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A MAXIMUM MULTIPLICATION RATIO OF GUARANTEED LOANS FOR THE CREDIT GUARANTEE FUND WITH ZERO SURPLUS ASSUMPTION : THE CASE OF THE CREDIT GUARANTEE FUND FOR FARMERS & FISHERS IN KOREA*

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I. Introduction

A credit guarantee program has been used as an alternative for external credit rationing. Commercial financial institutions are not likely to lend money to a borrower who does not have collateral. Hence, small farmers or entrepreneurs often failed to borrow money, even though they have very favorable investment plans. If someone guarantees small farmers' creditworthiness so that they can borrow money at an appropriate rate of interest, they would increase their income without making anyone worse off. That is, this system brings about a Pareto improvement.

A credit guarantee program is a mechanism that an institution supply creditworthiness to a borrower who wants to be guaranteed for borrowing money, while money lenders can get back the loans and interests from the guarantee institution when the borrower does not repay.

The amount of credit guarantee fund is not necessarily the same with that of outstanding loans guaranteed because it is not likely to happen that all guaranteed borrowers will not repay the loans. It is

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desirable that the credit guarantee institution needs to have minimum amount of fund for the non-repayment cases. If the institution has more money than repayment needs, then it means that there is unused money. If the institution has less, then the guarantee system can not be kept on. In other words, there exists an optimum level of fund size at which the social cost of the credit guarantee program is minimized. The optimum level can be expressed as a rate which is termed as the multiplication ratio of guaranteed loan(MRGL) hereafter. A limit of the MRGL is legally regulated by the government. A legal limit of the MRGL usually gives a sufficient range for the worst case that may happen. However, if the legal limit is too low, there must be inefficient resource allocation. Therefore, to reduce resource loss from keeping too much fund is another side of Pareto improvement as mentioned earlier.

The optimum MRGL depends on the size of probability of loan loss, i.e. risk of non-repayments, and the purpose of the credit guarantee institution. If the risk of non-repayment is high, the optimum MRGL would be low and vice versa. Thus, low MRGL with low risk level of non-repayment means that there are unused funds, while high MRGL with high risk of non-repayment implies that the funds will run short of guaranteeing loans. In the former case, raising the MRGL will increase investments so that social production will increase, but the latter case means that resources are not used productively. If the purpose of credit guarantee institution is profit maximizing, the optimum MRGL will be a point where marginal revenue is equal to marginal cost. However, if the purpose is zero profits(or surplus), then the optimum MRGL will be determined at a point where total revenue equals total costs, and the MRGL at this point will be higher than the profit maximizing MRGL assuming the revenue exceeds the cost in some range.

Since the Credit Guarantee Fund for Farmers and Fishers(CGFFF) of Korea is a public institution and its purpose is to reduce the portion of external capital rationing in rural financial markets, the zero profit assumption is reasonable. Therefore, the optimum MRGL is equivalent to a maximum MRGL.

The CGFFF was allowed to guarantee loans 15 times as much as the amount of fund until 1994. This legal MRGL is the same as that of Korea Credit Guarantee Fund or the Korea Technology Credit

Guarantee Fund, which are operated for middle and small scale firms, although the loan loss of CGFFF is remarkably smaller than that of the other credit guerantee institutions. The former shows considerably large surplus(revenue minus expenditure), while the latter shows large negative surplus because of large loan losses. This figure suggests that the fund of CGFFF may not be used efficiently to guarantee farmers and fishers due to the given legal MRGL. On the other hand, demand for credit guarantees have rapidly increased so that the CGFFF could not guarantee loans sufficiently by the early 1994. Thus, the Fund requested the government to contribute more money. It might not be wise to increase fund size without adjusting the legal MRGL. If the legal MRGL was raised to a level enough to be safe, the CGFFF might not need so much money as the amount with the given legal MRGL. These facts motivate us to search a maximum MRGL of CGFFF under the assumption of zero surplus.

There are few literatures related to this field. Han(1992) presented a model to determine the optimum MRGL with given fund size. But it is very complicate and requires much detailed accounting data, so it cannot be easily applied to the case with limited accounting data.

The purpose of this paper is to search a maximum MRGL of CGFFF in Korea. In the second section, the system of CGFFF will be described and its performance will be briefly discussed. In the third section, the modeling of maximum MRGL with zero surplus is presented. It is usual that credit guarantee institutions are public institution rather than commercial institution since the business of guaranteeing credit for the poor is not likely to be profitable. The purpose of the public credit institutions of Korea is to serve firms with weak creditworthiness. In other words, the purpose of the institution is not profit maximization. In the fourth section, the results of empirical results of the MRGL will be presented and the implication is discussed. In the fifth section, policy implication will be suggested as concluding remarks.

II. The System and Performance of CGFFF in Korea

The credit guarantee program for farmers and fishers is implemented by the CGFFF established under the National Agricultural

Cooperatives Federation(NACF). The CGFFF has a top level decision making organization called the Credit Guarantee Appraisal Committee, and is supervised by the Ministry of Finance and Economic Planning. The National Agricultural Cooperatives Federation has responsibility for management of the CGFFF, while the cooperatives related to agriculture and fisheries supply farmers or fishers with loans guaranteed by the CGFFF.

The CGFFF is allowed to guarantee only the loans for productive use. The certified borrowers pay 0.3 ~ 0.5 percent of the guaranteed loans as fees to the CGFFF. On the other hand, the CGFFF can deposit the funds at financial institutions or invest in government bills. The fees and interest revenues from deposits and investments are the main source of revenues of the CGFFF.

The fund sources of CGFFF are the contributions of the government, of the National Agricultural Cooperatives Federation, the Fishery Cooperatives Federation, and the current operating surplus(net revenue) of CGFFF. The fund size of CGFFF was 172.6 billion won(Korea currency unit) at the end of 1993(Table 1).

The first credit guarantee program in Korea was introduced in 1961 by the Industrial Bank of Korea established to strengthen financial support for small and medium enterprises. The CGFFF was established in 1972, and the National Agricultural Cooperatives Federation has been in charge of the operation of the fund. The purpose of CGFFF is to support farmers or fishers who cannot borrow money to invest in agriculture or fishery production because of weak creditworthiness even though they have good opportunities of investments. However, the CGFFF had not played a significant role in rural financial markets until the mid 1980s. Although it was hard for small farmers to borrow money from rural financial institutions, the CGFFF would not give credits for them. Actually there was little difference between general financial institutions and the CGFFF in screening borrowers. That is, the credit rationing problem to small farmers was not reduced. Thus, the small farmers with no collateral were obliged to depend on informal financial markets when they wanted to borrow capital.

From the end of 1970s to the mid 1980s, the debts of farm households had rapidly increased under the unfavorable conditions to agriculture, so that the government made several measures to reduce

the burden of debts for the years of 1987 ~1989. One of those measures was to replace the debts from informal financial markets with cheap cooperative loans such as of agricultural, livestock and fishery cooperatives. Since the small farmers and fishers did not have enough collateral for new debts from the cooperative loans, the government increased the fund of CGFFF to guarantee the new cooperative loans. Since then, the screening criteria of CGFFF has steadily relaxed to encourage the use of the fund of CGFFF.

The fund size has increased rapidly since 1987, when the government supplied 43.4 billion *won*(Korean currency unit) to CGFFF in order to support the Measure of Replacing Informal Financial Market Debts. Another main source of the fund is the current operating surplus, which had been increased from 14.7 billion *won* to 75.2 billion *won* for 1985 to 1993. Thus, the composition of CGFFF fund source is that the share of government contribution to the fund was 49.7 % of the total fund and the accumulated current surplus of the fund was 43.6% in 1993, while the share of the other fund source was only 6.7%.

The fact that the accumulated current operating surplus is the

TABLE 1 The Trend and Sources of CGFFF

unit : hundred million *Won*, %

Year	Contributions			Accumulated current surplus	Total
	Government	Agri. & fishery organizations	Agri. & fishery cooperatives		
1972	1(33.4)	1 (33.4)	1 (33.2)		2 (100.0)
1975	11(45.8)	1 (4.2)	9 (37.5)	3 (12.5)	24 (100.0)
1980	11(12.0)	1 (1.1)	45 (48.9)	35 (38.0)	92 (100.0)
1985	11(4.0)	2 (0.7)	114 (41.6)	147 (53.7)	274 (100.0)
1988	517 (58.0)	2 (0.2)	116 (13.0)	257 (28.8)	892 (100.0)
1990	617 (53.6)	2 (0.1)	116 (10.1)	417 (36.2)	1,151 (100.0)
1991	667 (51.5)	2 (0.1)	116 (9.0)	510 (39.4)	1,294 (100.0)
1992	667 (47.8)	2 (0.1)	116 (8.3)	610 (43.8)	1,395 (100.0)
1993	857 (49.7)	2 (0.1)	116 (6.7)	752 (43.6)	1,726 (100.0)

Note: The number in the parenthesis means the share of fund source to total amount of the fund.
Source: Credit Guarantee Fund for Farmers and Fishers(CGFFF)

second biggest fund source is not consistent with the purpose of CGFFF because profit maximizing is not reasonable operating objective of the fund. The fact may imply that the operation of the fund has been very healthy. However, the large surplus may suggest that the CGFFF is reluctant to give credits for the borrowers with weak creditworthiness so that the loss from non-repayments had been negligible.

This inference is supported the surueys by the CGFFF(1992) and Park and Hwang(1994). Park and Hwang's suruey showed that 45.7% of the guaranteed loan users applied the loans not because of low level creditworthiness but because of convenience, while the users with no collateral was only 42.6%.

The performance of CGFFF is shown in Table 2. The amount of guaranteed loans was 2,538.4 billion *won* at the end of 1993, which is 28 times more than the amount of 1980. The guaranteed loan size of 1993 is 98% of the loan size that CGFFF can guarantee, which means that there is little residual legally. Therefore, the CGFFF should raise the size of fund to meet increasing demand for credit guarantee as long as the legal MRGL is not raised.

TABLE 2 The Trend of Guaranteed Loan Size and Guaranteed Ratio (Guaranteed Loans/ Total Allowed Loans)

unit: 100 million *Won*, %

Year	Fund size	Loan allowance(A)	Outstanding guaranteed loans(B)	New guaranteed loans	Repayment	Guaranteed ratio (B/A)
1972	3	26	1	1		4.5
1975	24	244	167	107	22	68.5
1980	92	1,382	894	558	348	64.7
1985	274	4,110	3,461	2,280	1,733	84.2
1987	766	11,489	9,499	7,776	2,360	82.7
1990	1,151	17,272	11,237	6,041	6,313	65.1
1991	1,294	19,413	14,630	8,278	4,962	75.4
1992	1,395	20,921	19,494	11,740	7,053	93.2
1993	1,726	25,894	25,384	14,494	8,603	98.0

Note: The legal MRGL was raised from 10 to 15 in 1976.
Source: CGFFF

As mentioned above, the fact that the accumulated current surplus is large may be arguable because it may suggest inefficiency of the CGFFF due to extremely low level of the legal MRGL. The large current surplus of CGFFF is contrasted with other credit guarantee programs in Korea. The Korea Credit Guarantee Fund and the Korea Technology Credit Guarantee Fund that serve for small and medium firms has been suffering from heavy burden of losses. The ratio of loan losses to outstanding loans of the CGFFF was only 0.1% in 1993, while that of the Korea Credit Guarantee Fund and of the Korea Technology Credit Guarantee Fund were 4.6% and 5.6%, respectively in 1993(Table 3). In spite of differences in loan risk, the legal MRGLs of all credit institutions are same, which means that the regulation is not reasonable in theoretical sense. The CGFFF should be allowed to have higher legal MRGL, while the others should be regulated to have

TABLE 3 Repayment Rates on Behalf of Borrowers by the Credit Guarantee Funds

unit : hundred million *Won*, %

		Outstanding guaranteed loans	Net loan losses(repayment on behalf of borrowers)	Repayment rate on behalf of borrowers
CGFFF	1991	14,628	27	0.2
	1992	19,131	21	0.1
	1993	24,961	31	0.1
Korea Credit Guarantee Fund	1991	65,951	1,565	2.4
	1992	71,600	4,610	6.4
	1993	85,441	3,959	4.6
Korea Technology Credit Guarantee Fund	1991	14,527	517	3.6
	1992	12,749	1,493	11.7
	1993	21,767	1,224	5.6
Housing Credit Guarantee Fund	1991	18,406	2	0.01
	1992	26,293	3	0.01
	1993	34,986	4	0.01

Source : CGFFF

lower legal MRGL. Then which level of legal MRGL is appropriate?

III. Building an Equation of a Maximum MRGL

The purpose of the credit guarantee program is to alleviate external capital rationing. But the degree of alleviation effect of capital rationing is not easily measurable. To measure the effect, we need full information about rural financial markets such as borrowers, lenders, their agencies, the degree of capital rationing, and the guaranteed loan size for good borrowers who were rationed out in the financial markets, e.t.c. With limited information, the objective function of this problem cannot be appropriately and empirically defined. It is not easy to solve the problem of optimal multiplication ratio of guaranteed loan by using an usual method of maximization problem with some constraints.

This study tries to search the maximum MRGL with given revenue and costs under the assumption of zero surplus, which means that total revenue should be fully used to guarantee the loans for borrowers and for operating costs. If the original fund is decreased because of loan losses, it is considered as waste of resources due to the failure of the screening-out-method against bad borrowers. If there is positive surplus, it is considered that the operation of the fund is too conservative. Thus, total revenue should be equal to total expenditure to satisfy the assumption.

Total revenue of the fund (TR) is defined as a sum of guaranteed loan fees received from borrowers, interest revenue from depositing the fund at financial institutions or invested in securities(γ), and the other miscellaneous revenue(α). Total guaranteed loan fees depend on the amount of outstanding guaranteed loans and the rates of guarantees. Total fees can be calculated by multiplying the outstanding guaranteed loans by the average rate of guarantee(ρ). Furthermore, the outstanding guaranteed loans are equivalent to a multiplication of the original fund size(A) and the actual MRGL(λ). Therefore, the total revenue is expressed as follows in equation (1).

$$TR = A.\lambda.\rho + \gamma + \alpha \quad \cdots\cdots (1)$$

Total expenses of the fund account(EX) is defined as a sum of repayments for defaulters, wages, and the other operating expenses(C), taxes(T), and net surplus of the operating fund(K). The taxes is obtained by multiplying the tax rate(t) with gross income (TR - EX). The net surplus K is the residual of revenue calculated as gross income subtracted by the total tax, so that it is equivalent to profit in the case of firm. K should be zero at the optimal solution point of the model, since the profits should have been used to guarantee other good borrowers who had been rationed out in the financial markets.

If the fund size should not be decreased from operating losses, total revenue(TR) should exceed or equalized to the total expenses(EX), which implies that the equation (2) is always satisfied. Since the operating purpose of the fund is to get zero surplus, the purpose of this study is to find the maximum MRGL,λ, satisfying the equation. Among the variables A, ρ, γ, and α are assumed to be constant. This assumption can be rationalized in a short period since these variables are institutionally set up. Furthermore, T and K are systematically related to institutional regulation. Thus, the variables are interested in λ and C in this model. If we can get appropriate cost function C and risk of loan loss δ is known, it is easy to find optimal size of guaranteed loan ratio λ to the fund.

$$TR = A.\lambda.\rho + \gamma + \alpha \geq A.\lambda.\delta + C + T + K$$
$$= EX + T + K \cdots\cdots\cdots\cdots (2)$$
$$T = (TR - EX) \,.\, t$$
$$K = TR - EX - T = (TR - EX).(1 - t)$$

Here we assume that loan loss risk δ in the past can be used as a proxy value to true δ. Suppose that a cost function is described as a function of output(Q) in equation (3), then we can calculate a maximum MRGL as follows.

$$C=f(Q) \quad \text{s.t.} \quad Q = A.\lambda \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots (3)$$

Managerial costs are assumed to be a function of outputs only, the outstanding loan size guaranteed by the CGFFF. The cost is assumed to be independent of the prices of inputs such as labor and capital. Major portion of capital such as building and other facilities is

supplied by the National Agricultural Cooperatives Federation(NACF). The employees are hired by the NACF and the number of employees is not necessarily determined by the wage rates. Thus, the independency assumption of input prices can be regarded as not so severe problem in justifying the cost function in this study. Furthermore, the available data of the fund is only for 22 years from 1972 to 1993. Therefore, it is necessary to minimize the number of variables in order to estimate the cost function econometrically without incurring the problem of degree of freedom. The cost function is defined as the following equation (4).

$$C=f(Q)= a_0 + a_1 \cdot Q \quad \text{s.t.} \quad Q = A \cdot \lambda \quad \cdots\cdots (4)$$

The cost function shown below was estimated by using OLS. The intercept term is not statistically significant but the coefficient of output is significant.

$$C = 49.109 + 0.0051991 \cdot A \cdot \lambda \quad \cdots\cdots (5)$$
$$(0.208) \quad (18.734)$$
$$R^2 = 0.946$$

From the equation (2) and (3), the maximum MRGL λ^* is obtained as following equation (6).

$$\lambda^* = \frac{a_0 + [K/(1-t)] - \gamma - \alpha}{A \cdot (\rho - \delta - a_1)} \quad \cdots\cdots (6)$$

We can obtain partial derivatives of λ^* with respect to each variable in right hand side as shown in equation (7). Let total guarantee fees $R = \gamma A$.

$$\frac{\partial \lambda}{\partial K} = \frac{1}{A.(\rho - \delta - a_1).(1-t)} < 0 \quad \cdots\cdots (7)$$

$$\frac{\partial \lambda}{\partial t} = \frac{K}{A.(\rho - \delta - a_1) \cdot (1-t)^2} < 0$$

$$\frac{\partial \lambda}{\partial \rho} = \frac{-(a_0 + K/(1-t) - R - \alpha)}{A \cdot (\rho - \delta - a_1)^2} > 0$$

$$\frac{\partial \lambda}{\partial \delta} = \frac{a_0 + K/(1-t) - R - \alpha}{A \cdot (\rho - \delta - a_1)^2} < 0$$

$$\frac{\partial \lambda}{\partial a_1} = \frac{a_0 + K/(1-t) - R - \alpha}{A \cdot (\rho - \delta - a_1)^2} < 0$$

$$\frac{\partial \lambda}{\partial A} = \frac{-(a_0 + K/(1-t) - \alpha)}{A^2 \cdot (\rho - \delta - a_1)^2} < 0$$

The equation (7) implies that λ^* is an increasing function of the average guaranteed loan rate(ρ) and the size of fund(A), while it is a decreasing function with respect to surplus(K), tax rate(t), loan loss risk(δ) and the intercept term of cost function(a_1). These relationships are intuitively relevant.

IV. Calculation Results of Maximum MRGLs

The maximum multiplication ratio of guaranteed loans for the fund (MRGL) was calculated by scenarios shown in Tables 4 ~ 6 and by using equation (6) under the assumption of zero surplus. Table 4 presents the maximum MRGLs by changing net surplus (K) and the risk of guaranteed loans(δ). If the risk of guaranteed loans and net surplus from operating funds are 0.13% and 0, respectively, then the maximum MRGL is 57.4; that is, the fund can guarantee its' 57.4 times of loans. As the risk increases with 0 surplus, the MRGL decreases. If we assume a much worse case such as the risk rate being 0.5 and 1.0 %, then the maximum MRGL with zero surplus would be 23.2 and 12.8, respectively. In the past, the highest default rate of guaranteed loans was 0.18, when the maximum MRGL could be 47.9.

On the other hand, if we change the assumption such that net surplus(K) and the original fund size(A) vary but other variables are fixed, then the maximum MRGLs are presented at Table 5. With zero surplus assumption the maximum MRGL is 23.1 which are all the same regardless of the varying size of the original fund and the net surplus. In the case of changing risk rates(δ) and average rate of guarantee(ρ), Table 6 shows the maximum MRGL corresponding to each case. If risk rate is at current level of 0.13%, average rate of

TABLE 4 Maximum Multiplication Ratio of Guaranteed Loans by Scenarios Based on Risk Rates and Net Returns

δ \ K	14.2 billion *Won*	10	5	0
0.13%	12.7	25.8	41.6	57.4
0.18	10.6	21.5	34.7	47.9
0.5	5.1	10.4	16.8	23.2
1.0	2.8	5.8	9.3	12.8

TABLE 5 Maximum Multiplication Ratio of Guaranteed Loans by Scenarios Based on Fund Size and Rates of Net Returns

K \ A	172.6 billion *Won*	10	5	0
14.2 billion Won	5.1	12.7	16.8	18.6
10	10.4	15.7	18.7	19.9
5	16.8	19.4	20.9	21.5
0	23.1	23.1	23.1	23.1

TABLE 6 Maximum Multiplication Ratio of Guaranteed Loans by Scenarios Based on Risk Rates of and Guarantee Rates

δ \ ρ	0.6%	0.5	0.4	0.3	0.2
0.13%	286.7	95.5	57.3	40.9	31.8
0.18	143.2	71.6	47.7	35.8	28.6
0.50	34.1	27.5	23.1	19.9	17.5
1.00	15.6	14.0	12.8	11.7	10.8

guarantee can be much lower with keeping very high MRGLs. When the risk rate is 0.5%(very high rate) and the other variables have current value, the current average rate of guarantee of 0.4% allows the maximum MRGL to be 23.1, but the lower rate of grantee fee such as 0.2% will allow the MRGL to be 17.5. This fact means that lowering the rate of guarantee fee conflicts with raising the MRGL. Therefore,

the calculation results of maximum MRGLs indicates that it is safe even if the legal limit of MRGL is raised to 20 or higher level for the efficiency of fund use.

V. Concluding Remarks

The credit guarantee program can be a useful alternative for external credit rationing problem. The program may bring about Pareto improvement by enhancing resource allocation efficiency; by helping good producers with no collateral and by operating efficiently without storing the credit guarantee fund uselessly in the safe. One of the efficient ways of managing the fund is to determine an optimal multiplication ratio of guaranteed loans(MRGL). The fund does not need to be so large or should not be so little.

Korean Credit Guarantee Fund for Farmers and Fishers(CGFFF) has expanded its role in rural financial markets. The outstanding guaranteed loans have remarkably increased since the late 1980s so that the CGFFF requested the government to enlarge the fund to meet its increasing demand. On the other hand, the current surplus of CGFFF has considerably increased, while loan losses are still negligible. This fact suggests that the legal MRGL be too low, so substantial amount of money is not effectively used but deposited uselessly at banking accounts. If the legal MRGL is appropriately adjusted, the CGFFF could considerably increase the credit guarantee services without incurring original fund size.

This paper focuses on building an equation of maximum MRGL under the assumption of zero surplus and applied the equation to the case of CGFFF. Though the cost function used in defining the equation of maximum MRGL was estimated with strong assumption, the results seem to be not far from reality. If the current situation at 1994 is assumed, the legal MRGL could be 20 or more, whereas the current legal MRGL was 15. Since this scenario was supposed to be much worse than the current situation, it may be said that there still exists considerable possibility of improvement.

REFERENCES

CGFFF. 1992. *The Credit Guarantee System for Agriculture and Fishery of Korea.*

GAO. 1992. *Farmers Home Administration: Billions of Dollars in Farm Loans are at Risk*, United States General Accounting Office Report to Congressional Committees.

Han, Jong-Kwan. December 1992. "An Optimal Multiplication Ratio and Original Fund Size of a Credit Guarantee Institution," *Monthly Review of Credit Guarantee*, The Korea Credit Guarantee Fund.

Park, Byoung-Woo. 1993. 5. "A Study on Alternatives for Expanding Fund Size of the CGFFF," *Monthly Review of Agricultural Cooperatives.*

Park, Seong-Jae and Eui-Sik Hwang. 1994. A *Study for Improvement of Agricultural Credit Guarantee System*, Korea Rural Economic Institute.