9915a (.0956)	1.5672a (.1468)	1.5638a (.4264)	2.2457a (.6690)	1.8860a (.2320)	2.1635a (.3268)	−.2200 (.2637)	−.7934c (.4235)	.8579a (.1824)	1.1425a (.3541)
Profitability Ratio	.0250a (.0094)	.0131 (.0152)	.0206b (.0095)	.0176 (.0155)	.3734 (.3251)	.5021 (.5487)	.2656c (.1535)	−.3178 (.5882)	.0739b (.0320)	−.1353 (.1423)	.0340 (.0766)	−.1189 (.2184)
Guarantee frequency	.0130c (.0078)	.0140 (.0124)	−.0105 (.0095)	−.0040 (.0117)	.0354c (.0188)	.0711 (.0586)	.2218a (.0784)	.2120b (.0960)	.4976a (.1358)	.6086b (.2668)	.0132 (.0654)	.0422 (.1395)
Predicted credit amount (PCA)	.0519b (.0253)	−.1394a (.0438)	.1425a (.0350)	−.0567 (.0580)	.2573a (.0994)	.2932c (.1701)	.0441 (.0841)	−.1902 (.1314)	.0036 (.0737)	−.1829 (.1192)	.2343a (.0893)	.0273 (.1762)
Lagged PCA		.1251a (.0407)		.2385a (.0570)		.4392a (.1492)		.2293c (.1333)		.0794 (.1125)		.0485 (.1601)
Dummy patent	.2995a (.0316)	.3264a (.0452)	.5289a (.0396)	.5664a (.0578)	.6272a (.1290)	.6157a (.1964)	.2411b (.1049)	.2000 (.1413)	−.1310 (.1420)	−.0611 (.2191)	−.2101 (.2030)	−.4975 (.3146)
Dummy KOSDAQ	.2980a (.0644)	.2791a (.0905)	.3085a (.0881)	.1851 (.1198)	.5731a (.1818)	.4547 (.2778)	.2499 (.1605)	.2794 (.2343)	.4269 (.3019)	.6440 (.5056)	.2237 (.3105)	5.6086 (1683)
Dummy KOTEC	.0549c (.0293)	.0751c (.0433)	.0229 (.0376)	.0516 (.0561)	.6990a (.1115)	1.1952a (.1935)	.3087a (.0822)	.3301a (.1141)	.2566c (.1413)	.2031 (.2253)	.1330 (.1255)	.0798 (.2459)
Dummy Overlap	.0187 (.0295)	.2269a (.0424)	.0687c (.0397)	.3209a (.0576)	.4110a (.1042)	.5662a (.1526)	.5378a (.0863)	.7520a (.1169)	.0132 (.1092)	.0203 (.1646)	.3090b (.1235)	.7354a (.2538)
Observation Number	11,823	6,522	6,939	3,876	940	549	1,433	833	874	467	1,579	773
Log likelihood	−5,980	−2,825	−3,472	−1,602	−466	−212	−793	−423	−407	−178	−457	−142

Note: Figures in parenthesis are standard errors. Significant at the less than 1% is (a), 5% is (b), and 10% is (c). Results are corrected for heteroskedasticity. In case of KSIC1, the regression is impossible due to lack of observations. In case of KSIC5, credit guarantee amount is used since there is no endogeneity

Table 4 LS estimates of the effect of credit guarantee on growth of sale

Variable	Pooled		KSIC2		KSIC3		KSIC4		KSIC5		KSIC6	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Age	.0511a (.0072)	.0571a (.0108)	−.0076 (.0084)	−.0110 (.0106)	.0705a (.0185)	.0801a (.0291)	.0324a (.0057)	.0359a (.0076)	.0324b (.0129)	.0499a (.0153)	.0129c (.0069)	.0096 (.0081)
Employee	.0256 (.0239)	.0096 (.0357)	.6403a (.0524)	.5711a (.0591)	.0267 (.1050)	−.1393 (.1450)	.4027a (.0403)	.4554a (.0527)	.3057a (.0507)	.2137a (.0502)	.3907a (.0372)	.3364a (.0454)
Debt ratio	−.0001 (.0001)	.0021 (.1325)	.0017c (.0010)	.0027b (.0012)	−.0295 (.0442)	−.0987a (.0352)	.0058c (.0032)	.0058a (.0017)	.0014 (.0109)	−.0063 (.0116)	−.0002a (.0001)	.0038 (.0026)
Collateral ratio	.3134b (.1496)	.3451 (.2139)	−1.3238a (.1615)	−1.2311a (.1684)	−.6422 (.4480)	−.0338 (.5469)	−.4724b (.2001)	−.4718c (.2550)	−.9338a (.2250)	−1.0277a (.2601)	−.6376a (.1594)	−.8349a (.1901)
Profitability ratio	.1352a (.0232)	.1200a (.0294)	.0844a (.0216)	.0802a (.0287)	.8260c (.4774)	2.9633a (.4703)	.0189 (.0724)	.0768 (.0668)	.1791a (.0379)	.1106a (.0381)	.2403a (.0857)	.1705b (.0805)
Guarantee frequency	.0122a (.0026)	.0112a (.0041)	.0687a (.0045)	.0697a (.0042)	.0319a (.0089)	.0534 (.0350)	.0407b (.0206)	.0641a (.0204)	.0466a (.0050)	.0590a (.0128)	.0917a (.0141)	.1126a (.0139)
Credit guarantee amount (or Predicted CGA)	−.1954a (.0157)	−.2914a (.0230)	−.9768a (.0501)	−1.1708a (.0574)	−.3649a (.0651)	−.3722a (.0960)	−.6506a (.0684)	−.8606a (.0950)	−.9837a (.0908)	−1.1339a (.1002)	−.9377a (.0647)	−1.2866a (.0858)
Lagged credit guarantee amount (Predicted LCGA)		.0595a (.0176)		.2781a (.0381)		.0256 (.0709)		.0558 (.0820)		.2641a (.0589)		.3798a (.0640)
Dummy patent	.2913a (.0470)	.3357a (.0690)	−.1300c (.0740)	−.1126 (.0869)	.2218 (.1366)	.5340a (.1791)	.0113 (.0451)	.0504 (.0532)	.3500a (.0999)	.2371a (.0879)	.4354a (.1003)	.3771a (.1032)
Dummy KOSDAQ	.2557a (.0499)	.3123a (.0744)	.1384a (.0504)	.1482b (.0625)	.3141b (.1371)	.6240a (.1742)	.2355a (.0586)	.3232a (.0724)	.3274b (.1417)	.5332a (.1310)	.6032a (.1029)	.5259a (.1258)
Dummy KOTEC	.0064 (.0210)	−.0256 (.0257)	.0596a (.0207)	.0311 (.0233)	.1390 (.1566)	.4607b (.2099)	−.1206b (.0480)	−.1059b (.0539)	.4927a (.1024)	.6155a (.1052)	.0133 (.0774)	.0327 (.0898)
Dummy overlap	.1335a (.0218)	.1635a .0272)	.1280a (.0292)	.1424a (.0334)	.3719a (.1234)	.5951a (.1539)	.2259a (.0788)	.3078a (.0874)	.3248a (.0663)	.2544a (.0729)	.2276a (.0696)	.1434c (.0780)
Millr	1.8595a (.3307)	2.048a (.4957)	−1.1118a (.3281)	−1.1398a (.3832)	1.0204b (.5189)	2.2233a (.6866)	.1310 (.1991)	.3546 (.2640)	−.2404 (.2941)	.1400 (.3496)	−.1975 (.5309)	−.8252 (.7161)
Observation number	9,075	5,394	5,263	3,175	670	425	965	595	689	393	1,415	731
Adjust *R*-square	.0827	.1228	.3120	.4041	.2151	.3222	.2179	.3613	.2979	.3946	.2907	.4340

Note: Figures in parenthesis are standard errors. Significant at the less than 1% is (a), 5% is (b), and 10% is (c). Results are corrected for heteroskedasticity. In case of KSIC1, the regression is impossible due to lack of observations. In case of credit guarantee amount and lagged one, the predicted value is used instead when endogeneity exists

Table 5 LS estimates of the effect of credit guarantee on growth of employment

Variable	Pooled		KSIC2		KSIC3		KSIC4		KSIC5		KSIC6	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Age	−.0010 (.0027)	−.0024 (.0020)	.0011 (.0040)	.0047c (.0025)	.0029 (.0027)	.0027 (.0032)	−.0005 (.0026)	.0007 (.0024)	−.0012 (.0083)	.0044 (.0045)	.0028 (.0034)	−.0041c (.0022)
Employee	.0420a (.0098)	.0189a (.0057)	.0361 (.0228)	−.0010 (.0105)	−.0071 (.0105)	.0055 (.0143)	.0390b (.0165)	.0375b (.0165)	.0474c (.0269)	−.0021 (.0151)	.0161c (.0091)	.0145c (.0078)
Debt ratio	.00001 (.00002)	−.00001 (.0001)	−.00004 (.0002)	−.0003b (.0001)	−.0033 (.0026)	−.0041c (.0024)	−.0004 (.0006)	−.0003 (.0003)	.0018c (.0010)	.0011 (.0010)	.0001b (.00003)	.0002 (.0008)
Collateral ratio	.0252 (.0564)	−.0264 (.0348)	.0561 (.0728)	.0733c (.0392	.0556 (.0404)	.0813c (.0445)	−.0926 (.1115)	.1631 (.1105)	.1242b (.0627)	.0667c (.0374)	.1486b (.0618)	−.0137 (.0295)
Profitability ratio	−.0008 (.0018)	−.0006 (.0011)	.0002 (.0016)	.0020b (.0010)	.0100 (.0110)	.0416 (.0341)	−.0078 (.0348)	.0112 (.0128)	−.0009 (.0053)	−.0051 (.0057)	.0004 (.0118)	.0015 (.0038)
Guarantee frequency	.0021a (.0006)	.0011 (.0007)	.0027b (.0012)	.0005 (.0006)	.0010 (.0008)	−.0009 (.0044)	−.0081 (.0098)	.0120 (.0086)	.0018b (.0008)	.0054b (.0021)	.0028 (.0032)	−.0012 (.0020)
Credit guarantee amount	−.0335a (.0065)	−.0141a (.0031)	−.0346a (.0132)	−.0064 (.0043)	−.0042 (.0085)	−.0111 (.0076)	−.0122 (.0167)	−.0359b (.0175)	−.0298c (.0168)	−.0471b (.0209)	.0003 (.0064)	−.0160b (.0063)
Lagged credit guarantee amount		−.0039 (.0028)		−.0104a (.0036)		−.0106c (.0054)		−.0155 (.0159)		.0246 (.0151)		−.0044 (.0052)
Dummy patent	−.0005 (.0158)	−.0086 (.0110)	.0191 (.0301)	.0408c (.0209)	.0166 (.0156)	.0343c (.0179)	−.0408c (.0216)	.0174 (.0130)	.0331 (.0337)	.0448c (.0229)	.0393 (.0363)	.0149 (.0261)
Dummy KOSDAQ	−.0071 (.0170)	−.0062 (.0124)	−.0204 (.0214)	.0121 (.0159)	.0141 (.0153)	.0341b (.0147)	.0218 (.0347)	.0554c (.0320)	−.0389 (.0465)	−.0139 (.0356)	.0600 (.0462)	.0234 (.0390)
Dummy KOTEC	−.0048 (.0074)	−.0037 (.0030)	−.0063 (.0078)	−.0001 (.0031)	.0183 (.0131)	.0138 (.0147)	−.0239 (.0306)	.0140 (.0128)	−.0339 (.0555)	−.0276 (.0242)	−.0002 (.0313)	−.0122 (.0164)
Dummy Overlap	.0009 (.0074)	−.0047 (.0040)	−.0019 (.0109)	.0045 (.0057)	.0038 (.0110)	.0187 (.0129)	−.0393 (.0363)	.0103 (.0194)	.0197 (.0213)	.0106 (.0170)	.0364 (.0270)	−.0198 (.0146)
Millr	−.0141 (.1164)	−.0093 (.0791)	.0801 (.1348)	.1753c (.0939)	.0567 (.0360)	.1090b (.0480)	−.1202 (.0790)	.0464 (.0612)	.0387 (.1145)	−.1390 (.1124)	.4395b (.1846)	−.0740 (.1010)
Observation number	9,075	5,394	5,263	3,175	670	425	965	595	689	393	1,415	731
Adjust *R*- square	.0164	.0125	.0190	.0226	−.0077	.0317	.0096	.0803	.0067	.0720	.0212	.0190

Note: Figures in parenthesis are standard errors. Significant at the less than 1% is (a), 5% is (b), and 10% is (c). Results are corrected for heteroskedasticity. In case of KSIC1, the regression is impossible due to lack of observations. In case of credit guarantee amount and lagged one, the predicted value is used instead when endogeneity exists

Table 6 LS estimates of the effect of credit guarantee on growth of labor productivity

Variable	Pooled		KSIC2		KSIC3		KSIC4		KSIC5		KSIC6	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Age	.0008	.0593a	−.0085	−.0131	.0671a	.0768a	.0325a	.0357a	.0320a	.0441a	.0480a	.0161c
	(.0057)	(.0107)	(.0090)	(.0112)	(.0180)	(.0285)	(.0050)	(.0076)	(.0111)	(.0142)	(.0088)	(.0087)
Employee	.4166a	−.0080	.6020a	.5535a	.0372	−.1460	.3712a	.4186a	.2522a	.2253a	−.0057	.2981a
	(.0232)	(.0353)	(.0547)	(.0626)	(.1003)	(.1403)	(.0383)	(.0504)	(.0448)	(.0514)	(.0334)	(.0456)
Debt ratio	−.0002b	.0021	.0017	.0028b	−.0253	−.0939a	.0060c	.0059a	−.0007	−.0075	.0001	.0035
	(.0001)	(.0013)	(.0010)	(.0013)	(.0422)	(.0339)	(.0034)	(.0015)	(.0106)	(.0112)	(.0001)	(.0028)
Collateral ratio	−1.2598a	.3610c	−1.3811a	−1.2621a	−.7023	−.1123	−.4079b	−.6265a	−1.0472a	−1.0729a	.2395	−.7547a
	(.1237)	(.2115)	(.1667)	(.1820)	(.4345)	(.5345)	(.1778)	(.2318)	(.2231)	(.2631)	(.1579)	(.1922)
Profitability ratio	.1008a	.1201a	.0837a	.0783a	.8163c	2.9207a	.0185	.0657	.1803a	.1085a	.3354a	.1724b
	(.0201)	(.0296)	(.0216)	(.0289)	(.4784)	(.4470)	(.0595)	(.0667)	(.0380)	(.0386)	(.0931)	(.0795)
Guarantee frequency	.0348	.0099a	.0658a	.0669a	.0311a	.0572c	.0481a	.0517b	.0414a	.0492a	.0027	.1063a
	(.0027)	(.0038)	(.0046)	(.0040)	(.0087)	(.0324)	(.0184)	(.0201)	(.0049)	(.0122)	(.0124)	(.0137)
Credit guarantee amount	−.7903a	−.2783a	−.9381a	−1.1393a	−.3653a	−.3650a	−.6516a	−.8177a	−.9125a	−1.0325a	−.1173a	−1.2191a
	(.0271)	(.0226)	(.0504)	(.0573)	(.0634)	(.0950)	(.0550)	(.0949)	(.0919)	(.1065)	(.0308)	(.0868)
Lagged credit guarantee amount		.0639a		.2831a		.0390		.0690		.2023a		.3778a
		(.0172)		(.0383)		(.0711)		(.0816)		(.0701)		(.0642)
Dummy patent	−.0264	.3423a	−.1480c	−.1319	.2024	.4906a	.0465	.0367	.3048a	.1862b	.1925c	.3575a
	(.0373)	(.0681)	(.0785)	(.0931)	(.1299)	(.1748)	(.0389)	(.0511)	(.0945)	(.0882)	(.1020)	(.1006)
Dummy KOSDAQ	.2057a	.3186a	.1586a	.1396b	.3012b	.5932a	.2241a	.2651a	.3436a	.5078a	.3160a	.5215a
	(.0391)	(.0715)	(.0504)	(.0621)	(.1306)	(.1700)	(.0457)	(.0675)	(.1307)	(.1283)	(.1031)	(.1212)
Dummy KOTEC	.0266	−.0226	.0648a	.0272	.1198	.4509b	−.1014b	−.1177b	.5102a	.6152a	.0209	.0521
	(.0175)	(.0255)	(.0201)	(.0234)	(.1503)	(.2061)	(.0395)	(.0524)	(.0886)	(.1023)	(.0816)	(.0904)
Dummy overlap	.1910a	.1687a	.1295a	.1408a	.3682a	.5794a	.2554a	.2999a	.2942a	.2357a	.4571a	.1803b
	(.0186)	(.0268)	(.0286)	(.0335)	(.1199)	(.1530)	(.0695)	(.0867)	(.0639)	(.0740)	(.0775)	(.0788)
Millr	−1.1736a	2.1331a	−1.1874a	−1.2190a	.9554c	2.1157a	.2174	.3094	−.3188	.2141	3.2290a	−.5063
	(.2659)	(.4895)	(.3479)	(.4130)	(.4935)	(.6724)	(.1850)	(.2563)	(.2803)	(.3543)	(.6114)	(.7328)
Observation number	9,075	5,394	5,263	3,175	670	425	965	595	689	393	1,415	731
Adjust *R*-square	.2747	.1212	.3058	.3885	.2134	.3145	.2709	.3524	.3018	.3563	.1220	.4153

Note: Figures in parenthesis are standard errors. Significant at the less than 1% is (a), 5% is (b), and 10% is (c). Results are corrected for heteroskedasticity. In case of KSIC1, the regression is impossible due to lack of observations. In case of credit guarantee amount and lagged one, the predicted value is used instead when endogeneity exists

up, credit guarantee frequency enables guaranteed firms to achieve good performances in general. On the contrary, the effect of credit guarantee amounts is ambiguous in that there is difference between the contemporary effect and the lagged effect. On the other hand, guarantee amounts fails to increase or maintain employment in both contemporary and lagged model.

One of the reasons why the provision of credit guarantee did not contribute to employment is that guaranteed loans were used as operating capital or to refund high interest liability rather than investment in Korea. SMEs have tried to increase their competitiveness through severe reconstruction programs rather than investment. Environmental change in international trade led to restrain SMEs pattern in hiring employees, as well. While Korean firms suffered from financing in unfavorable circumstances, Chinese products based on low- or medium-level technology encroached on the market to a large extent. Consequently, many firms, even the competitive, moved their plants to China or Southeast Asia in search of reduced labor costs.

It seems that there is inefficiency in the allocation of public resources. Like the survival case, firms on KOSDAQ or those with high profitability show better performance in growth of sales and productivity. This implies that credit guarantees were distributed to superior applicants, which could have financed for themselves or from the market without credit guarantee. In addition, the overlap of provision from both KCGF and KOTEC increases sales and productivity. In accordance to the policy goals to speed up recovery from the deep depression after the economic crisis, credit guarantee institutions increased the amount of credit guarantee; the balance of guarantee was 6.1% of GDP in 2003.Inevitably, the surplus in credit provision resulted in failure to distinguish competitive firms from incompetent counterparts properly. This disturbed the original goal of credit guarantee of improving the financial opportunity for low ranked firms. Consequently, such firms became more vulnerable to financial shock.

Size and age have effects on the growth of sale and labor productivity. Generally, larger and older firms are superior to smaller and younger ones.[14] Like a survival case, age is one of the most important factors to manage crises. The gap between large-sized enterprises (LSEs) and SMEs originates in R&D investment partially. Only LSEs to some degree could accumulate potential capability, technology superiority, by R&D investment to take advantage of the opportunity during the economic crisis period. Better performance of firms holding patents indicates importance of technology based on R&D. On the other hand, risk and liquidity show inconsistent results across industries.

6 Summary and conclusions

In the early 2000s, a huge blow affecting the survival of SMEs, especially of NBTFs, was experienced with the collapse of venture bubble in Korea. The depression of the venture capital business forced SMEs to heavily depend more on the public credit system. In this study, impacts of credit guarantee on the survival and performance of SMEs are analyzed at the firm level. The data covers the economic recovery period after the collapse of the venture bubble. To measure effects of credit guarantee, we analyzed the relationship between credit guarantee, survival, and productive performance of firms. In sum, credit guarantee frequency enabled guaranteed firms to achieve good performances in general. On the contrary, the effect of credit guarantee amounts is ambiguous in that there is difference between the contemporary effect and the lagged effect. Therefore, we conclude that credit guarantee satisfied partially its goal to alleviate SMEs' difficulty in acquiring finance and to stabilize employment. It promoted growth of sales and productivity, but failed to stabilize employment.

Credit guarantee helps SMEs to restore their business activities at a lower social cost. However, the surplus in distribution of credit guarantees prolongs the withdrawal of inefficient firms and deprives new entrants of the opportunity to access scarce credit. If credit guarantees are distributed not only to competitive firms, but also to inefficient enterprises, debtors tend to lose incentive to

[14] Of course, there are differences across industries.

innovate and improve their competitiveness. Inefficient firms distort the market, which reduces efficient firms' ability to generate enough profit to improve their competitive power. Therefore, credit guarantees should be deployed carefully so that they best contribute to the achievements of policy targets.

Size and age play a decisive role in survival and performances. High survival likelihood of old firms establishes that management experience is the critical fact in economic crisis. Larger and older firms are superior to smaller and younger counterparts in performances. The polarized performances between LSEs and SMEs are attributed to the fact that LSEs accumulates growth potential by investment into R&D and innovative restructuring while SMEs suffer from shortage of sources to finance and lose competitiveness consequently.

Although this study generates interesting results in that it is the first attempt to analyze the effects of credit guarantee on SMEs in Korea at the firm level, there are some limitations. Owing to limits in the data collection, this study uses a pseudo panel data instead of the original raw data. Inevitably, partial loss or distortion of information could occur in the process of data transformation. The impossibility of identifying individual observations prevents clear comparison between guaranteed and non-guaranteed firms. Moreover, the relatively short observation period is not sufficient to include the long run effects of the economic crisis of late 1990s. Therefore, it is necessary to supplement these limitations in future datasets or alternatively merge data sources with available registered data.

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Appendix

Table A1 Distribution of firms by sector, data type and funds

KSIC	Mining and Quarrying		Manufacturing		Construction		Wholesale and retail trade		Business activities		The others	
	Original	Pseudo	Original	Pseudo	Original	Pseudo	Original	Pseudo	Original	Pseudo	Original	Pseudo
KCGF	180 (.12)	119 (1.00)	56,957 (36.51)	6,223 (52.42)	17,100 (10.96)	907 (7.64)	69,816 (44.76)	1,386 (11.67)	4,990 (3.20)	882 (7.43)	6,943 (4.45)	2,355 (19.84)
KOTEC	74 (.17)	51 (.61)	29,076 (65.02)	5,272 (63.57)	2,250 (5.03)	565 (6.81)	7,783 (17.41)	878 (10.59)	4,183 (9.35)	631 (7.61)	1,350 (3.02)	896 (10.80)
Total	254 (.13)	170 (.84)	86,033 (42.87)	11,495 (57.00)	19,350 (9.64)	1,472 (7.30)	77,599 (38.66)	2,264 (11.23)	9,173 (4.57)	1,513 (7.50)	8,293 (4.13)	3,251 (16.12)

Figures in parenthesis mean percentage share

Table A2 Distribution of firms by location, type of data and funds

Location	Seuol, Gyunggi, and Inchon		Gangwon		Daejon and Chungcheong		Pusan, Daegu, Ulsan, and Gyungsang		Gwangju, Jeonla, and Jeju	
	Original	Pseudo	Original	Pseudo	Original	Pseudo	Original	Pseudo	Original	Pseudo
KCGF	89,397 (57.31)	3,839 (32.34)	3,429 (2.20)	954 (8.04)	12,038 (7.72)	2,008 (16.91)	36,891 (23.65)	3,026 (25.49)	14,231 (9.12)	2,045 (17.23)
KOTEC	23,669 (52.93)	2,820 (34.00)	903 (2.02)	535 (6.45)	3,920 (8.77)	1,422 (17.15)	12,927 (28.91)	2,175 (26.23)	3,297 (7.37)	1,341 (16.17)
Total	113,066 (56.34)	6,659 (33.02)	4,332 (2.16)	1,489 (7.38)	15,958 (7.95)	3,430 (17.01)	49,818 (24.82)	5,201 (25.79)	17,528 (8.73)	3,386 (16.79)

Figures in parenthesis mean percentage share

Table A3 Distribution of firms by size, type of data and funds

Size	Small		Medium		Large	
	Original	Pseudo	Original	Pseudo	Original	Pseudo
KCGF	149,146 (95.61)	10,989 (92.56)	6,598 (4.23)	744 (6.27)	242 (.16)	139 (1.17)
KOTEC	40,720 (91.06)	7,592 (91.55)	3,863 (8.64)	614 (7.40)	138 (.30)	87 (1.05)
Total	189,866 (94.6)	18,581 (92.14)	10,461 (5.21)	1,358 (6.73)	375 (.19)	226 (1.12)

Figures in parenthesis mean percentage share

Table A4 Distribution of firms by year, type of data and funds

Year	2001		2002		2003		2004	
	Original	Pseudo	Original	Pseudo	Original	Pseudo	Original	Pseudo
KCGF	36,339 (23.30)	3,006 (25.32)	36,998 (23.72)	3,194 (26.90)	43,038 (27.59)	3,119 (26.27)	39,611 (25.39)	2,553 (21.50)
KOTEC	15,038 (33.63)	2,439 (29.41)	10,968 (24.53)	2,248 (27.11)	12,371 (27.67)	2,203 (26.56)	6,339 (14.18)	1,403 (16.92)
Total	51,377 (25.60)	5,445 (27.00)	47,966 (23.90)	5,442 (26.99)	55,409 (27.61)	5,322 (26.39)	45,950 (22.89)	3,956 (19.62)

Figures in parenthesis mean percentage share

Table A5 Correlation between variables

	Age	Employee	Sales	Dept ratio	Collateral ratio	Profitability ratio	Guarantee frequency	Guarantee amount
Age	1	.3734 (.0001)	.4046 (.0001)	−.0114 (.0001)	.0545 (.0001)	.0486 (.0001)	.0949 (.0001)	.3009 (.0001)
Employee		1	.6952 (.0001)	.0117 (.1039)	.0380 (.0001)	.0083 (.2493)	.1807 (.0001)	.6467 (.0001)
Sales			1	.0107 (.1345)	−.2143 (.0001)	.1487 (.0001)	.1584 (.0001)	.7256 (.0001)
Dept ratio				1	−.0132 (.0612)	.0016 (.8210)	−.0018 (.7956)	.0352 (.0001)
Collateral ratio					1	−.0253 (.0004)	−.0335 (.0001)	−.0618 (.0001)
Profitability ratio						1	.0040 (.5763)	−.0154 (.0307)
Guarantee frequency							1	.2306 (.0001)

p-Values in parenthesis

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