THE JOURNAL OF THE KOREAN ECONOMY, Vol.10, No.3 (December 2009) 367-393

Estimation on Performance of Credit Guarantee to SMEs by 'Treatment Effect' Method*

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Credit guarantee is a system to guarantee loans so that firms can get loans from banks more easily than otherwise. We develop a model to analyze the effect of the credit guarantee where failure of firms is an explicit possibility and firms, banks, credit guarantee institutions and the government together determine credit guarantee. Two observations emerge. First, rather than using the probability of repayment as the only criteria, the expected amount of profit of firms need be considered in providing credit guarantee. Second, even though firms demand guarantee (as they believe they can make profit from loans) in reality many firms fail. It is necessary to educate firms about business cycles. There is a minimum 'Treatment Effect' of the credit guarantee by the Korea Credit Guarantee Fund (KODIT) to firms for the period between 2001 and 2005. However, the usual estimation result is only a part of the 'Treatment Effect' of the guarantee as made clear by the model. The benefits to firms that could have perished if not guaranteed and to the workers working for these firms are not easily measured.

JEL Classification: G2, C3
Keywords: credit guarantee, performance evaluation, treatment effect method

* Received April 6, 2009. Accepted November 8, 2009. This thesis is based on a research for Korea Credit Guarantee Fund. We appreciate the support of Korea Credit Guarantee Fund (KODIT), comments by the participants of seminars in KODIT and Korea Applied Economic Academy and Hyung Bae, professor of Dongguk University and advice on econometric methodology by Jinwook Chung, professor of Yonsei University and Yonghwan Rho, professor of Seoul Women's University. We thank the detailed comments and suggestions of referees.

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1. INTRODUCTION

Credit guarantee is necessary in a credit society. Banks require credit guarantee often when small and medium-sized enterprises (SMEs) apply for loans. Banks can lend money to SMEs with greater ease if the credit guarantee institutions support firms. If there are SMEs failed to repay loans, the credit institutions compensate banks for the failed SMEs. Many SMEs have the ability to repay loans, but do have not enough credit history or collateral.

The credit guarantee institutions hold a key post in the financing of SMEs in Korea. However, they have been criticized for providing excessive credit guarantee after the Foreign Exchange Crisis of 1997 in Korea. The ratio of the balance of guaranteed loan to GDP has been very high compared to that in other high-income countries.

While this criticism aroused interest in the performance of credit guarantee, there are limited studies mainly due to insufficient data. In order to estimate the performance of credit guarantee properly, the financial statements for firms both guaranteed and not guaranteed with similar characteristics should be available for a period before and after the firms are guaranteed.

The necessary financial statements of firms were received from KODIT (the largest credit guarantee institution in Korea) and performances of firms are estimated. First, a model is developed to analyze the effect of credit guarantee on firms and other agents in the economy. Then, estimable equations are derived from the model and the performance of guarantee by KODIT via ‘Treatment Effect’ method is estimated.

The amount of credit guarantee is determined by the interactions of SMEs, banks, KODIT, and the Korean government. The credit guarantee is determined after the investigation of the behavior of these four players. Using the ‘Treatment Effect’ method (which is currently popular in policy evaluation) we estimate the effect of credit guarantee for firms using equations derived from the model and discuss policy implications.

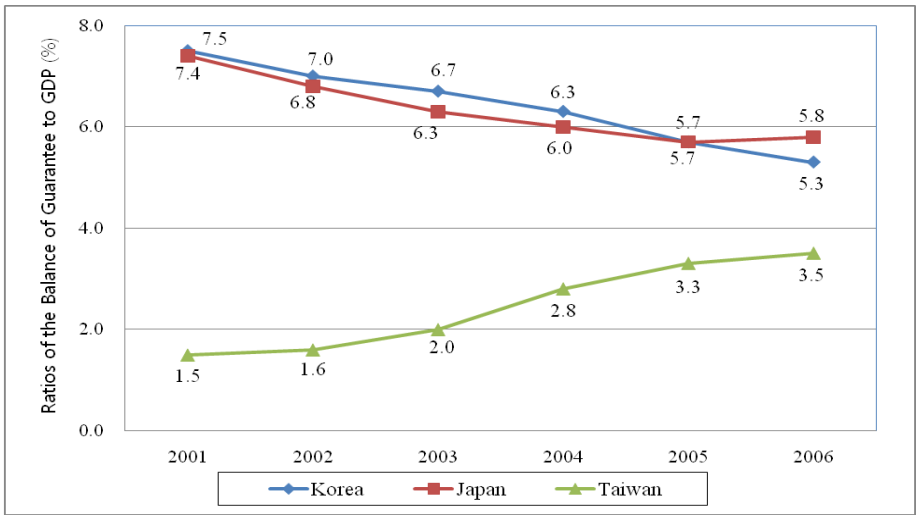
2. CREDIT GUARANTEE IN KOREA

Many promising SMEs do not have a collateral or credit history when they apply for bank loans. If these SMEs fail to receive loans, it is a loss to the Korean economy; as a result the Korean government established credit guarantee institutions to enable these firms to receive loans. When a bank is not sure whether a firm can repay a loan, it can ask for a guarantee from a credit guarantee institution. If the firm fails to repay the loan, the guarantee institution pays the loan to the bank on behalf of the firm. Then the firm becomes a debtor to the credit guarantee institution. If the firm cannot pay back the loan to the guarantee institution, the representatives of the firm become credit delinquents.

Three organizations are charged with credit guarantee service for SMEs in Korea: Korea Credit Guarantee Fund (KODIT), Kibo Technology Fund (Kibo), and Regional Credit Guarantee Foundations (Regional CGF). KODIT was established in 1976 to support SMEs generally. Kibo was established in 1989 to support high-tech SMEs. Regional CGFs were organized in 16 large self-governing regional governments starting with Kyunggi province in 1996 and finishing with Jeju province in 2003 to support small local firms.

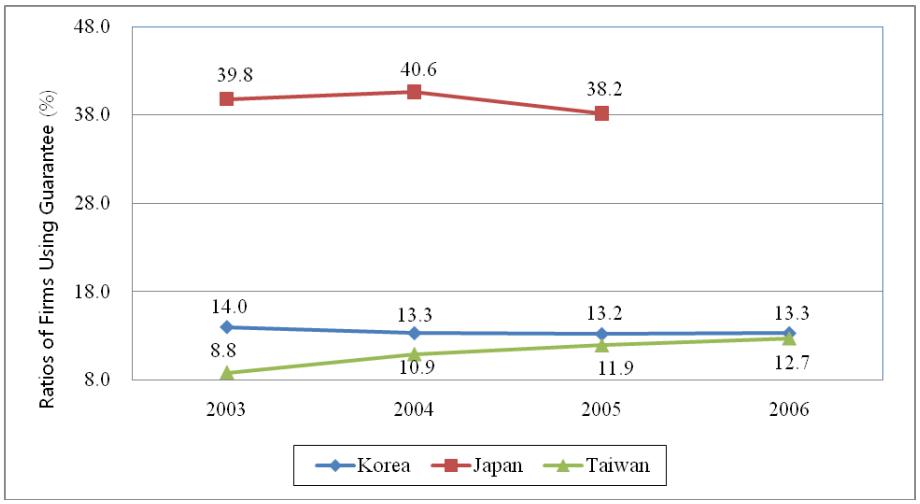
The guarantee balance of public guarantee institutions is $46.5 billion at the end of December 2006 and reached 5.2% of GDP (figure 1). Even though this is considerably smaller than 7.4% of 2002, it is still high compared to those in the EU and the USA. However, the percentage of firms receiving a guarantee is average in Korea. The percentage of firms using guarantee in Korea does not reach to 20% while it is around 40% in Japan (figure 2). The guarantee balance of KODIT is $31 billion covering 65.3% of the public guarantee institutions (table 1).

Figure 1 Ratios of the Balance of Guarantee to GDP in Korea, Japan, and Taiwan



Source: KODIT.

Figure 2 Ratios of Firms Using Guarantee in Korea, Japan, and Taiwan



Note: Ratio of Firms Using Guarantee = Number of Guaranteed Firms / Number of Firms.
Source: KODIT.

Table 1 Balance of Guarantee for the Korea Credit Guarantee Institutions and Number of Guaranteed Firms

(Unit: hundred mil. won, no.)

	KODIT		Kibo		Regional CGF		Total	
	Guarantee Amount	Number of Firms	Guarantee Amount	Number of Firms	Guarantee Amount	Number of Firms	Guarantee Amount	Number of Firms
1998	214,542	122,486	113,402	55,574	2,247	3,050	330,191	181,110
1999	196,209	196,570	113,055	65,313	5,594	14,376	314,858	276,259
2000	202,784	259,405	124,977	74,215	10,114	29,867	337,875	363,487
2001	232,672	272,019	137,448	80,641	15,058	50,076	385,178	402,736
2002	256,885	267,494	141,263	89,159	19,326	70,023	417,474	426,676
2003	283,933	270,886	144,190	100,363	23,124	89,347	451,247	460,596
2004	305,148	252,544	133,766	80,685	26,269	99,688	465,183	432,917
2005	291,528	223,430	115,013	67,642	34,133	136,228	440,674	427,300
2006	285,250	203,512	111,508	51,659	40,327	164,386	437,085	419,557

Source: SMBA, Re-cited from "Developing Financing for SMEs under New Financial Environment," Oh *et al*. (2007).

3. LITERATURE REVIEW

In the past, the impact of credit guarantee tended to be overestimated in Korea since much of the value added of guaranteed firms are ascribed to guarantee. Although a few works improved the estimation method to correct this overestimation, it is still problematic since they maintained the basic structure of previous analyses.

Two known works that made improvements in estimating the performance of the credit guarantee institutions are the Korea Institute for Industrial Economics & Trade (KIET) in 2001 and the Korean Association for Governmental Accounting in 2006. Even though these works tried to lineate

the part of value-added of firms caused by guarantee these are not adequate to the extent they do not utilize individual firm data. In addition, these works assumed that the investment could not occur without guarantee. Since the investment is possible without guarantee, the effect of guarantee should be estimated after excluding the investment that could have happened without guarantee.

The 'Treatment Effect' method is designed to overcome the previously mentioned problems. Explained well in Econometrics textbooks (for instance, Wooldridge 2001), this method is widely used for policy evaluations. It defines the effect of a policy to a firm as performance differences of this firm between the actual situation of receiving and the imaginary situation of not receiving a policy support. For the theoretical situation, the data of firms that failed to receive the policy aid are used after correcting for the differences between the theoretical failed situations of the firms that succeeded to receive the policy support and the firms that failed to receive the policy support.

There have been at least two studies in Korea closely related to this estimation method. The first estimated the performance of policy loans supplied by the Small Business Corporation (J. Kim *et al*., 2006) and the other estimated the performance of the government R&D support by the Korea Institute of Industrial Technology Evaluation and Planning (2006).

There is also a paper that estimated the performance of the KODIT as this paper did but with a somewhat different approach (Oh *et al*., 2006). They used firms without guarantee for the given period with similar characteristics of guaranteed firms as controlled firms, while here firms that applied but failed to receive guarantee are used as the controlled firms. The method adopted here uses the fact that firms applied for guarantee are basically the same type of firms. However, this method requires elusive data. The method adopted by Oh *et al*. is less demanding on data, but it cannot utilize the data of firms that applied and then failed to receive guarantee.

A few Japanese researchers are notable in the literature in the estimation of

the effect of Japan's credit guarantee[1] (Uesugi *et al*., 2006), the work estimating the policy for promoting creative companies in Japan (Nobuyuki and Honjo, 2005) and the work that estimated the policy for innovation support to small businesses (Motohashi, 2001). These works and this research are similar in using firms not receiving a policy program, as a control group and the correct selection bias. However, there is a large difference in modeling between Japanese works and this one. In Uesugi *et al*., guarantees are assumed to be randomly awarded to firms; however, this is not the case in Korea.

4. MODEL[2]

There is a need to understand the activities of the four players (SMEs, banks, KODIT, and the government) that determine credit guarantee; this study searches for the motives and identifies the interactions.

4.1. Behavior of Borrowing Firm

A key feature of SMEs is that they are unstable. Consequently, a model of SMEs should be developed so that the possibility of liquidation can be explicitly considered. Firms choose to liquidate if they believe that the present value of expected revenue is lower than that of expected expenditures for the period until money runs out.

To establish a value function of SMEs with the possibility of market liquidation, we introduce some notation. $P(\geq 0)$ is a firm's probability of

[1] Japan provided a 30 trillion yen (10% of total loan) credit guarantee to 1.7 million SMEs that covers most SMEs under 'A Special Credit Guarantee Program for Financial Stability' between 1998 and 2001, at 100% of guarantee ratio without guarantors or credit rating. However, the insolvency rate was 7% worth 2.1 trillion yen and rate of return on assets increased by 0.5% for the firms receiving credit guarantee.

[2] This model is based on the public guarantee system used by Korea where the representative(s) of a firm is (are) ultimately made responsible to the compensation made by guarantee institutions to banks.

continuation in the mind of the manager, U is the value of the firm[3] when it continues its business, and V is the value of the firm when it liquidates. V is the sum of claims and the liquidation value[4] after subtracting debt. Then, the equation, (1) follows. It also represents the objective function of a firm.

$$W = PU + (1-P)V. \tag{1}$$

W denotes value of a firm. When a firm receives a loan L from a bank the probability of continuation, the firm's values when the firm continues and that when the firm fails are affected. A change of a firm's value by loan is represented as,

$$\frac{\delta W}{\delta L} = \frac{\delta P}{\delta L}U + P\frac{\delta U}{\delta L} - \frac{\delta P}{\delta L}V + (1-P)\frac{\delta V}{\delta L}. \tag{2}$$

$(\delta U / \delta L)$ and $(\delta V / \delta L)$, each indicates change in the firm value of continuation and liquidation by obtaining a loan. $(\delta P / \delta L)$ is change the in probability of continuation. It is possible to rearrange the equation (2) to (3).

$$\frac{\delta W}{\delta L} = \frac{\delta P}{\delta L}(U-V) + P(\frac{\delta U}{\delta L} - \frac{\delta V}{\delta L}) + \frac{\delta V}{\delta L}. \tag{3}$$

Assume that a firm completes the investment as soon as a loan is secured from a bank at the beginning of the year and repays the loan and the end of the year. Assume that R is the expected net revenue[5] of the firm from the loan, r is the bank's interest rate on the loan, then the change in the expected

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[3] On the assumption that firms keep doing business, U is the net present value of cash flow that is comprehensively decided after considering values such as sales, the amount of orders received, and business improvement for future performance.

[4] This is the size of assets that could be retrieved when a firm is disposed in the least amount of time. This corresponds to the value that could be obtained by disposing the production equipment or real estate.

[5] The net revenue is revenue caused by assets obtained with the loan after paying for labor and other cost.

firm value of continuation is $(\delta U / \delta L) = R - L(1 + r - \gamma)$, and the change in the expected firm value of liquidation is $(\delta V / \delta L) = R - L(1 + r - \eta)$. γ and η are the value of new assets in terms of ratio of L in cases of continuation and liquidation when the firm purchases a building or equipments for investment. A building or an equipment is more valuable when the firm which purchased uses it, that is, $\gamma \geq \eta$. Then, the equation (3) is changed as follows.

$$\frac{\delta W}{\delta L} = \frac{\delta P}{\delta L}(U - V) + P(\gamma - \eta)L + (R - L(1 + r - \eta)). \quad (4)$$

A firm is willing to make a loan when the sum of the net revenue from a loan and the increase of assets through an investment could make loan payment possible. This observation can be written as the inequality (5).

$$R > L(1 + r - \eta).^{6)} \quad (5)$$

With the condition (5), it is possible to tell more about the equation (4). Consider the general case that a firm's value of continuation is bigger than that of liquidation. When the condition (5) is satisfied, the probability of continuation, $(\delta P / \delta L)$, will increase. Then all terms in the equation (4) are positive.

Proposition 1: *If a firm's value of continuation is bigger than that of liquidation and the sum of the expected net revenue and the asset increase of the firm by a loan are bigger than the loan repayment, getting the loan increases the firm's value.*

If the condition (5) is not satisfied, the first and third term of the condition (4) has a negative value each and the second term has a positive value. In

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6) The reason to use 'η', the case of liquidation in evaluating the increase of asset value by investment reflects that entrepreneurs approach investments with care.

general, the loss of the firm's value by a decrease of probability of continuation and the loss from investment is larger than the difference in the value of the new asset added by the loan between when the firm survives and fails.

Proposition 2: *If a firm's value of continuation is bigger than that of liquidation and the expected net revenue by a loan is smaller than the loan payment, it is likely to lose the value of the firm if the firm receives the loan.*

In case that a firm's value of continuation is less than that of liquidation, the first term of the equation (4) has a negative value. Even if the second and third terms have positive values by satisfying the condition (5), a firm's enhancement is undefined since the first term has a negative value. If the condition (5) is not satisfied, the first and second terms have a positive value and the third term has a negative value. If the firm's value of continuation is significantly smaller than that of liquidation, and the net gain from investment is not significantly negative, a firm could seek for a loan even in this case.

Proposition 3: *If a firm's value of continuation is less than that of liquidation, the firm undertakes a loan only if the gain from investment with the loan is large.*

A firm is supposed to be risk-neutral. However, a firm may be willing to take risks. In this case, the probability distribution of net revenue and the utility function should be introduced. It is possible to show that firms preferring risk may want to make a loan even when the expected net return to investment is negative.

A firm could raise money even if it fails to receive a guarantee. This is an important observation since this is a basis to use the 'Treatment Effect' method as the empirical method later. Suppose the expected net revenues are R_1, R_0, the loans are L_1, L_0, the lending rates are r_1, r_0 for a firm, for the

case of getting a loan by guarantee and not getting guarantee in each case. The fee rate for guarantee service charged by KODIT is k. Then the following equation (6) needs to be satisfied in addition to the equation (5).[7)]

$$(R_1 - L_1(1+r_1+k)) > (R_0 - L_0(1+r_0)) \geq 0. \quad (6)$$

The fee rate for guarantee service is included since this study focused on the case where a firm cannot get a loan without credit guarantee. $R_1 - L_1(1+r_1+k)$ and $R_0 - L_0(1+r_0)$ are equal to or larger than 0. That is because the investment is assumed not to be planned if a negative value is expected.

Then the value of loan and guarantee is the left-hand side term after deducting the right-hand side term of (6). The value of guarantee is same as the value of the loan since the firm cannot receive a loan without guarantee.

Banks perform the loan screening in order to identify firms with difficulties in repaying loans. A bank provides a loan after securing collateral or the guarantee certificate in many cases. KODIT also performs screening to discover the firms that are qualified for receiving guarantee. KODIT issues the guarantee certificate after securing one or a few guarantors.[8)]

When the firm cannot repay the loan, KODIT repays on behalf of the firm that it guaranteed. However, the representative of the firm becomes credit delinquent if they cannot repay the loan to KODIT. This system induces a firm not to apply for a loan haphazardly and keeps the managers prudent after obtaining the loan.

[7)] Symbols of γ and η are omitted from now on for notational simplification. There are limited effects on the results.

[8)] The guarantors are the ones who promise to pay to KODIT if the borrowing firm fails to repay a loan. There are limitations in asking people for guarantors. In case of proprietors, the representative and the person in charge of business, the participant in business as a direct descendant of the representative of the firm can be subject to the duty of the guarantors. In case of corporations, the representative, the real manager, a director being an oligopolistic stockholder, the participant in business as a spouse or a direct descendant of the representative can be subject to the duty of the guarantor.

Firms borrow money when they expect net positive return to investment. The fact that there are many firms that could not make loan repayments implies that the managers of the firm often experience unexpected events. Loss occurs not because firms anticipate loss, but because firms do not understand the circumstances in which firms are placed.[9)]

4.2. Behavior of Banks

A bank provides a loan to a firm when the gains from lending a loan exceed the cost of raising a loan. From this point, firms need be differentiated since the interest rate charged on a loan could vary by firm. The inequality should be satisfied in the following equation.

$$p_i(1-d_i)L_i + (1-p_i)x_iL_i + r_iL_i > L_i(1+\rho+\delta). \quad (7)$$

p_i is the firm i's repayment rate on a loan expected by a bank, x_i is the guarantee ratio that KODIT compensates the bank in case of subrogation (<1),[10)] d_i is the discount rate on the expected repayment rate of the bank toward SME i, ρ is the bank's cost in raising loan, δ is the fee rate that the bank pays in the form of contribution to KODIT at the year end, L_i and r_i are the amount of the loan and the interest rate charged to firm i. The first term of left-hand side in the inequality (7) is the expected revenue from the firm's redemption, the second term is the expected revenue when the firm fails redemption, and the third term is the interest revenue. The right-hand side is the cost of raising a loan and the operational cost. By the assumption that the interest on a loan is taken off in advance before lending, the interest on the loan r_iL_i is always set to be collectable whether the firm pays off the principal or not.

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9) There are firms that apply for guarantee with the intention to abscond with the loan. However, to the extent that the representatives of the firms are made to assume the responsibility of repayment of loan, it is limited (at least in Korea).

10) The guarantee ratios are different depending on financial institutions and the guarantee object like general loan or corporate note or trade financing.

The contribution of banks to the credit guarantee institutions is not imposed on all kinds of loans. Instead, it excludes loans for facilities. In this case, δ is 0. The discount rate of d_i reflects the tendency that a bank is reluctant to provide a loan to an SME due to the high cost of collecting information about the firm and a tendency to avoid risks. The incidence of loss may not be the reason for a bank to provide loans through the guarantee institutions for SMEs. It is rather that banks are conservative in lending to keep the confidence of depositors and its ability to create profit in other businesses than lending to SMEs.

Banks contribute to KODIT for loans, equivalent to additional charge, that are indirectly related to the guarantee service.[11] The contribution from banks is a kind of compensatory cost that allows banks to reduce expenses related to the information search for identifying firms' credit and the collection of bad loans. Although a bank may be tempted to require the credit guarantee certificate from every borrowing firm, it cannot always do so when there is competition among banks.

4.3. Behavior of KODIT

A credit guarantee institution awards credit guarantee to a firm for fee. The credit guarantee institution assumes responsibility for the loans by banks to guaranteed firms. The fee is used as the subrogation fund for the insolvent firm.[12]

KODIT does not limit credit guarantee to SMEs. However, large corporations usually obtain loans without guarantee. According to the 2006 annual report of KODIT, 99.5% of the guaranteed balance was directed to SMEs.

The monetary revenue for providing credit guarantee to firm *i* comes from

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[11] Banks pay a certain percentage of total loans to firms except for loans for facilities and consignment guarantee. This whole arrangement is a unique mechanism of Korea to help the credit guarantee institutions.

[12] From the establishment until the end of 2006, the ratio of total amount of the subrogation over the total fee is about 6.2.

firm *i*'s guarantee fee, $L_i \times k_i$ and from the lending bank's fee, $L_i \times \delta$, and expected expenditure is $x_i(1-p_i)L_i + C_i + rK_i$. Here k_i is the guarantee fee rate the firm pays, δ is the guarantee fee rate a bank pays, L_i is the guaranteed amount of loan, p_i is KODIT's expected repayment rate of firm *i*, C_i is KODIT's labor cost and general expenses incurred for guaranteeing L_i, r is the opportunity cost of fund, K_i, which is required for guaranteeing L_i. $x_i(1-p_i)L_i$ is the expected amount of subrogation.

KODIT was established to help SMEs have better access to finance and there exists a need to search for benefits other than monetary ones. The effect on the workers of firm *i* of credit guarantee comes through the increase in probability of survival of the firm and decrease in the probability of liquidation. Since the workers' utilities in cases of firm *i*'s survival and liquidation are different; their total values of survival and failure are assumed as H_{is} and H_{ie}.

When a credit guarantee results in investment, the employment of firm *i* by guarantee is likely to be increased. If ΔE_i is the increase per 1 won (Korean money unit) in employment by investment, the additional employment of $L_i \Delta E_i$ is realized.

The profits of bank also changes through lending. The profit varies depending on whether a firm with guaranteed loan repays it. However, survival of the bank will be assumed as unaffected even if the firm fails.

The benefit of the economy as a whole by guaranteeing firm *i* can be represented as in the equation (8) and the cost to the entire economy as in the equation (9), by way of equation (2). Since the value of new assets are assumed zero whether the firm survives or not (refer to footnote 11) $P\frac{\delta U}{\delta L} + (1-P)\frac{\delta V}{\delta L} = \frac{\delta U}{\delta L} = \frac{\delta V}{\delta L}$. The effect on the firm in the equation (8) comes from the condition (6). In the case of bankruptcy, the bank receives part of loan as a subrogation from KODIT that appears as a cost in KODIT.

$$\Delta p_i(U_i + H_{is} - V_i - H_{ie})$$

$$+[(R_{i1} - L_{i1}(1 + r_{i1} + k_i)) - (R_{i0} - L_{i0}(1 + r_{i0})) + \theta L_i \Delta E_i] \quad (8)$$

$$+L_i[(r_i - (\rho + \delta)) - (\rho_a - \rho) - (1 - p_i)(1 - x_i)],$$

$$x_i(1 - p_i)L_i + C_i + rK_i. \quad (9)$$

R_{i1}, R_{i0}, L_{i1}, L_{i0}, r_{i1}, r_{i0} are the expected net revenue, the guaranteed loan, and the interest rate of the loan in case that firm i receives and not receives guarantee. p_i is the probability of continuation of firm *i*. θ_i is the average change in utility for workers who are newly employed by guarantee.

$p_i[(R_{i1} - L_{i1}(1 + r_{i1} + k_i)) - (R_{i0} - L_{i0}(1 + r_{i0})) + \theta_i L_i \Delta E_i]$ is equivalent to $P(\delta U / \delta L)$ and $(1 - p_i)[(R_{i1} - L_{i1}(1 + r_{i1} + k_i)) - (R_{i0} - L_{i0}(1 + r_{i0})) + \theta_i L_i \Delta E_i]$ is equivalent to $(1 - P)(\delta V / \delta L)$ in the equation (2).

If a loan based on credit guarantee is made, then the bank increases the profit by $L_i(r_i - (\rho + \delta))$. However, it can still earn $L_i(\rho_a - \rho)$ by purchasing bonds. ρ is the cost to the bank in raising the fund. ρ_a is the interest earned by the bank besides lending money and is similar to the rate of return of government bonds. As the probability of failure is $(1 - p_i)$, the expected amount of loss to the bank is $(1 - p_i)(1 - x_i)L_i$. The net effect of guarantee to the bank is the profit earned from guaranteed loan minus the profit earned from the alternative use and the loss by the imperfect guarantee coverage.

The cost incurred from guarantee to the firm and the bank is reflected in the cost of the firm and the bank in the equation (8). The overall cost of the economy incurred from supplying credit guarantee to firm *i* is the sum of expected subrogation, $x_i(1 - p_i)L_i$, that KODIT pays, expected employment cost, and the cost of running KODIT, C_i, along with the opportunity cost of the fund (K_i) reserved for guaranteeing L_i. The sum of the compensation for the insolvency of firm *i* that the bank and KODIT pay is $(1 - p_i)L_i$.

4.4. Behavior of the Government

The credit guarantee balance by KODIT strongly depends on the government contribution, $\bar{B}$. Under the assumption that the revenue and expense of KODIT are equal, L is determined by the equation (10). k and δ are determined to achieve policy goals.

$$L = (\bar{B} - C + D) / (x(1-p) - (k+\delta)). \tag{10}$$

5. REGRESSION EQUATIONS

The first step in answering the question is to see whether guarantee-awarded firms increase profit. We estimate the effect on firms only.[13] Theoretically, only firms that believe they can make more than the principal and interest try to borrow money and ask for guarantee. KODIT provides guarantee to firms only if firms look highly probable to repay the loan. However, the calculations are based on expectations. The actual effect of guarantee is not known.

In order to estimate performance of credit guarantee to a firm, all changes in the firm's value by guarantee should be investigated as in the equation (2). Since it is difficult to survey the firm's liquidation value and the probability of survival, one has to figure out $(\delta U / \delta L)$ in the equation (2) as performance by guarantee.

Performance by guarantee, $(\delta U / \delta L)$, is defined as $(R_{i1} - L_{i1}(1 + r_{i1} + k_i)) - (R_{i0} - L_{i0}(1 + r_{i0}))$ as it is implied by the equation (6).

The performances of a firm when it receives and when it does not receive credit guarantee are compared in order to accurately estimate the performance of guarantee. However, there is a need for an alternative way of

[13] To try to calculate the cost and benefit of credit guarantee of the Korean government, banks, and KODIT is another matter and precise estimations require detailed data from banks and the government.

comparison since it is impossible to obtain the data regarding the hypothetical situation.

For the hypothetical situation, the data of firms that did not receive guarantee could be used. However, there is a need to correct the difference (selection bias) between the firms that passed the criteria and the firms that failed to pass the criteria set by KODIT for guarantee. However, it is noted that this method cannot capture the benefit of guarantee for the case that a firm perishes without guarantee.

Instead of estimating the difference of $(R_{i1} - L_{i1}(1 + r_{i1} + k_i))$ and $(R_{i0} - L_{i0}(1 + r_{i0}))$, we estimate the change in the rate of return on assets in both cases. If we examine the effect of guarantee for a firm, we compare increases in net revenue between the guaranteed and non-guaranteed situations. However, if we want to examine the effect of guarantee for many firms, it is better to estimate rate change of net revenue. In the financial statements of firms, there is no ready data for rate of net revenue change. Instead of using rate change of net revenue, we use change in the rate of return on assets for a performance indicator. If a firm succeeds to receive guarantee, it could lower the cost of borrowing and have a more proper amount of money. The performance of guarantee is the difference in the rate of return on assets between the guaranteed firms and the non-guaranteed firms during a period that includes before and after receiving guarantee. A change in the operating profit rate is also estimated. Guarantee is expected to increase the ratio of profit to net sales through the improvement of the quality of the product or the reduction of cost with the money it received as loan.

The estimation is done in two steps since the bias in the data needs to be corrected. One way to solve the bias is to use the difference in the probability of receiving credit guarantee of firms. The probability of receiving policy program (credit guarantee) is called the propensity score, or $q_{i,t}(w_{i,t})$. This is a conditional probability of receiving credit guarantee for each firm given the firm's observable characteristics.

The first step is to run a regression, taking $w_{i,t}$, a binary variable taking 1 when guarantee is received and 0 when not received at time *t*, as the

dependent variable, and other characteristics of firms as the explanatory variables at time t–1. We use variables depicting firm i's general characteristics and scale of the firm as well as those depicting the management structure and financial status at time t–1 as the explanatory variables.

The industry the firm belongs to, the age of the firm, and the number of workers is used for the general characteristics of a firm. For the scale of firm, total assets, equity capital, total sales, and interest expense are used. For the management structure and financial status, debt ratio, current ratio, and fixed ratio are used.[14] Then, the first empirical equation is given as follows.

$$w_{i,t} = \alpha + \beta X_{i,t-1} + e_{i,t}. \tag{11}$$

$X_{i,t-1}$ =(industry, age of business, number of employees, total asset, equity capital, total sales, interest expense, debt ratio, current ratio, fixed ratio). Then, we calculate $\hat{q}_{i,t}(w_{i,t})$, the 'estimated propensity score,' with the estimated parameters, and values of the explanatory variables, $X_{i,t-1}$ of firm i.

In the second step, the dependant variable is the difference between the rate of return on assets from the period (t+1), after determination of credit guarantee and that from the period (t–1), before determination. As for the explaining variables, there are binary variable indicating whether credit guarantee is received, $w_{i,t}$, the 'estimated propensity score' for correcting selection bias, $\hat{q}_{i,t}(w_{i,t})$, interaction term between $w_{i,t}$ and $\hat{q}_{i,t}(w_{i,t})$, the industry dummy variable, and the dummy variable of the year of application. For the interaction term, we use variable, $\hat{q}_{i,t}$ deducted by $\hat{\mu}$, which is the average value of $\hat{q}_{i,t}$, instead of using $\hat{q}_{i,t} \cdot \hat{q}_{i,t}(w_{i,t})$ corrects the bias incurred by using data of firms which failed to receive guarantee, as a substitute for data of the hypothetical failure case of firms that actually received guarantee. The second empirical regression is

[14] The study of Kim *et al*. (2006) is considered in the selection of variables.

$$\Delta ROA_{i,\,t+1,\,t-1} = a_0 + a_1 w_{i,\,t} + a_2 \hat{q}_{i,\,t} + a_3 w_{i,\,t}(\hat{q}_{i,\,t} - \mu) + a_4 industry_{i,\,t} + a_5 yearofapplication + u_{i,\,t}. \quad (12)$$

Coefficient a_1 of the variable $w_{i,\,t}$ is the consistent estimator of performance of credit guarantee. If $\hat{a}_1$ is statistically significant positive number, it can be said that credit guarantee raises the rate of return on assets. t–1 indicates the year, one year before guarantee review. t+1 is the year, one year after guarantee review. We pool all the data available to regress the equation (12).

6. DATA

During 2001 to 2005, the number of firms with the financial statements for the period between one year before and one year after of guarantee review is 7,341. After we remove observations with extreme values, the number of firms is reduced to 6,894. 5,659 firms succeeded to receive guarantee and 1,235 firms failed to receive guarantee (table 2).

Table 2 Number of Firms Available for Estimation

(Unit: number)

		Firms with Financial Statements	Firms with Extreme Values	Firms Examined
2001	Grty	2,293	129	2,164
	Non Grty	412	44	368
2002	Grty	1,585	39	1,546
	Non Grty	356	31	325
2003	Grty	1,226	31	1,195
	Non Grty	319	52	267
2004	Grty	591	11	580
	Non Grty	332	86	246
2005	Grty	179	5	174
	Non Grty	48	19	29

Notes: 1) Removed firms with outliers that are 10 times greater than the standard deviation.
2) Grty denotes guaranteed firms and Non Grty denotes non-guaranteed firms.

Table 3 Descriptive Statistics of Reviewed Firms for Guarantee in the Period 2001-2005

(Unit: years, workers, million won, %, number)

	Guaranteed Firms		Non-Guarantee Firms	
Age of Business	4.5	(4.7)	6.0	(6.0)
Work Force	4.6	(17.4)	23.6	(34.2)
Assets	1,442.8	(4,587.6)	3,876.5	(11,308.0)
Capital	523.3	(1,666.2)	1,259.2	(3,622.8)
Sales	3,082.7	(6,310.3)	5,601.5	(12,851.9)
Interest Expense	26.5	(119.8)	89.7	(426.8)
Debt Ratio	256.5	(961.5)	253.3	(862.4)
Current Ratio	401.2	(1,186.3)	329.7	(820.5)
Fixed Ratio	109.9	(394.1)	125.6	(431.6)
Operating Profit Ratio	2.4	(14.7)	0.3	(23.8)
Return on Assets	117.5	(546.3)	5.9	(19.4)
Number of Firms		5,659		1,235

Notes: 1) Each number is the average value of a variable and the number in parenthesis is standard deviation.
2) Debt ratio is liability divided by capital, current ratio is current asset divided by current liability, fixed ratio is fixed asset divided by capital, operating profit ratio is operating profit divided by sales and return on assets is net income divided by assets.

Table 3 show the difference of characteristics between firms that received guarantee and those not for the period 2001-2005. The guaranteed firms are younger and smaller in employees, assets, capital, sales, and interest expenses. However, there limited difference in the debt ratio, current ratio, and fixed ratio. Not only the ratio of operating profit to net sales of the guaranteed firms is higher than the non-guaranteed firms, but also the return on assets of the guaranteed firms is higher than the non-guaranteed firms. A

typical firm with guarantee is younger and smaller in assets but better in returns than firms without guarantee. Therefore, it is possible to view that deserving firms are rewarded generally.

7. ESTIMATION

Regressions are run for each year. The regression result of the equation (11) is summarized in table 4. For each year in 2001-2005, the probability of receiving guarantee is higher for older firms, firms with smaller worker size, and firms with larger sales. In addition, the probability is higher for firms with larger assets, lower capital, and interest expense in 2001. Lower capital also helped to earn a guarantee in 2003. However, in 2004, larger interest expense accompanies a higher probability of receiving guarantee that contradicts common sense.

The result of the second regression (12) is in table 5. Since the coefficient of the variable ω, is not statistically significant it is possible to assume there is no effect of credit guarantee on the rate of return to assets. However, there are two caveats to accept the results of the estimation as it appears. First, sufficient data was not possible for estimation. It may take more than a year to realize the effect of an investment before the firm guarantees are rewarded. There was great loss in terms of the number of firms for the period two years before and after the application for guarantee if we include firms for better estimation having five years of financial statements. Second, the comparison is made between firms with guarantee and those without. We could not estimate the effect on the firms that could have perished without guarantee and the firms that perished because of the failure to receive guarantee. Banks may also have increased profits by utilizing guarantee. The variable used to control the selection bias is negative, but statistically insignificant. 'Application year dummy' indicates that the year guarantee was reviewed. This dummy is included to capture any change in screening policy over time. It is not reported in the table 5, but year 2004 and 2005 have negative

Table 4 Result of Regression Analysis on Probability of Receiving Guarantee

Description	2001	2002	2003	2004	2005
Ln Age of Business	0.19***	0.22**	0.38***	0.57***	0.31
	(4.76)	(5.10)	(12.77)	(26.72)	(1.32)
Ln Work Force	–0.25**	–0.16*	–0.19**	–0.16*	–0.35
	(7.16)	(2.94)	(4.32)	(2.84)	(2.40)
Ln Assets	0.74***	–0.21	–0.02	–0.48	–0.88
	(7.29)	(0.74)	(0.00)	(1.99)	(1.09)
Ln Capital	–0.74***	0.12	–0.44	0.15	0.53
	(8.56)	(0.33)	(2.30)	(0.23)	(0.48)
Ln Sales	0.44***	0.20*	0.45***	0.23*	0.17
	(20.43)	(3.32)	(17.90)	(3.65)	(0.32)
Ln Interest Expense	–0.13**	0.06	0.02	0.10	0.01
	(3.95)	(0.79)	(0.11)	(2.48)	(0.00)
Debt Ratio	0.00**	0.00	0.00	0.00	0.00
	(5.91)	(0.55)	(1.89)	(0.20)	(0.09)
Current Ratio	0.00**	0.00	0.00	0.00	0.00*
	(4.07)	(0.18)	(0.04)	(0.01)	(2.72)
Fixed Ratio	0.00	0.00	0.00	0.00	0.00
	(3.41)	(0.98)	(0.52)	(0.22)	(0.06)
Constant Term	–3.64	–0.99	–1.17	0.44	4.08**
	(35.63)	(2.37)	(3.29)	(0.44)	(6.40)
Industry Dummy	Included	Included	Included	Included	Included
Observed Measure	2,532	1,871	1,462	826	203
Likelihood Ratio	58.42	27.35	50.22	44.61	17.38

Notes: 1) Wald Chi-Square value is in parenthesis.
2) *, **, *** each indicates the statistical significance of estimation at the level of 10%, 5% and 1%.

Table 5 Result of Regression Analysis on Change of Return on Assets

ω	$\hat{q}$	Interaction Term	Industry Dummy	Application Year Dummy	No. of Obs.	Adjusted Coefficient of Determination
9.83 (0.85)	–34.01 (–0.70)	–51.80 (–0.72)	Included	Included	6,894	0.01

Note: *t*-value is in parenthesis.

Table 6 Result of Regression Analysis on Change of Ratio of Operating Profit to Net Sales

ω	$\hat{q}$	Interaction Term	Industry Dummy	Application Year Dummy	No. of Obs.	Adjusted Coefficient of Determination
4.96 (1.22)	12.48 (0.73)	–16.81 (–0.66)	Included	Included	6,894	0.00

Table 7 Descriptive Statistics of Main Variables

	Guaranteed Firms	Non-Guaranteed Firms
Difference in R.O.A.	34.48 (2,182.79)	–1.24 (25.96)
Difference in Operating Profit Ratio	0.58 (20.41)	–3.01 (94.54)
$\hat{q}$	0.60 (0.18)	0.45 (0.18)

Note: Standard deviation is in parenthesis.

coefficients meaning that the increase of the rate of return to assets for the firms guaranteed is smaller in these years than 2001, reference year. The result of the 'industry dummy' is not reported in the table 5 too. However, the wholesale and retail industry dummy produced a statistically positive value implying the effect of guarantee is higher in this industry than in other industries.

Using change in the ratio of operating profit to net sales as dependant

variable does not make much difference as shown in table 6. We could not find any statistically significant result. To understand why the regression did not produce statistically meaningful results, we calculated the averages of dependent variables and the explanatory variable for selection bias (table 7). The sign of the average is positive for firms with guarantee and negative for firms without guarantee for both dependent variables. However, the large numbers of standard deviation implies that dependent variables are too scattered to provide any statistically meaningful results. The propensity score of guaranteed firms is somewhat higher than that of non-guaranteed firms.

8. CONCLUSION

This paper consists of two parts: a theoretical part and empirical part. A model with a few unique features is presented for the theoretical part. The first model explicitly allows for the possibility of a firm's failure, second, the model is designed to be consistent with the empirical technique of the 'Treatment Effect' method, third, the model reflects Korean institutions like owners of the credit-guaranteed firms that undertake the final responsibility for repaying the guaranteed loan. For the empirical part, the performance of credit guarantee is estimated using the 'Treatment Effect' method. There was no positive effect of the guarantee. This contrasts with the work of Oh *et al*. The data used in this paper is different from that of Oh *et al*. The availability of data seems to govern the estimation method. While we used firms who applied and failed to receive guarantee from KODIT as the controlled firms Oh *et al*. used firms who did not use guarantee and had similar characteristics with guaranteed firms.

The model presented in this study shows that the estimated performance is only part of the performance of guarantee because effects perished firms, the workers that benefitted from guarantee, and profit increase of banks are not taken into account; the empirical results can be interpreted differently. We

show that there is no evidence of the oversupply of guarantee during the examined time period for KODIT.

Emphasized is that the model in this paper depends on the Korean practice of where the representative of the firm takes ultimate responsibility even though guarantee institutions pay the loan for the firm. The representative of the firm becomes credit delinquent if they fail to repay KODIT.

For the future performance analysis of credit guarantee, it is recommended to establish a system that encourages the accumulation of guaranteed firms' data as well as data of unwarranted firms that have applied for guarantee.

Recessions seem to be a main cause to make firms fail since firms seek guarantee when they expect positive return on loans; proper education on the effect of recessions on firms needs be provided to SMEs.

The ability for screening firms should be also persistently improved through the specialization of reviewers and the refinement of the credit evaluation system.

The credit guarantee institutions can be described as social venture capital. They provide credit guarantee to firms that cannot obtain loans from banks and settle loans in case of insolvency. However, they receive nothing when guaranteed firms succeed. The role of a credit guarantee institution as social venture capital justifies the intervention of the government. Government can reduce the risk by supplying credit guarantee at a subsidized price when the risk to start a firm is too high. The appropriateness of subsidization is determined by the performance of guaranteed firms.

The motivation of this research was whether there was too much credit guarantee offered to firms. The results show that there is no evidence of the oversupply of guarantee. Now Korea is experiencing a financial crisis again and credit guarantee is used as an important tool to support SMEs.

There are no better tools to support SMEs in financing than credit guarantee during a financial crisis. However, the government needs to prepare what to do after the financial crisis. It is not easy to reduce the level of guarantee. When the demand of the Korean economy returns to the normal, the amount guaranteed need to gradually return to normal levels.

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