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Optimal Mutual Guarantee Contracts in Face of Asymmetrical Information and Capital Constraints: A Theoretical Model and a Lesson from the Case of Israeli Kibbutzim

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Abstract

Impediments in financial markets and asymmetrical information may lead to underinvestment as well as overinvestment problems**.** The model in this paper shows that a correctly priced, partial cover mutual guarantees contracts can effectively eliminates both problems. This theoretical finding lends some explanation to the global widespread and flourishing of Mutual Guarantees Associations that provides guarantees for credit to Small- Medium- Enterprises.

The findings of our model is well reflected in the economic results of the Israeli "Kibbutzim' who moved in the last 20 years from 100% full cover and without charge, mutual guarantee contracts, to ones with partial cover with reasonable charge.

Key Words: Credit Insurance, Mutual Guarantees, Asymmetrical Information, UI, OI, SME

I. Introduction

Mutual Guarantee Associations (MGAs) exist for a long period all around the world. Traditionally their goal was to encourage debt financing for Small and Medium Enterprises (SMEs), mainly agricultural ones. More recently, MGAs support equity and debt financing in the early stages of Venture Capital (VC)[1].

Lack of Finance to SME can be due to various well known reasons such as: lack of excess to equity and debt markets, short record for credit, lack of guarantees and asymmetrical information.

Credit guarantee increases borrowing capacity and reduces potential Under-Investment (UI) due to rejections of positive NPV projects[2]. However, in case that asymmetrical information prevails, guarantees may generate an incentive to accept negative NPV projects. Namely, it may lead to Over-Investment (OI).[3] The structure and the prices embodied in the mutual guarantee contracts have an important role on the negative, as well as the positive sides of the credit guarantees.

This paper is an extension of Kroll and Cohen (2000) who analysis alternative ways to overcome UI but did not discussed the impact of their solutions on OI. Kroll and Cohen (2000) methods include credit insurance and compensating balances. The common ground of these methods is the transfer of wealth from the shareholders to the bank, interest rate ceiling along these transfers. However, these methods reduce the probability of UI in the probability of OI. The purpose of this paper is to develop a theoretical model for

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[1] See a review in De Gobbi (2002) and Independent Expert Group repotrs (2003, 2005).

[2] Discussion and analysis of the effectiveness of guarantees in India see Suran (2008). On the ways to measure the effectiveness of guarantees, see Riding and Maddill and Haines (2007).

[3] There is voluminous literature that discuss and analysis the various reasons for UI and OI. See a for example: Jensen and Meckling (1976), Gali and Masulis (1976), Myers (1977), Myers and majluf (1984), jensen (1986), Shlifer A. and S. Vishny (1997), Grinblatt and titman (2001).

optimal contract of Mutual Guarantee that eliminates UI as well as OI, in face of asymmetrical information, limited excess to equity market and ceiling on interest rate. Under these reasonable and wide assumptions and over all set up, our optimal contract is a first best solution that eliminates UI without generating OI. A well priced with partial cover, mutual guarantees contract, can eliminate both UI as well as OI. The optimal mutual guarantee contract must be with positive expected NPV to the MGA and thus this contract also reduces the probability of the ruin of the MGA.

The next section provides some required definitions and the basic set up of the model. In this section we also develop a first best, optimal solution for the MG contract. The third section presents some empirical partial indications that coincide with our theoretical findings. These empirical finding are based on the experience of the Israeli Kibbutzim. The Kibbutzim shifted from 100% free of charge MGA system that provides partial cover guarantees to its members at ar reasonable price of less than 1% a year. The last section discusses the implications and concludes the paper. The first appendix provides mathematical proofs. Simple but clarifying and pedagogical numerical examples are given in the rest of the appendixes.

II. The Basic Model and definitions

At time zero, a firm i (i=1,,,,,,N) draws independently and randomly without repetitions one project, out of a given distribution of feasible projects[4]. The feasible set of projects for each firm is from a given "industry" in which the firm decides to operate. For simplicity of the presentation assume that the firms are new project ventures.

Denoted by I_j The required investment of the project j (j=1,......,m) that is drawn by firm i. The firm has limited access to the equity markets; that is, the available equity of firm i is constrained by E_i. The equity holders in firm i can use only the cash flow from the project as collateral to the bank. They cannot provide any additional personal collaterals or guarantees for the bank loan.

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[4] One can assume that the firm selects more than one project at the same time and also sorts the projects by the highest NPV. These cases can be extensions of this paper.

For simplicity of the arguments and without loosing generality we assume that each firm can borrow from only one bank.[5]

In order to avoid agency problems between shareholders and managers, we also assume that the shareholders directly manage the firm.

The posterior return of a drown project is X^*_j where $X^* \geq 0$ for all *j* and its distribution function is denoted by $g_j(X^*)$,. The implementation of the project is at time zero and the realization of the outcome X* is at time 1.

Assume also that $E_i < I_j$ for all i and j. Thus, the projects must be partially financed by debt. The bank considers lending B_i to firm i, where $B_i = I_j - E_i$. The bank loan fraction of the investment is denoted by θ_i where $0 \leq \theta_i \leq 1$. For the simplicity of the notations we avoid the subscript i and denotes E_j by E, θ_i by θ and B_i by B.

The banks operate in a competitive market and there is interest rate ceiling of r^*. Denote the face value of debt of firm i by F and the loan interest rate by r and $F = B(1+r)$. We assume that the banks and the shareholders are risk-neutrals, who make their decisions according to the maximum expected profit criterion. For simplicity of presentation we also assume that the time value of money is zero.[6]

Only the firm (the shareholders) holds unbiased posteriori estimates of the selected project's distribution of outcomes. There is asymmetrical information between the lender and equity holders since the bank holds only prior unbiased industry estimate of the outcomes of the projects, the total required investment, I_j and the amount of debt needed. The size of the selected project does not hint the bank about the specific x^*_j where $x^*_j = X^*_j / I_j$). The bank holds only an estimate of the prior to the selection distribution of $x = E(X)/E(I)$ where x is the expected return on projects in the industry. Thus, the bank assumes that the distribution of income of the specific project is the prior one according to the selected industry[7].

UI exists with respect to project j that has been selected by firm i, if it has positive NPV, but the bank refuses to finance the project. UI accrues, if the bank has to finance and $X_j = x \cdot I_j$ is assumed by the bank and

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[5] This behavior of small firms is consistent with Petersen and Rajan's (1994) finding that 82% of small firms' debt is in the form of bank loans, and that small firms borrow (on average) from only one bank whereas large firms borrow from three banks.

[6] Alternatively, we can assume complete markets for Arrow-Debreu assets. Under the assumptions of risk neutrality and zero time value of money, the price of an Arrow-Debreu asset is equal to the probability of the matching state.

[7] If the firm is not new and has investment and borrowing history, then the bank can improve his prior estimates

the bank calculates negative NPV (denoted by NPV_b), for any interest rate equal to the ceiling rate r^*. Namely;

$$(1) \quad NPV_j = E(X^*_j) - I_j > 0$$

But:

$$(2) \quad NPV_b = E(Xj)_{/X \le F} * \Pr(Xj \le F) + F(1 - \Pr(Xj \le F)) - \theta . I_{j_j} < 0$$

UI holds, if and only if, (1) and (2) hold simultaneously.

Note that (1) and (2) can hold simultaneously even when there is a symmetrical information between the stockholders and the bank.

Also note that if there is no interest ceiling, then the bank can always increase the interest rate to compensate for the default risk such that the NPV of its loans will be nonnegative[8].

Recall that F= $\theta \cdot I_j (1 + r^*)$ and rearranging (2), to find the following necessary condition for UI:

$$(3) \quad E(Xj)_{/X \le F} < \theta \cdot I_j \cdot \left[(1 + r^*) - \frac{r^*}{\Pr(Xj \le F)} \right]$$

Note that under the symmetrical information conditions, E(Xj) and X_j in (2) and (3) can be replaced by E(X*j) and X^*_j.

Inequality (3) can lead us to the following simple but not very intuitive corollaries:

Corollary 1

. Under symmetrical information, a necessary condition for UI is: probability of insolvency selected project greater than the "interest rate-ceiling ratio" r*/(1+r*), namely:

$$(4) \quad \Pr(X^* \le F) > \frac{r^*}{1 + r^*}$$

Corollary 2

[8] Following Stiglitz and Wiese (1981) and the practical "usury" low and court practice, it is reasonable to assume interest ceiling.

Under asymmetrical information, a necessary condition for UI is that the: probability of insolvency of a potential project is given in (4) but the prior cash-flow X replaces X* in (4).

The proof of the Corollaries is immediate as (4) guarantees positive bracket in (3).

According to our asymmetrical information setup, OI occurs when the $NPV_b(x \cdot I_j)$, that is calculated under the limited information of the bank, is positive, but the NPV of the specific project, $NPV(X^*_j)$, is negative while the $NPVs(X^*_j)$ of the shareholders in (5) below, is positive. Under these conditions the true NPV for the bank, had he knew all the available information that is known to the firm, is actually negative.

Formally, the conditions for OI are:

(1') $NPV_j = E(X^*_j) - Ij < 0$ and

(2') $NPV_b = E(X)_{/X \le F} \Pr(X \le F) + F(1 - \Pr(X \le F)) - \theta \cdot I_{j_j} > 0$ and

(5) $NPV_s = (E(X^*_{|X^* > F} - F) \cdot \Pr(X^* \ge F) - (1 - \theta \cdot I) > 0$

Note that according to our model, OI cannot exist under symmetrical information conditions. In case of symmetrical information the terms in (2') and (5) are equal to the term in (1'). Namely, $NPV_j = NPV_b + NPV_s$

There are several ways to overcome UI, among them are compensating balances and credit insurance.[9] The common ground of these methods is the transfer of wealth from the shareholders to the bank, g the interest rate ceiling. However, under asymmetrical information, these methods reduce the probability of UI and increase the probability of OI.

Assume that: "Credit Insurance"(CI) firms compete on insuring the credit risk to the bank. Assume the competition set to zero the NPV of the CI. Assume also that the CIs have the same information the banks have. If NPV is positive but NPV_b is negative, then credit insurance may eliminate the UI. However it is very possible that the selected project has negative NPV but the CI and the bank who posses the same prior information do not know it and they assume positive NPV prior distribution. Without the CI the bank will rejected the project. With CI the project may be accepted by the bank, but OI may be generated due to the CI.

Under zero NPV equilibrium in the financial market of banking and insurance, is the banks and the CI to raise the insurance premiums in order to eliminate the potential OI.

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[9] See Kroll and Cohen (2000) for an analysis of these methods as alternative solutions for UI problems.

If the insurance premiums are raised more then it is needed in order to set NPV=0 in the banking and insurance industry, then the probability of OI may be reduced while UI may rise. Positive NPV in the insurance and banking industry is not aligning with our competitive assumptions. According to our simplistic model only the stockholders-managers can have positive NPV. Thus, only the stockholders of the various firms under consideration have the incentive to gain more NPV by avoiding UI and OI

Avoiding OI and UI can increase the total expected NPV for the whole group of firms and thus has social merit.

The Mutual Insurance/Guarantees Associations (MIA/MGA)[10]

Below we show how MIA or MGA can eliminate at the same time both UI and OI. The basic idea is that MIA or MGA, as well as governmental investment aid agencies, have the incentive to eliminate UI and OI.

Recall that the participating firms have limited excess to the equity market. Thus, in case of MGA, the participating firms have to borrow less than under the MIA. On the other hand, it is reasonable to assume that MGA has higher managerial cost of collecting the premiums out of the profits at the ending period. In this paper we ignore this collecting cost. Thus, in our frictionless setup, MGAAA does [11]

If the MIA and MGA are "properly" structured and "correctly" price the premium, then the full benefits of avoiding both UI and 0I can be ripped by its members. Thus, i, a group of firms, with the limited equity, have an incentive to form an MIA or MGA before they draw the projects[12].

Below we analyze only the case of MGA. In appendix B we demonstrate a numerical example of both MIA and MGA.

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[10] The difference between MIA and MGA is that in the case of MIA the insurance premium is collected in advance and in the case of MGA the premiums are at the ending period and have to be collected from the profits of the participating firms the generated profits.

[11] The Kibbutzs in Israel use MGA up to 1989 and then switched to MIA.

[12] The firms know the prior distribution of potential projects, their equity constraints and the bank considerations. Thus, they can calculate the cost and benefit from joining the MIA/MGA. This cost benefit analysis is not the main issue of our paper and will not be discussed in this paper.

The MGA has the same information as the bank has. The MGA determines premium and coverage rates at time zero. The firm applies for credit. Actual inflows and outflows of the MGA are only at time 1 when the firms obtain their inflows.

The terms of the MGA are:

(a) At time 1, each firm i (shareholders) will pay to the MG a proportion α of their profits if they have a profit. Namely, the premium which is paid by firm i at time 1 is:

$$(6) \begin{cases} 0 & \text{if } x_j < F \\ \alpha\left(x_j - F\right) & \text{if } x_j \geq F \end{cases}$$

Where χ_j is the realization of X^*_j.

(b) The MGA compensates the bank that finances firm i as follows:

$$(7) \begin{cases} \beta\left(F - x_j\right) & \text{if } x_j < F \\ 0 & \text{if } x_j \geq F \end{cases}$$

The parameter α represents the premium factor, while β represents the coverage factor of the insurance program. It is assumed that $0 \leq \alpha, \beta \leq 1$.

As partially noted before, there are two major differences between this MGA and other insurance programs. First, the premium α is determined before the project is selected. Secondly, the premium is paid only out of realized profit at the ending period.. This arrangement is equivalent to a case in which the MGA has a given level of “share” in the positive profit of the firm and another level in case of a loss. This situation is closed but not equal to the situation in which the firms exchange shares of each other[13].

Only for pedagogical reasons, we finding α and β that eliminate UI .Only in a second step we find α and β that solve simultaneously UI and OI.

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[13] The Japans methods of reducing risk by sharing equity between firms is described in Nakatani (1984), Hoshi and Kashyap and Scharfstein (1991), Osano (1996) and Berglof and Perotti (1994)".

Avoiding UI

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α and β factors to lead to zero NPV for the MGA and the bank[14].

The coverage parameter β_i is derived by equating the bank's NPV to zero as follows:

$$NPV_{b_i} = \underset{/Xj<F}{E(Xj)} \cdot \Pr(Xj \le F) + E\left[\beta^* \left(\underset{/Xj<F}{F - Xj}\right)\right] * \Pr(Xj \le F) + F\left(1 - \Pr(Xj \le F)\right) - \frac{F}{1+r^*} = 0$$

$$= \left(1-\beta^*\right)\underset{/Xj<F}{E(Xj)} * \Pr(Xj \le F) + F\left(1 - \left(1-\beta^*\right)\Pr(Xj \le F)\right) - \frac{F}{1+r^*} =$$

$$(8) \qquad = \left(1-\beta^*\right)\left(\underset{/Xj<F}{E(Xj)} - F\right) * \Pr(Xj \le F) + \frac{Fr^*}{1+r^*} = 0$$

Recall that, $X_j = x \cdot I_j$, were the CI and the bank estimates only x from the prior, out of the family of the potential projects. Only x, the actual Ij and the available equity E_j are known to the MGA and to the bank at the time the firm applies for finance.

Solving (8) for β, we obtain:

$$(9) \qquad \beta^* = 1 - \frac{F \cdot r^*}{\left(1+r^*\right)\left(F - \underset{/Xj<F}{E(Xj)}\right) \cdot \Pr(Xj \le F)}$$

UI implies $\beta^* > 0$.

By imposing this requirement in (9) , we can improve the necessary condition for UI in (4):

Corollary 2

A necessary condition for UI is;

[14] The above pricing has several drawbacks. First, it can increase the motivation of the firms to select negative NPV projects. (This drawback will be eliminated later by a second pricing model that eliminates both UI and OI). The second major drawback is that with this pricing the MGA is only actuary balanced. If the MGA does not have equity funds at time zero, then ruin chances of the

$$(10) \qquad \Pr(Xj \le Fj) > \frac{F \cdot r^*}{(1+r^*)\left(F - \underset{/Xj\ <F}{E(Xj\ \ )}\right)}$$

The premium's factor α is calculated by equating the expected premiums with the expected claims so that the actuarial NPV of the MGA is zero. .

$$(11)\ \alpha * \left(\underset{/Xj>F}{E(Xj)} - F\right)(1 - \Pr(Xj \le F)) = \beta\left(F - \underset{/Xj<F}{E(Xj)}\right) * \Pr(Xj \le F)$$

One should be aware that the distribution of the cash flow from the project that is selected by the stockholders is affected by the premium, α. The premium lowers the after premium profits of the firm. Thus, stock holders will decide to apply for finance only if the selected profit has higher profitability compare to the case where no α is not charged. Namely, higher α improves the profitability of projects that the firm would like to accept. Thus, the β in (9) is also affected by the α given in (12) below[15]. Thus, both parameters α and β should be solved simultaneously (see the examples in appendix B).

The left-hand side of (11) represents the firm expected premium, and the right hand side represents the bank expected claim due to default of the firm .Both expectations are calculated by the bank and the MGA, with the partial information that they posses.

Insert β^* from (9) into (11) to obtain:

$$(12) \quad \alpha* = \frac{\left(F - \underset{/Xj<F}{E(Xj)}\right) \cdot \Pr(Xj \le F) - \dfrac{Fr^*}{1+r^*}}{\left(\underset{/Xj>F}{E(Xj)} - F\right)(1 - \Pr(Xj \le F))}$$

One can notice from (9) that β increases with the probability of default. It is easy to see in (11) that if β^* is higher and $\Pr(X_j<F)$ is higher and then α^* must be higher.

MGA cannot be ignored. However, the next extension of the model, in which both UI and OI are eliminated, requires higher premium that generates actuary surplus for the MG. Such a premium lowers the probability of a ruin

[15] This is because α effects the probability of default and the expectations of $E(X_j)$ below and above F.

As intuitively expected the impact of the lack of equity available to the firm is in the same direction as presented in the following very intuitive Proposition.

Proposition

The higher the proportion of debt, the higher is the coverage factor β and the premium factor α that leads to zero NPV for the bank and the MGA.

The intuition behind this theorem is straightforward. A formal Proof is provided in Appendix A.

Avoiding OI and UI simultaneously

The above pricing of α and β solves only the UI problem. As noted under asymmetrical information, OI may exist and the banks may finance some negative NPV projects. Increasing α above the one in (12) will increase the profitability of the project that the firm decide to accept out of the picked up projects, but on the other hand may generate again UI since the firm may abandon positive NPV picked up projects. In order to avoid UI due to the higher α, we have to find α^{**}, above the* in (12), that leads the firm to apply for finance only if NPV of the picked up project is non negative.

In order to simplify the proposed solution, assume that the various potential projects differ from each other such that a project with a higher expected return has also higher risk (in terms of standard deviation or down side risk)[16].

Below we show that under such assumptions the OI problem can be solved without reintroducing UI.

Let replace α by a higher one, α^{**} in a way that for any givenβ, if NPV of the project is negative, also the NPV for the shareholders is negative.

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[16] One can view the cash flow of the stockholders in a leveraged firm as a cash flow of a call option with a striking price equal to the face value F of the debt (see Galai and masulis (1976). The value of this option is equals to our NPV_s. The value of an option increases with the risk.

α **can be calculated by setting NPVs=0 for the project with NPV(X_0)=0, where X_0 denotes the cash-flow of the zero NPV project.

(13) $$NPV_0 = 0 = \left(E\left(X_0\right)_{x_0 \geq F}\right) * P_r\left(X_0 \geq F\right) + \left(E\left(X_0\right)_{x_0 \leq F}\right) * P_r\left(X_0 \leq F\right) - I$$

Thus:

(13') $$\left(E\left(X_0\right)_{x_0 \geq F}\right) * P_r\left(X_0 \geq F\right) = I - \left(E\left(X_0\right)_{x_0 \leq F}\right) * P_r\left(X_0 \leq F\right)$$

The α** that set the NPV of the shareholders to zero is calculated by equation (14) below:

(14) $$NPV_s = 0 = \left(1 - \alpha **\right)\left(E\left(X_0\right)_{x_0 \geq F} - F\right) * P_r\left(X_0 \geq F\right) - \begin{pmatrix} 1-\theta \\ \end{pmatrix} I$$

Insert (13') into (14) to obtain:

(15) $$\left(1 - \alpha **\right)\left(I - E\left(X_0\right)_{x_0 \leq Fi} \cdot P_r\left(X_0 \leq F\right) - FP_r\left(X_0 \geq F\right)\right) - \left(1 - \theta\right)I = 0$$

(15') $$\left(1 - \alpha ** \right) = \frac{\left(1-\theta\right) \cdot I}{I - E\left(X_0\right)_{x_0 \leq F} * P_r\left(X_0 \leq F\right) - F \cdot P_r\left(X_0 \geq F\right)}$$

Hence α_i^* is given by:

(16) $$\alpha ** = 1 - \frac{\left(1-\theta\right) \cdot I}{I - E\left(X_0\right)_{x_0 \leq F} P_r\left(X_0 \leq F\right) - F \cdot P_r\left(X_0 \geq F\right)}$$

. Unlike the previous case (when α was used), when α** is used, only non negative NPV projects are selected by the stockholders. Therefore, the higher premium α** lead to higher expected cash flow X_j and lower β** can lead to zero NPV_b

. Note also that the new α^*, which is greater than α leads to positive actuary surplus for the MGA. This expected surplus reduces the risk of ruin of the MGA. Realized profits of the MGA can be redistributed among the members of the MGA. However, the redistribution mechanism should not be related, either to the decision of the firm to join the MGA, or to the decision to accept a drawn project. Redistribution the MGA's surplus proportionally to the initial equity of each member does not distort the above decisions.

III. **The Case of the Israeli Kibbuts' MGA**

The Israeli "Kibbutzim ("kibbutzim" is plural of individual kibbutz) started about one hundred years ago as communal Jewish agricultural settlements.   In years 2006 the populations of the 267 kibbutzim was 117,700 (about 1.8% of the Israeli population)[17]. About 50 years ago the kibbutzim started to move from agriculture to industry. This shift was involved with heavy investment. In year 2006 there are 265 industrial plants in these kibbutzim that sale 27.2 billions NIS. (About 6.3 billions USD).The sale of the kibbutzim industry is 7.7% of the industrial sales in Israel.

. In 2006 this industry employs 41 thousands workers. The number of kibbutzim's members that work in industry is almost three times as those who are employed in agriculture and the income of the kibbutzim from industry is almost five time as much as the income from agriculture.

The long term shift from agriculture to industry was involved with heavy investments. Almost all these investments, as well as the other investments in the kibbutzim, were finance by debt. The ability of an individual kibbutz to issue equity was limited because of the following reasons; first, most of the Kibbutzim are SMEs. Secondly only after 1990 some kibbutz started to float IPO in the Tel Aviv Stock Exchange (TASE), the Israeli equity market. Up to that time the kibbutzim refused ideologically to share their assets with "private" investors.

More than 50 years ago the Kibbutzim generated an MGA in order to improve their borrowing capacity[18]. This MGA provided free of charge and 100% credit insurance coverage to all the debts of every Kibbutz. Formally, in case of a financial failure of one Kibbutz all the other kibbutzim had to bail him. The result of this mutual guarantee system that almost all the Kibbutzim failed and the few ones that did not failed were not able to save the others. (See Figure 1)

It worth to mention the each kibbutz operated as a Labor Managed Firm (LMF) rather than Capital Managed Firm (CMF). In addition, theoretically, the optimal level of capital per employ of LMF is higher than that of

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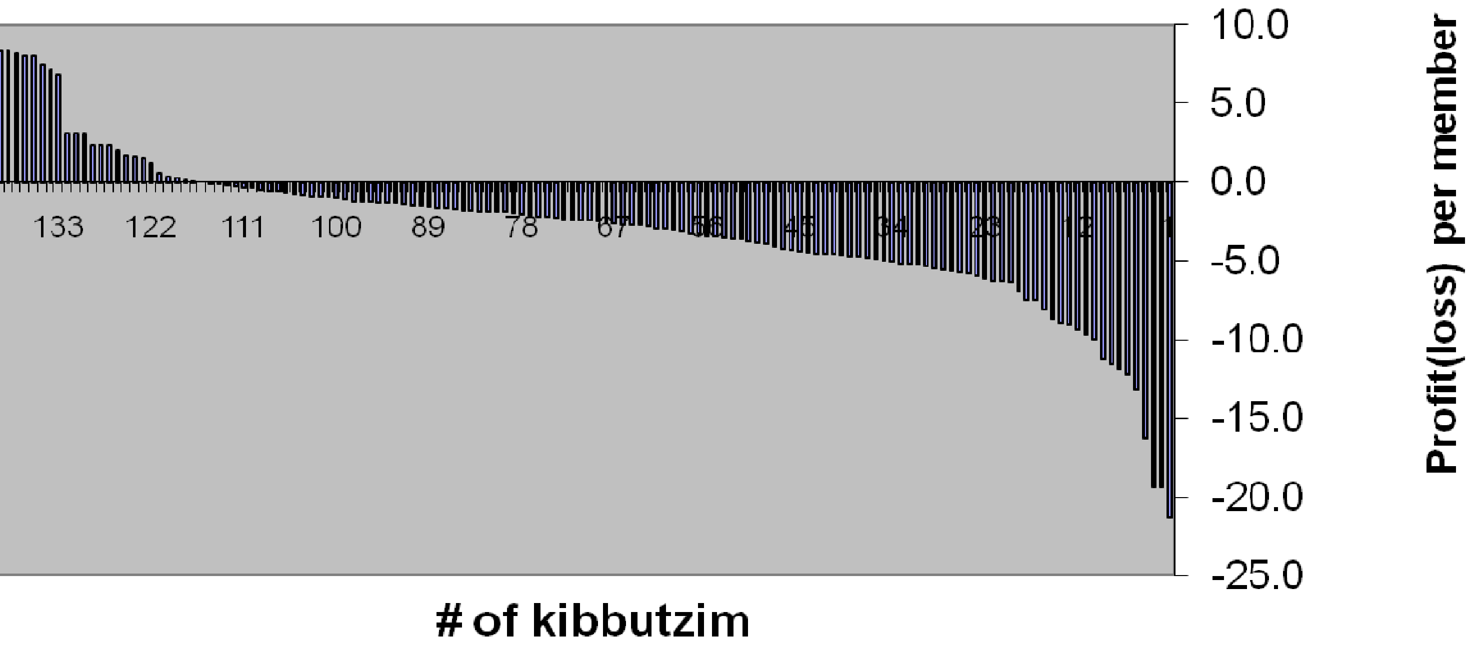
[17] All the data and numbers related to the kibbutzim and their industry is collected from internal reports of the Kibbutzim's Industry Association, from "Yad Tabenkin", Kibbutzim's Archive , Internal Reports of the Kibbutzim Movement, and the Israel Central Bureau of Statistics (ICBS)

[18] It should be noted that at that time the Israeli bank provided loans to the kibbutzim since they belived that due to the extra political power of the kibbutzim, in case of ruin of the Kibbutzim's MGA, the Israeli government will be invoved and bailed out the Kibbutzim and the ruined MGA. This assumption proved to be correct later.

CMF[19]. For these reasons, as well as the excess political power of the kibbutzim it was not surprising that due to heavy investment and consumption, each 10 years and up to year 2000, the Kibbutzim had to be bailed out of their financial crisis by a Governmental aid program[20]. The latest major crisis of the Kibbutzim was from 1985 up to 2000[21]. The MGA was not able to solve the crisis of 1985. Thus, the MGA was formally abolished in 1989[22]. The disastrous depth of the crisis is well reflected in Figure 1:

Figure 1: 1988 profit per member in United Kibbutzim Movment "TAKAM" (-000-USD)



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[19] See: Domar (1966), Meade (1972), Keren and Levhari and Byalsky(2006)

[20] In the years 1970-1982 the kibbutzim debt had been vanished simply due to the high rate of inflation and their position as holders of Non-Inflation Indexed Debt.

[21] The Israeli Government and the Israeli major banks arranged three bailout consecutive agreements along this period

[22] From 1990, The Kibbutzim, the Israeli banks and Israeli Government, established a new MGA that started to provide partial Guarantees at a price of about 0.5% a year

Source: Kroll and Rozental(1988)

According to figure1 above, in 1998 only 10 kibbutzim out of 140 made profits between 5-9 thousands USD per Member[23]. At that times the GNP per capita of the Kibbutzim is about 60% of the average GNP per capita in Israel but the consumption per capita is above the average. Namely, the main reasons for the crises are the heavy investments and consumption and low productivity[24].In addition to to financial reorganization, an important part of the solution to the kibbutzim crisis was the abolishing of the 100% free of charge MGA and the generating of a new MIA that charge a β of about 1%-0.5% a year, and has an initial equity of about 20 millions USD[25].

The new MIA of the Kibbutzim was established in 1990 and adopted the following main principles:

1. Maximum guarantees leverage of 3 times of its equity

2. The guarantee is limited for one project per kibbutz and it must be below 50% of the requested loans or 750,000 USD.

3. The charge is 1%-0.5% a year.

The 1998-2006 main operations of the "Mutual Guarantee Fund", of the Kibbutzim is given in Table 1

[23] There were 40 additional "young" Kibbutzim in United Kibbutz Movement (UKM) that were not profitable but they are not in the above figure as they were subsidized by the Jewish agency

[24] See Kroll and Polovin (1997)

Table 1: The main Operation of the Kibbutzim Guarantee Mutual Fund

Year	# Applications	Guarantees in -000- USD	Paid guarantees cases	Paid Amounts 000- USD
2006	18	3400		
2005	18	3179		
2004	36	4493		
2003	29	2961	1	
2002	23	2220	1	713
2001	16	785		18
2000	24	2101		
1999	38	5426		
1998	25	2151		
Total	**227**	**26716**	**2**	**731**

Since 1998 the amount of new guarantees that was given was only 26.7 Millions USD. In the 9 years the MIA had to pay guarantees only in 2 cases that sum to 731 thousands USD. The average annual payment is only 0.3%.

The outstanding level of guarantees in 2006 is about 7 million USD, According to the maximum leverage of 3 the maximum amount of Guarantees is about 60 millions USD. The above results indicate that in the last 9 years there was a little use of the MIA where before 1988 the amount of guarantees of the MGA was over 4 Billons USD[26].The main reasons for the negligible use of the new Kibbutzim MIA is the cost of the guarantees, the high selectivity standards of the MIA, the fact that most investment were executed by financially strong Kibbutzim in existing plants with good historical financial records rather than in new plants and the trend that started from about 1990 to close losing business where 10 years earlier each year more industrial plants were erected and losing business were

[25] The accumulated equity of the Kibbutzim's new MGA was provided mainly by the Israeli Banks and the Israeli Government as part of the financial bailing out agreement.

[26] This estimate is based on data for 140 Kibbutzim with debt of over 2.2 billions USD and interpolation for 266 kibbutzim. All the debt up to 1988 was covered by mutual guarantees.

not shut down[27]. In addition, due to the trauma of the ruin of the old MGA and the abolishing of the unlimited guarantees, the kibbutzim and the banks become much more selective in the investment and finance decisions. In 1969 there were 157 plants in 186 kibbutzim. The number of plants grew to almost 400 on 1990, but went down to 265 in 2006 as many of the industrial plant that were erected at the full guarantees period turned to be flops and were shut down. The result was a dramatic increase in profits. In 2006 the operating profits of all the kibbutzim is over 500 Million USD (9.1% of sales and an average of close to 500 USD per member) were in 1988 it was negative. The improvement of the kibbutzim since 1988 and after the abortion of the total MG system is well reflected in figures 2-3 below that present the distribution of operating profits per member in each Kibbutz in the years 1991 and 2006.

Figure 2: 1991 Operating Profit per Member, -000-USD

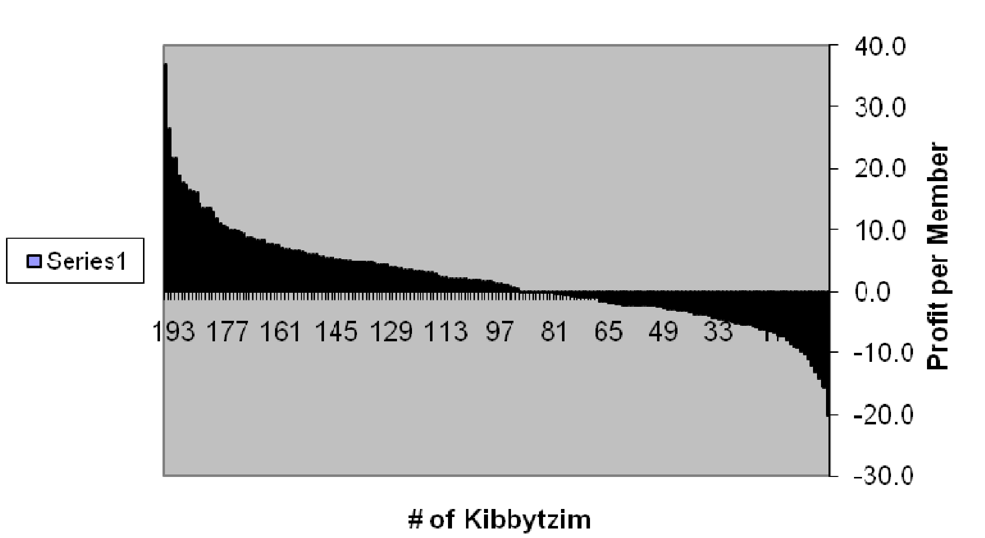

Figure 3: 2006 Operating Profit per member, -000- USD

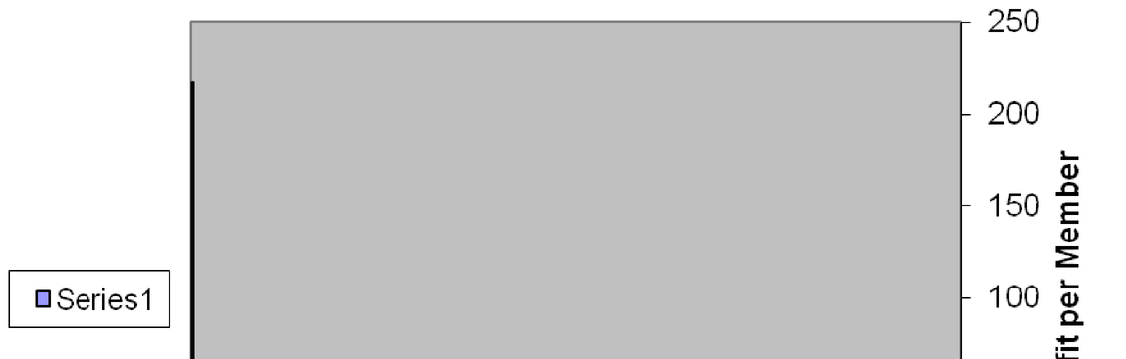

Figure 1, 2 and 3 represents the dramatic change in the results of the kibbutzim after the erection of the new MGA. In 1988 only few kibbutzim are profitable and average annual operating profit per member is about 3000 USD. In 1991 the average profit per member is even lower and it is only 1700 USD per year. However, in 2006 the annual average operating profit per member, per year soars up to about 7500 USD.Betwenn 1991 and 2006 the average size of a kibbutz shrink from 244 to 188 members. It is very possible that the trend of privatization with in most of the Kibbutzim and the implied lower level of guarantees between members of each kibbutz, caused members to leave the kibbutz. In addition, it is very reasonable to assume that the almost abolishing the mutual guarantees between the kibbutzim caused them to be much more profitable/

Summary and Conclusions

The idea of Mutual Guarantees Associations (MGA) or Mutual Insurance Associations (MIA) as a vehicle for raising fund by S Medium Enterprises (SME) with limited excess to the capital markets is not new among agricultural and industrial cooperatives and among banks. Recently MGA has been adopted to promote finance of also new technological ventures[28]. Mutual Guarantee or insurance contracts can solve Under Investment (UI) but can generate Over Investment (OI).

The UI and OI problems in this paper are due to restricted equity market and constraints on the level of interest on debt financing along asymmetrical information regarding the cash-flows of the real investment opportunities

This paper solves the MG/MI contract terms of premiums and payments that eliminate both (UI) and (OI). Thus, the MGA/MIA can create value for the participating members.

The main idea behind the MGA solution is the pricing of the insurance premium at a level which leads to zero NPV for the stockholders when the selected projects have zero NPV.

The above pricing leads to positive profits for the MGA that lower the risk of its ruin. The profit of the MGA should be shared among the participating firms in a way that should not distort the investment decision. Redistribution of the MGA profits proportionally to the initial equity of the participating firms will not distort the initial decision of the firm to join the MG and will not distort the mechanism that force the stockholders to invest only positive NPV projects. The example of the MGA of the Kibbutzim in Israel demonstrated well the negative effects of unlimited and costless mutual guarantees contracts, as well as the positive effect of well priced and structured guarantee contracts.

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Appendix A: Proof of Proposition 1

The coverage factor β^* is given in equation (9):

Rewrite (A1):

$$\text{(A1)} \quad \beta^* = 1 - \frac{F \cdot r^*}{\left(1 + r^*\right)\left(F - \underset{/ Xj<F}{E(Xj)}\right) * \Pr(Xj \leq F)}$$

Or:

$$\text{(A2)} \quad \beta^* = 1 - \frac{F \cdot r^*}{\left(1 + r^*\right)\int_0^F (F - Xj) p_r(Xj) dXj}$$

Recall that $F = (I - E)(1 + r^*)$. Therefore, when equity (E) is lower, the face value of debt (F) is larger. To see how a change in F influences β, divide both numerator and denominator of (A2) by F to obtain:

$$\text{(A3)} \quad \beta_i^* = 1 - \frac{r^*}{\left(1 + r^*\right)\int_0^F \left(1 - \frac{Xj}{F}\right) p_r(Xj) dXj}$$

It is clear that F and β^* are positively correlated. Therefore, E and β^* are negatively correlated. Q.E.D.

The premium factor α^* is given in equation (12) let rewrite it as follows:

:

$$\text{(A3)} \quad \alpha^* = \frac{\int_0^F (F - Xj) p(Xj) dXj - \frac{F \cdot r^*}{1 + r^*}}{\int_F^\infty (Xj - F) p_r(Xj) dXj}$$

Divide both numerator and denominator of (A3) by F to obtain:

(A6) $$\alpha^* = \frac{\int_0^F \left(1 - \frac{Xj}{F}\right) p(Xj)\, dXj - \frac{r^*}{1+r^*}}{\int_F^\infty \left(\frac{Xj}{F} - 1\right) p_r(Xj)\, dXj}$$

When E decreases, F becomes larger. The numerator increases, while the denominator decreases. Hence, E and α^* are negatively correlated. Q.E.D.

Appendix B: Numerical Examples

Below we present two highly simplified numerical examples. The first one is based on a binomial distribution that exhibits various features of the UI and OI problems and the alternative solutions. The second example is based on a uniform distribution that allows us to present a simple graphical solution.

Example 1: The Binomial case

We first analyze the simple and unrealistic case of **symmetrical information** regarding the distribution of future cash flows. n a second step we analyze the impact of **asymmetrical** information.

Part 1A: Symmetrical Information

A new Investment of 100 is considered at time zero (I=100).

The equity for this investment is constrained to $(1-\theta)I=(1-0.8)*100=20$

The ceiling interest r* is 20%.

For simplicity of the calculations the risk free rate r_f is set to zero.

There are two future cash flows at time 1: the High Cash Flow, $CF_h=150$ and the Low Cash Flow, $CF_l=50$.

Assume first that the probability of CF_h is 0.6 ($P_h=0.6$) and probability of CF_l is 0.4 ($P_l=0.4$). All players know the above cash flows and their probabilities

The NPV of the project under these assumptions is:

$NPV=-100+0.6*150+0.4*50=10$

The bank, which has information on these cash-flows and their probabilities[29], will refuse to finance it since the bank's NPV (denoted by NPV_b is negative, when the ceiling interest rate is charged. Namely:

$NPV_b=-80+0.6*80*1.2+0.4*50=-2.4$

Had the bank finance the project, shareholders make an extra gain above the NPV:

$NPV_s=-20+0.6*(150-80*1.2)=12.4$

The extra gain of the shareholders is the loss of the bank, namely:

$NPV_s + NPV_b = 12.4 - 2.4 = 10 = NPV.$

In order to avoid expected loss the bank denies the loan application and UI exists.

Note that under the conditions of symmetrical and complete information regarding the distributions of the cash-flows, OI is not possible. Namely, negative NPV projects will not be accepted, since either the bank or the shareholders or both must have negative NPV.

According to Eq.(10), the necessary condition for UI holds, as the probability of default is 40% =

$$\Pr(Xj \le Fj) > \frac{F \cdot r^*}{(1+r^*)\left(F - E(Xj_{/Xj<F})\right)} = 96\cdot 20\%/(1.2\cdot(96-50)) = 34.7826\%$$

Note also that UI may not exist even when the necessary condition for UI holds. When the level of equity is low, then UI may exist, but if equity is high enough then the UI may disappears.

Potential solutions for UI

In capital markets with symmetrical information, and no constraints on interest rate and equity, the above UI problem can be resolved either by increasing the amount of equity or by increasing the interest rate. Let observe these solutions.

I. Additional Equity

If equity (E) is increased from 20 to 28.6 then there is no UI[30].

If equity is above 28.6, then UI will not exist even if the necessary condition of UI holds.

II. Removing interest rate ceiling

According to Inequality (4), r*=67% solves the equation; r*/(1+r*)=0.4. For every r> r*= 67%, the necessary condition for UI cannot hold and thus there will be no UI regardless of the proportion of debt.

Note that even r* = 33% is sufficient to eliminate UI when debt financing is 100% [31].

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[29] Later we assume that the banks know only the distributions of the potential projects that differ from one another only with the probabilities CF_H and CF_L

[30] To obtain the 28.6 solves the equation NPV_b= -(100-E)+0.6*(100-E)*1.2)+0.4*50=0.

III. Credit Insurance

The bank can bypass the interest rate ceiling by credit insurance.

Let assume that the credit insurance is proportional. Namely, the insurance company pays the bank β% of a default and charge the firm a premium of c.

Competition set the NPV of the bank and the insurance firms to zero. Namely, c=3.33 and β=0.[32]lead to NPVb =NPV_{ins}=0 and solve the UI.

Note that the above insurance plan is not the only one that solves the UI.

If the bank would like to reduce its risk and apply any borrowing rate below r* and even a risk free rate, then the insurance coverage rate β and the premium c should go up to equate NPV_b= NPV_{ins}=0 for an interest rate below r*. Our set up allows any financial market equilibrium rate r by applying appropriate insurance plane that solve the UI[33].

Also note, that tthe higher the premium C, the higher is the required that must finance also the insurance premium.

One can sum up that under our set up and symmetrical information conditions only the UI problem exists and this problem can be easily solved by credit insurance without generating OI problem.

This is not so under asymmetrical information conditions that may generate also OI situations. The credit insurance can solve the UI but not necessarily the OI. However, mutual insurance or guarantees contracts, if properly can solve at the same time both UI and OI.

Part 1B: Asymmetrical Information

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[31] This rate is solved by the equation 0.6*100*(1+r*)+0.4*50-100=0.

[32] These terms are solved by:

NPV_b= 0.6*(80+C)*1.2+ 0.4*[50+β*((80+C)*1.2-50)]-80-C=0

NPV_{ins}= C-0.4* β*[(80+C)*1.2-50]=0

[33] An equilibrium risk-free lending is possible for β=1 and C=20.

Assume the firms draw randomly one project out of a family of available distributions.

Only the stockholders of the firm know the probabilities of the actual cash flows of the actually selected project.

The bank knows only the distribution family (the prior) of all the projects from which the firms draw the project. The bank and the MGA do not know the distribution of the actually selected project. The bank knows that only if $NPV_s>0$ the stockholders will apply for finance. The lowest probability of success, P_h that guarantee non negative NPV_s is 37.04% [34]. A project with P_h=37.04% has NPV=-13. Let denote this lowest P_h by P_{h*}. A selected project with P_h in the range P_{h*} 37.04% < P_h<0.5 has negative NPV but the stockholders which obtain positive NPV_s may still apply for finance.

If interest rate and the distribution family of the available projects are given, then P_{h*} can be solved, and then the bank can define the subset from which the stockholders will apply for finance. The bank can then calculate the prior **<u>expected</u>** probability parameters of the "accepted" project. Let denote the prior <u>expected probability</u> of the accepted project by $P_{h^\wedge}$. This $P_{h^\wedge}$ increases with P_{h*} and P_{h*} is affected by the level of equity, interest ceiling rate and the MG contract[35]. Let review these affects in order to come closer to the solution.

I.<u>Additional Equity</u>

As before, having more equity can solve the UI problem.

For example, if equity is 25 rather than 20. The stockholders will take any project with P_h above P_{h*}= 41.67%[36] which is above the previous P_{h*} when equity was limited to 20. Now the subset of the accepted projects by the stockholders has a higher prior expected probability of success, ($P_{h^\wedge}$), say 62% rather than the 60% that we had before. This higher $P_{h^\wedge}$ reflects the positive impact of higher equity due to less OI cases in the stockholders' admissible subset of accepted projects. If $P_{h^\wedge}$ is 62%, then NPV_b=0.62*75*1.2+0.38*50-75=-0.2 and still there is UI. If equity is even higher than 25, say 30, then the UI problem disappears but the OI

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[34] it can be found by solving p_h from the following equation:

NPV_s= P_h*[150-80*1.2]+0-20=0.

[35] The exact impact of p_{h*} on $p_{h^\wedge}$ requires specification of the distribution of the probabilities of success and failures of the potential projects. Such a specification is demonstrated in the next example..

[36] This probability is calculated by solving NPV_s=P_s(150-75*1.2)-25=0

problem remains. Note that in case UI is eliminated, the interest rate ceiling is not binding and the equilibrium interest rate will be below r*.

For example, Assume E=30, and then assume $P_{h^}$=63%. These, two assumptions coincide with no UI and an equilibrium interest rate of 16.78% and Ph* of 0.4395[37]. Since P_{h*} is below 50%, also in this case, OI may still exist.

II Lifting Interest rate ceiling

This change can also solve UI but OI will only be reduced but not necessarily eliminated.

For example assume interest ceiling is totally removed. Assume then that $P_{h^}$ is then 62%. This assumption fits equilibrium r of 22.98%[38].,

This P_{h*} of 43.59% is below 50% and therefore OI may exist. However, this P_{h*} is above 37.04% , the one that we had when interest ceiling was 20% and thus the number of OI cases shrinks.

II Credit Insurance solution:

The credit insurance can easily solve the UI by transferring wealth from the stockholders to the bank. However, we show below that credit insurance may not solve the OI problem when NPV_b= NPV_{ins} =0 .

Assume that a premium C and a proportional coverage (claim rate) of β are determined such that the equilibrium interest rate is the ceiling interest rate r* of 20%. Assume also that $P_{h^}$ under this equilibrium is

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[37] The equlibrium r of 16.78% is solved from the equation; NPV_b=0= 0.63*70*(1+r)+(1-0.63)*50-70. P_{h*} of 43.59% is then solved by the equation NPV_s=0= P_{h*}(150 –70*1.1678)-30=0.

[38] Solve the equation NPV_b= 0.62*80*(1+r)+(1-0.62)*50-80=0 and

The lower bound of the stockholder's admissible set, P_{h*} = 38.75%, fits the equation, NPV_s= P_{h*}[150-80*1.2298]-20=0

62%. A premium C of 1.989 and a proportional claim rate β of 10.82% fits this equilibrium assumptions and they are solved by setting to zero NPV_b= NPV_{ins}=0.

NPV_b= 0.62*(80+C)*1.2+ 0.38*[50+β*((80+C)*1.2-50)]-(80+C)=0

NPV_{ins}=C-(1-0.62)*β*[(80+C)*1.2-50]=0

Using the above C and β implies lower bound of P_{h*} of 38.75% [39]. This lower bound is exactly equal to 37.04%, the othat is obtained by increasing interest rate.

The equality between the equilibrium conditions under the two methods is not surprising since according to our assumptions, the credit insurance instrument perfectly substitutes the interest increase as away to transfer wealth to the lenders.

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If we cause the stockholders to reject projects with P_h below 50% and also assume that in this case the prior expected selected $P_{h\wedge}$ is 64%, then UO and OI are eliminated and the NPV of the prior expected project goes up from 10 to 14 and thus the total welfare is increased. In the next parts of the example we demonstrate that MGAs or MIAs can avoid acceptance of negative NPV projects while avoiding UI even when the only available information to the MGA/MIA is only the prior distribution thatis known to the bank. The basis for this solution is the positive NPV pricing of the MG/MI contract.

<u>The Mutual Guarantees/Insurance (MG/MI) Solutions</u>

[39] it is solved by the equation; o= P_{h*}[150-81.989*1.2]-20=0

Avoiding OI can be obtained by determining higher insurance premium that equates to zero NPV_s when a zero NPV project is picked. This higher premium leads to positive NPV for the insurer. This solution of OI be solved under zero NPV competitive conditions of the insurance and banking industry[40].

Under competition, the individual price taking the banking and insurance firms have neither the power nor the incentive to avoid the OI. However, cooperation between the firms by generating Mutual Insurance (Guarantee) Associations can lead to a policy structure and pricing that will ripe the $4 additional expected benefit and share it among the members of the associations.

Theoretically, two basic types of associations can be established.

The first one, The Mutual Insurance Association (MIA) that collects the premiums at the beginning of the insurance period and pays the claims to the bank s at the ending period.

The second Association A, that at the ending periods according to that are determined at the beginning of the period[41].

<u>The MIA solution</u>

Denote by P_0 the P_h of the zero NPV project. In our example P_0=50%.

OI is avoided if $P_{h*}=P_0$=50%. Assume that for P_{h*}=50% the prior expected probability of success is $P_{h^\wedge}$= 64%. Under these assumptions, an equilibrium premium C and β of 11.67 and 15.38% are solved by setting two equations to zero:

The first one, set to zero NPVs the zero NPV project is selected. Namely,

NPV_s=0.5*[150-B*1.2]-20=0 , Where B=80+C,

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[40] A regulator can also eliminates OI by intervention that increases the cost of the insurance, either by eliminating competition in the banking or/and the insurance industries or simply by adding regulation cost to the insurance policy. The above regulatory solutions are not recommended.

[41] As was mentioned before an MGA of the Kibbutzim in Israel existed up to 1988.

The second one set NPVb to zero when the prior expected accepted project is assumed;

NPV_b= 0.64*B*1.2 +(1-0.64)*[50+β*(B*1.2-50)]-B=0.

The prior expected NPV of the stockholders of the MIA is now;

NPV_s= 0.64*[150-(80+11.67)*1.2]-20=5.60

And the expected profit of the MIA is:

NPV_{MI}=11.67-0.36*0.1538*[91.67*1.2-50]=8.4

The total gain of the stockholders who own the MIA is 8.4+5.6=14 compare to only 10 when OI was not avoided or compare to zero when UI prevails.

Note that the positive NPV of the MIA reduces the ruin risk of the MIA. In this paper we ignore this risk[42]. Also note that in order not to distort the decision of the firm, the profit of the MIA should be distributed to the member firms in a way that is unrelated neither to the decision to accept a project nor to the result of the project. For example, If the ownership of the in the MIA and the distribution of profits are proportional to the equity of the firms, then the investment decision of the firm is not distorted. Another possibility is that all firms will have equal shares in the ownership and profits of the MGA/MIA[43].

The MGA solution.

The main deficiency of the MIA solution is the extra finance needed to finance the insurance premiums. These extra financial needs are subject to potential debt constraint due to internal or external (regulation) obstacles on the amount of borrowing to individual borrowering firm. In such a case mutual guarantee can be considered. The MGA pays claims of the bank as before, but instead of collecting premiums at the beginning of the period, each firm commit to the MI a share α of its profit if it is positive.

In our example, α of 25.93% and β of 3.38% are solved by the following two equations:

NPV_b= 0.64*80*1.2 +(1-0.64)*[50+β*(80*1.2-50)]-80=0

[42] We can further ignore this risk if we consider multi-periods. Since the MIA has a positive NPV activity in each future period the bank can finance the cost of the ruin in a given period.

[43]Though this arrangement does not distort the accepting-rejecting decision, it lower the motivation of firms with relatively high level of equity to join the MGA/MIA.

NPV_s= 0.5*(1-α)*[150-80*1.2]-20=0.

The NPV of the firm and MGA in this case are exactly the same as in the MIA cases:

NPV_s= 0.64*(1-0.2593)*[150-80*1.2]-20=5.60

NPV_{MG}=0.64*0.2593*(150-80*1.2)-0.36*0.0338 (80*1.2-50)=8.40

And NPV=NPV_s+NPV_{MG}=5.60+8.40=14

The main serious deficiency of the MGA is the cost of selecting premium at the ending period.

II A Second Example of prior Uniform Distributions

Let the prior distribution of x be uniform:

(B-1) x~U[d+δ, u+ δ]

When x, d, u, δ are calculated for one dollar of investment. δ is a random variable with zero expected value that is realized when a project is selected. The different realizations of the parameter δ represent the differences between the potential projects. Assume the amount of debt payment is bounded between the lowest and the highest possible payoffs. Namely:

(B -2) $d+\delta \le \theta(1+r^*) \le u+\delta$, where $d+\delta \ge 0$.

The expected net present value of a selected project is:

(B -3) $NPV = \frac{u+d}{2} + \delta - 1$

δ is the differences factor among the projects. Since the mean of δ is zero, the expected cash flow prior to the selection of a picked up project, is (u+d)/2. We assume in this example that the NPV of the prior expected project is positive, but the NPV to the bank (NPV_b) is negative. This situation is the incentive for the creation of the MGA. The parameters α and β that solve UI (but not necessarily OI) are set while assuming that $\delta = 0$.

Substituting $\theta \cdot (1+r^*)$ for F, and applying the normalized uniform distribution, we can rewrite (9) as:

(B- 4) $$\beta^* = 1 - \frac{\theta \cdot r^*}{\left[\theta \cdot (1+r^*) - \left(\frac{\theta \cdot (1+r^*) + d}{2}\right)\right] * \left[\frac{\theta \cdot (1+r^*) - d}{u-d}\right]}$$

Rearranging (B-4) to obtain:

(B -5) $$\beta^* = 1 - \frac{2 \cdot r \cdot^* \theta \cdot (u-d)}{\left(\theta \cdot (1+r^*) - d\right)^2}$$

The premium factor α in (12), for one dollar of investment, is given by the following equation:

(B- 6) $$\alpha^* = \frac{\left[\theta \cdot (1+r^*) - d\right]^2 - 2 \cdot \theta \cdot r^* (u-d)}{\left[\theta \cdot (1+r^*) - u\right]^2}$$

Using the relationship between α and β in (9) and β as presented in (B-5), we can rewrite α as:

(B 7) $$\alpha^* = \beta \left[\frac{\theta \cdot (1+r^*) - d}{\theta \cdot (1+r^*) - u}\right]^2$$

For givenα,β and δ the bank's NPV is:

(B -8) $$NPV_b = (1-\beta^*)\left[\frac{(d+\delta)+\theta\cdot(1+r^*)}{2} - \theta\cdot(1+r^*)\right] * \left[\frac{\theta\cdot(1+r^*)-(d+\delta)}{u-d}\right] + \theta\cdot r^* =$$

$$= (1-\beta^*)\left[\frac{-[\theta\cdot(1+r^*)-(d+\delta)]^2}{2(u-d)}\right] + \theta\cdot r^*$$

Insert β^* from (B- 5) to obtain:

(B - 9) $$NPV_b = \frac{2\cdot r^*\theta\cdot(u-d)}{[\theta\cdot(1+r^*)-d]^2} * \left[\frac{-[\theta\cdot(1+r^*)-(d+\delta)]^2}{2\cdot(u-d)}\right] + \theta\cdot r^* = \theta\cdot r^*\left[1-\left[\frac{\theta\cdot(1+r^*)-(d+\delta)}{\theta\cdot(1+r^*)-d}\right]^2\right]$$

By re-arranging (B- 9), NPV_b can be presented as a quadratic function of δ:

(B 10) $$NPV_b = \left[\frac{-\theta\cdot r^*}{[\theta\cdot(1+r^*)-d]^2}\right] * \delta^2 + \left[\frac{2\theta\cdot r^*}{\theta\cdot(1+r^*)-d}\right] * \delta$$

It is clear that when $\delta = 0$, the NPV for the bank is zero, and the bank finances the prior expected project while charging the ceiling interest rate r^*. If $\theta\cdot(1+r^*) < d+\delta$ holds, the bank will get the full amount of $\theta\cdot(1+r^*)$. Therefore, the bank's NPV for δ greater than $\theta\cdot(1+r^*)-d$ equals to $\theta\cdot r^*$, and the quadratic formula is not valid in this range.

The net present value for the shareholders is calculated by multiplying $(1-\alpha^*)$ by the expected payoffs left for shareholders, minus the equity invested by them:

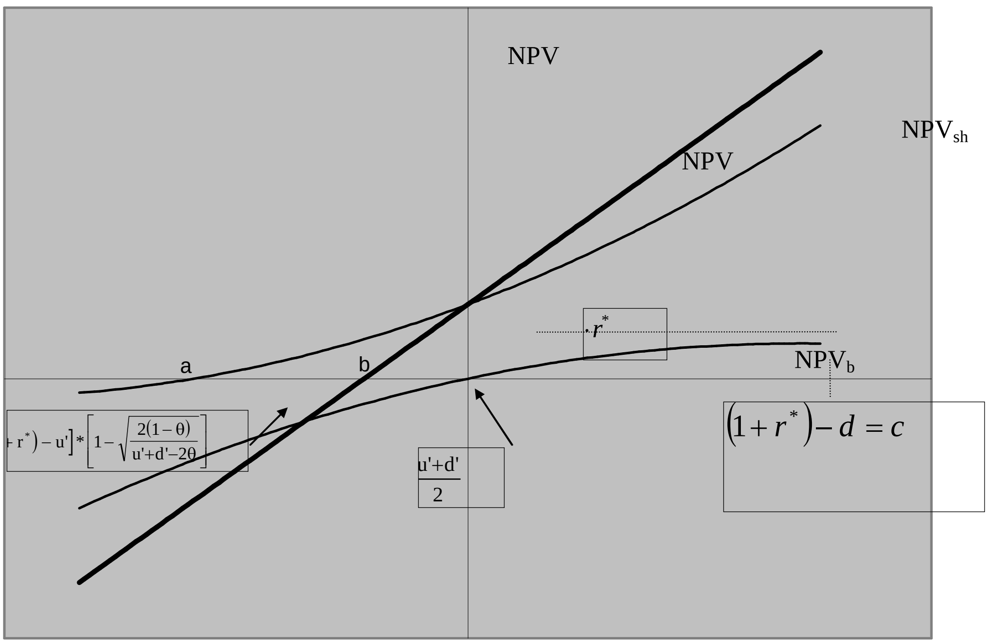
(B 11) $$NPV_{sh} = (1-\alpha^*)\frac{1}{2\cdot(u-d)}[(u+\delta)-\theta\cdot(1+r^*)]^2 - (1-\theta)$$

Inserting α^* from (B- 6),[44] and re-arranging the equation in order to present NPV_{sh} as a quadratic function of δ:

$$\text{(B- 12)}\ NPV_{sh} = \left[\frac{u+d-2\theta}{2\left(\theta\cdot\left(1+r^*\right)-u\right)^2}\right]\cdot\delta'^2 + \left[\frac{u+d-2\theta}{u-\theta\left(1+r^*\right)}\right]\cdot\delta + \frac{u+d}{2} - 1$$

According to (B -12), if $\delta = 0$, NPV_{sh} equals to the project's NPV, since the NPV for the bank is zero.[45]

The Overinvestment problem is demonstrated by the following graph, which presents the NPV's curves as function of δ:



[44] The parameter α is calculated in (16) while assuming that $\delta = 0$. This is true for the prior expected project, but for a specific project, δ could be different.

[45] Note that in the case of MIA, the project's NPV equals to the sum of the bank's and shareholders' NPVs only in the special case of $\delta = 0$. If, for a specific project, $\delta > 0$, the Association pays to the bank less than the prior expected amount (which was calculated by β, while assuming that the project is less profitable), and shareholders pay to the MIA more than the expected amount.

The horizontal axis represents different projects, each one of them is characterized by different δ. The prior expected project has $\delta = 0$. At this point NPV= and NPV_{sh} both equal to $\frac{u+d}{2} - 1$, and NPV_b=0.

The net present value for shareholders (NPV_{sh}) is zero at point a, when: $\delta = \left[\theta\left(1+r^*\right)-u\right] * \left[1-\sqrt{\frac{2(1-\theta)}{u+d-2\theta}}\right]$

The project's profits NPVis zero at point b, when: $\delta = 1 - \frac{u+d}{2}$.

The maximal NPV for the bank is $\theta \cdot r*$, achieved at point where $\delta \geq \theta\left(1+r^*\right)-d$.

,prior to selection of the projects. The graph presents possible situations, which can rise after each firm selects the it's project. If the project has δ greater than zero, the project will be executed, it has positive NPV, and both bank and shareholders have positive NPV's.[46]

If δ is negative, but greater than point (b), the project has positive NPV. The NPV for the bank is negative, but the bank doesn't hold this information. The shareholders NPV is positive and they execute this project.

If δ< b, the shareholders have positive NPV but bondholders have negative NPV and the project has negative NPV. OI. If δ lies on the left side of point (a), the NPV of the project are highly negative and the shareholders will abandon the project.

In order to solve the OI, the shareholders' profits should be reduced in a way that lead to zero NPV_{sh} at a level of δ , for which the project's NPV is zero. Graphically, the NPV_{sh} curve should be shifted downwards so that NPV_{sh} line intersects the horizontal axis at point (b). After such a change, the shareholders will lose their

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Therefore, the MIA "gains" the difference between the project's NPV, and the sum of bank's and shareholders profits. When $\delta < 0$, the opposite case prevails, namely NPV< NPV_{sh}+NPV_b.

[46] When the bank decides to finance the project, his information set includes the prior project, and α,β are set in a way that given r^*, the bank's NPV is zero. However, after the true project is revealed (only to the shareholders) the bank's NPV will be positive if δ>0 or negative if δ<0.

incentive to implement negative NPV projects. The above change can be done by increasing the premium factor from α to α** That equates NPV_{sh} to zero, for the same δ which equate NPV to zero:

NPV is zero for $\delta = 1 - \frac{u+d}{2}$. By inserting this term into the NPV_{sh} function (equation 16)) , and equating to zero, we obtain:

(B 13) $$(1-\alpha^{**})\frac{1}{2\cdot(u-d)}\left[\left(u+1-\frac{u+d}{2}\right)-\theta\cdot(1+r^{*})\right]^{2}-(1-\theta)=0$$

The premium factor which solves equation (B -13) is:

(B 14) $$\alpha^{**}=1-\frac{2(u-d)\cdot(1-\theta)}{\left[\left(1+\frac{u-d}{2}\right)-\theta\cdot(1+r^{*})\right]^{2}}$$

By using this new α^{**} the OI problem is solved. Now the expected premiums paid to the MGA/MIA is greater than the expected claims paid to the banks. Therefore, on average the MGA/MIA will increase its expected equity.[47]

We can interpret the "excess premium" as a levy, which is imposed on shareholders in order to achieve economic efficiency by preventing OI problems. Note that even after paying higher premiums, the shareholders are better off with the MGA/MIA as these systems eliminate the UI that implies refusal of the banks to finance the projects.

[47] Pricing the premium at a level of α^{**} has a secondary impact on the MIA/MGA. Now the banks know that negative NPV projects would not be implemented by the shareholders. Therefore, they change their calculation of the prior expected accepted project. Based on that a new lower β^{*} is calculated.