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RESEARCH ARTICLE

Government-sponsored microfinance program: Joint liability vs. individual liability

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Abstract: Swarnajayanti Gram Swarozgar Yojana (SGSY) is a government-sponsored microfinance program. The scheme is based on four features: group lending with joint liability, progressive lending, back-ended subsidy, and social capital. We propose a new model of SGSY having these features: group lending with individual liability, progressive lending, back-ended subsidy, and social capital. "Joint liability" clause of the existing model is replaced with individual liability in the new model. The paper shows that problem of adverse selection is removed in both models, i.e. in "SGSY with group lending and joint liability" and "SGSY with group lending and individual liability." The problem of "moral hazard" is more severe in the existing model of SGSY compared with the proposed model of SGSY. Borrowers are also benefitted from participation in the proposed scheme of SGSY than that in the existing model of SGSY.

Keywords: cooperative game, non-cooperative game, microfinance

JEL classifications: C71, C72, D70

The literature points out several advantages of joint liability: it solves informational asymmetries by shifting the burden from the lender to the clients (Ghatak & Guinnane, 1999) resulting in lower transaction costs for the institution. It provides a way around the common problems of adverse selection (screening and sorting) and moral hazard (ex-ante and ex-post). However, group liability is not without its own problems. The literature has identified several potential disadvantages: excessive pressure may increase dropouts and inhibit growth. Che (2002) observes that the joint liability lowers the liquidity risk of default but creates a free-riding problem. Che points out that in the static setting, the free-riding problem dominates the liquidity risk effect, thus making group lending unattractive. Besides, if

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PUBLIC INTEREST STATEMENT

Swarnajayanti Gram Swarozgar Yojana (SGSY) is a government sponsored microfinance program in India. The scheme tries to establish a large number of micro enterprises or businesses for the poor in the rural area. As poor people do not have any collateral, lending institution suffers from the problem of adverse selection and moral hazard. Standard literature shows that group lending with joint liability can solve the above mentioned problems. However, joint liability put enormous pressure for the successful borrowers. The successful borrower may willing to pay her own liability, but repayment for partner's liability may provide an incentive for default. Joint liability also creates free riding problem. In this paper we have tried to find an instrument which will create interdependence among borrowers like joint liability does, but free from the vices of joint liability.

a critical number of group members cannot repay, members that would otherwise repay find it in their interest not to repay (Besley & Coate, 1995). Our aim in this paper is to find a mechanism, which can play the same role as joint liability plays in group lending, but being free from the vices of joint liability. It may be back-ended subsidy. This character is found in Swarnajayanti Gram Swarozgar Yojana (SGSY).[1] "Back-ended subsidy" means if the "group" successfully repays the loan, then the lender pays a part of the loan back. This "back-ended subsidy"[2] creates interdependence among borrowers, which ultimately reduces the problem of adverse selection and moral hazard.

SGSY is a government-subsidized microfinance program. The scheme has been designed on four principles: group lending with joint liability, progressive lending, back-ended subsidy, and social capital. Here, we have developed a two-period model.

In the initial part, we have shown that "individual lending with progressive lending and back-ended subsidy" cannot solve the problems arising from information asymmetry in the credit market. In the next section, we make a comparative assessment between "SGSY program with group lending and joint liability" and "SGSY program with group lending and individual liability."[3] The paper shows that groups are formed on the basis of "positive assortative matching" in both models. Good borrowers form group with good borrowers, and bad borrowers form group with bad borrowers. However, if borrowers take decision cooperatively, then problem of moral hazard is less severe in the second model compared with the first model. Section 1 describes the features of SGSY. Section 2 portrays "SGSY program with individual lending model."[4] Sections 4 and 5 make a comparison between "SGSY program with group lending and joint liability" and "SGSY program with group lending and individual liability" regarding adverse selection and moral hazard problems of credit market. Section 6 shows which model is beneficial for the borrowers.

1. Features of SGSY program

Our theoretical model has been developed on the features of SGSY program. In 1999, the Government of India started subsidized micro-credit program named SGSY. The assisted families in the program may be individuals or groups. The emphasis is on the group approach. Generally, groups are among the members of "Below Poverty Line" families. The very first step of this program is to form SHGs. The group is formed sometimes through self-selection mechanism, sometimes through the initiative of local bodies, NGO, and District Rural Development Authority of the State Government. Initially each member has to contribute some amount to her respective group corpus regularly. At least after six months of the formation of the groups, each SHG may appear in a "gradation test." The performance of a group depends on the average number of meetings arranged by the group in a particular month, regularity of the monthly contribution by the members, regularity of the repayment of loans by the borrowing members, etc. This gradation test is conducted in order to minimize the adverse selection problem, which may arise when the borrowers have characteristics that are unobservable to the lenders and may affect the probability of the ability of loan repayment. Consequently, the groups have to go through the II—graduation test. As groups pass different gradation tests, they become eligible to get higher amounts of credit (progressive lending), and ultimately get the "back-ended subsidy."

2. The model

This is a two-period model of a credit market under adverse selection. A large number of borrowers live in the same village. All borrowers are assumed to be risk-neutral and maximize expected returns. Every borrower is endowed with one unit of labor and a risky investment project in each period. The project at period-I requires one unit of capital and one unit of labor. The outcome of the risky project is either a success or a failure, denoted as a binary variable. Borrowers do not have initial wealth, so they cannot self-finance their projects and, therefore, raise funds from outside lenders, or do not undertake the project. Assume that borrowers are of two types: safe (a) and risky (b). The proportion of each type of borrowers is same. Output takes two values, Y_i^H and 0, for a project of type *i*. The probability of high output is p_i, where $i = a$, b, and $1 > p_a > p_b > 0$. There is an opportunity cost of participation for borrowers of both types in the form of an exogenously given reservation payoff at both periods.

If one borrower is successful and repays the loan, then she gets "*a*" times higher loan in the second period, where $a > 1$. Investment in another project at period-II, yields Y^{2H} if successful and 0 otherwise, where $Y^{2H} > Y^H$. This project requires one unit labor and "*a*" unit capital. The probability of high output is p_i, where $i = a$, b, and $1 > p_a > p_b > 0$. The borrower appropriates the surplus generated in the first period. In the second period, if a borrower repays her loan, then a part, say "*c*", of the loan is paid back to the borrower where $0 < c < 1$ and $ac < 1$.

The FI is risk neutral in nature. The opportunity cost of capital per loan is $\rho \geq 1$. The FI faces a perfectly elastic supply curve of fund from the depositor at ρ cost.[5] Borrowers will borrow only if their payoff exceeds the opportunity cost of their labor. The project returns of different borrowers are assumed to be uncorrelated. We assume that all projects are socially profitable in the sense that the expected return from the project is greater than the opportunity costs of the capital and labor employed in the project. There exists a limited liability constraint. In case their projects fail, borrowers are liable up to the amount of the wealth they posses, *w*. We take $w = 0$ for simplicity.

Let there be two types of credit contracts.

2.1. Individual liability contract

That is a standard debt contract between a borrower and the bank with a fixed repayment *r* for per unit capital borrowed if the project is successful, and zero recovery of debt if the project is a failure.

2.2. Joint liability contract

Two borrowers form a SHG. Each borrower has an individual liability component *r* and a joint liability component *r*. In case of bankruptcy or failure of the project, the borrower pays nothing back to the bank. In the case of non-bankruptcy state or success of the project, the borrower pays *r* for his own debt and an additional joint liability payment *r*[6] for her partner of the group whose project has failed.

3. Individual liability lending

At stage-I, if the borrower is successful then FI earns *r*, where *r* comprises 1 unit capital and interest rate. At stage-II, FI lends "*a*" unit capital to the borrower. If the borrower is successful, then FI earns "*ar*". However, as a reward of repayment, FI pays back "*acr*" to the borrower.

3.1. Full information model

If FI has full information about a borrower's type, then it earns 0 when the borrower's project fails, and $\{r + 1/\rho\ ar\ (1 - c)\}$ when the borrower's project succeeds. If FI lends money on zero profit condition, then:

$$p_i\{r + 1/\rho\, ar(1 - c)\} = (\rho + a) \tag{1}$$

and equilibrium interest rate is:

$$r_i = \frac{\rho(\rho + a)}{p_i\{\rho + a(1 - c)\}}, \quad \text{where } i = a, b \tag{2}$$

3.2. Asymmetric information model

So far, we have been assuming that the project types are common knowledge. In this section, we assume that this is private knowledge to the entrepreneur. The type of a borrower is unknown to the lenders (banks). Borrowers know each other's type. It is in the interest of risky firms to pose as safe firms, as the (zero FI profit) debt claim from a safe firm is less than that from a risky firm. We assume that it is prohibitively costly for the bank to verify returns in all states. This assumption rules out contracts contingent on project returns. We, however, assume that the bank is able to verify whether a project has yielded positive or zero return, so that there is no strategic default.

Now if,

(1) $p_a\, Y_a^{\,H} = p_b\, Y_b^{\,H} = \mu_1$ and $p_a\, Y_a^{\,2H} = p_b\, Y_b^{\,2H} = \mu_2$[7]

As $p_a > p_{b,,}$ this assumption implies $Y_a^{\,H} < Y_b^{\,H}$ and $Y_a^{\,2H} < Y_b^{\,2H}$

(2) $(\mu_1 + \mu_2/\rho) > (\rho + a) > 2$

The FI cannot distinguish between risky and safe borrowers. The average probability of repayment to FI is: $\hat{p} = (p_a + p_b)/2$. The FI will offer the same contract to both types of borrowers. Now the zero profit condition of the FI is: $\hat{p}\{r + 1/\rho\ ar\ (1-c)\} = (\rho + a)$

The return of an entrepreneur of type *i* is: $(\mu_1 + \mu_2/\rho) - p_i\,(\rho + a)/\hat{p}$

(3) $(\mu_1 + \mu_2/\rho) < p_a\,(\rho + a)/\hat{p}$

Given the assumptions (1)–(3):

$$(\mu_1 + \mu_2/\rho) - \{p_a(\rho + a)/\hat{p}\} < 0 < (\mu_1 + \mu_2/\rho) - \{p_b(\rho + a)/\hat{p}\} \tag{3}$$

Therefore, safe borrower will never borrow from FI, whereas risky borrowers will borrow from the FI. The FI will anticipate it and offer the contract $p_b\ \{r + 1/\rho\ ar\ (1-c)\} = (\rho + a)$. The presence of risky borrowers can push the equilibrium interest rate high enough to drive the safe borrowers away from the market. Only bad borrowers will borrow from FI. This problem is known as the problem of lemon (Gangopadhyay & Lensink, 2012).

4. Group lending and adverse selection

4.1. Group lending with joint liability

Borrowers know their types, however, FI, which lends money, does not know the type of the borrowers. If FI does not know a borrower's type, and if collaterals are not available, then problem of lemon will arise in the credit market. In this scenario, joint liability may ensure full efficiency. In individual liability model, borrower must repay the principal and interest rate. In joint liability model, if one member does not repay the loan, another member will repay her own as well as partner's debt, provided her return is enough.

In SGSY program, at period-I, FI lends Rs.[8] 2 to the "group." "Group" consists of two members. At period-I, if the group repays the loan with interest, then at period-II "group" gets Rs. 2*a* from "FI." At period-II, if the group repays its debt, then it gets "back-ended subsidy," *c*, a fraction of the entire debt is waved by FI. In stage-II, the group has to pay 2*ar*. If it repays entire loan, then it receives "back-ended subsidy" 2*acr*. Therefore, at period-II, "group" repays $2ar\ (1-c)$. Each borrower of the group gets "*a*" amount of capital. With the same probability of period-I, the project at period-II yields Y^{2H} ($<Y^H$) and 0. The surplus generated in period-I is appropriated. At period-II, the project started with borrowed capital *a*.

Payoff of FI

At period-I

FI lends Re. 1 to both the members of the group. If there is joint liability, then earning of the FI:

$2r$ with probability $p_i\,p_j$
$2r$ with probability $p_i\,(1-p_j)$
$2r$ with probability $(1-p_i)\,p_j$
0 with probability $(1-p_i)\,(1-p_j)$

where $i=a$, b and $j=a$, b.

Therefore, payoff of the "group" at period-I is:

$$\Pi^{FI1} = 2r\{p_ip_j + p_i(1-p_j) + p_j(1-p_i)\} \tag{4}$$

At period-II

If "group" can repay the loan, then it gets Rs. $2a$ amount of credit in the form of progressive lending at the beginning of period-II. If the "group" repays the loan, then a part of the loan, c, is waved. This is known as the "back-ended subsidy." Therefore, payoff of FI, at period-II:

$2ar-2acr$ with probability $p_i\,p_j$
$2ar-2acr$ with probability $p_i\,(1-p_j)$
$2ar-2acr$ with probability $(1-p_i)\,p_j$
0 with probability $(1-p_i)\,(1-p_j)$

Therefore, payoff of the "group" at period-II is:

$$\Pi^{FI2} = 2r\{p_ip_j + p_i(1-p_j) + p_j(1-p_i)\} \tag{5}$$

Total payoff of FI is:

$$\Pi^{FI} = \Pi^{FI1} + \Pi^{FI2}$$

$$\Pi^{FI}_{ij} = 2r\{p_ip_j + p_i(1-p_j) + p_j(1-p_i)\} + 1/\rho\left[2\{a(1-c)r\}\{p_ip_j + p_i(1-p_j) + p_j(1-p_i)\}\right]$$

or

$$\Pi^{FI}_{ij} = (p_i + p_j - p_ip_j)\,[2r + 1/\rho\{2a(1-c)r\}] \tag{6}$$

Expected payoff of the borrower "*i*" when her partner is "*j*":

Period-I

$$\begin{aligned}\Pi^1_{ij} &= p_ip_j\{Y_i^H - r\} + p_i(1-p_j)\{Y_i^H - 2r\}\\ &= p_i(Y_i^H - r) - p_i(1-p_j)r\end{aligned} \tag{7}$$

Period-II

$$\begin{aligned}\Pi^2_{ij} &= p_ip_j\{Y_i^{2H} - a(1-c)r\} + p_i(1-p_j)\{Y_i^{2H} - 2ar + acr\} + p_j(1-p_i)(acr)\\ &= p_i\{Y_i^{2H} - 2ar\} + (acr)(p_i + p_j - p_ip_j) + p_ip_j(ar)\end{aligned} \tag{8}$$

Total expected payoff of the borrower "*i*" when her partner is "*j*":

$$\pi^{jl}_{ij} = \pi^1_{ij} + \frac{\pi^2_{ij}}{\rho} \tag{9}$$

Problem of adverse selection:

Net expected gain of a risky borrower from having a safe partner is:

$$\pi_{ba}^{jl} - \pi_{bb}^{jl} = (p_a - p_b)p_b r + 1/\rho\ [(p_a - p_b)(1 - p_b)(acr) + (p_a - p_b)p_b ar] \tag{10}$$

Net expected loss of a safe borrower from having a risky partner is:

$$\pi_{aa}^{jl} - \pi_{ab}^{jl} = (p_a - p_b)p_a r + 1/\rho\ [(p_a - p_b)(1 - p_a)(acr) + (p_a - p_b)p_a ar] \tag{11}$$

If the latter expression is larger than the former, then a risky borrower will not find it profitable to have a safe partner. The latter expression is larger than the former as $p_a > p_b$ and $ar > acr$.

> Proposition 1: In "SGSY program" "group lending" with simultaneous financing, joint liability, progressive lending and back-ended subsidy" create positive assortative matching during group formation.
>
> The intuition behind this result is very simple. In joint liability lending one borrower becomes concerned about her partner only when her partner's project fails. Therefore, each borrower, whether safe or risky, prefers safe partner due to low expected joint liability payments. However, benefits of having a safe partner will be realized only when the borrower's own project will be successful. Hence, a safe borrower is much more concerned about the type of partner than risky borrower.

A borrower of any type prefers a safer partner, but the safer the borrower herself is, the more she values a safe partner. A risky borrower in theory could pay the safe borrower to accept her as a partner, but the expressions above imply that such payments would have to be so large that the risky borrower would not want to make them. If the bank offers two contracts, one with high joint liability and low interest rates and the other with low joint liability and high interest rate, safe borrowers will select the former contract and risky borrowers the latter (Ghatak & Guinnane, 1999).

4.2. Group lending with individual liability

Let two members "*i*" and "*j*" form a group. FI lends Re. 1/ to both the borrowers simultaneously. However, there exists no joint liability. If the project is successful, then both the borrowers can repay the loan.

Payoffs of FI

At period-I

2r with probability $p_i\, p_j$
r with probability $p_i\,(1 - p_j)$
r with probability $(1 - p_i)\, p_j$
0 with probability $(1 - p_i)\,(1 - p_j)$

Payoff of the FI at period-I is:

$$\Pi_{nl}^{FI1} = r(p_i + p_j) \tag{12}$$

At period-II

If both borrowers are successful, then Rs. 2/ amount loan is repaid, and the game moves to period-II. The group gets Rs."2a"/ as credit and this is distributed equally between the two borrowers. If both borrowers are successful, then "group" can repay the loan and receive back-ended subsidy.

"Group" receives "back-ended subsidy" only when both members repay the loan at this stage. Therefore, the payoff of the FI is:

$2ar-2acr$ with probability $p_i\, p_j$
ar with probability $p_i\,(1-p_j)$
ar with probability $(1-p_i)\, p_j$
0 with probability $(1-p_i)\,(1-p_j)$

Payoff of the FI at period-II is:

$$\Pi_{nl}^{FI2} = 1/\rho\{ar(p_i+p_j)-2acr\,p_ip_j\} \tag{13}$$

Total Payoff of the FI is:

$$\Pi_{nl}^{FI} = r(p_i+p_j)+1/\rho\{ar(p_i+p_j)-2acr\,p_ip_j\} \tag{14}$$

Payoff of the borrower:

Payoff of the borrower *i* when her partner is j at period-I is:

$$\Pi_{ij}^{njl1} = P_i(Y^H-r) \tag{15}$$

Payoff at period-II is:

$$\Pi_{ij}^{njl2} = 1/\rho\{P_i(Y^{2H}-ar)+p_ip_jacr\} \tag{16}$$

The total payoff is[9]:

$$\Pi_{ij}^{njl} = \left[P_i(Y^H-r)+1/\rho\{P_i(Y^{2H}-ar)+p_ip_jacr\}\right] \tag{17}$$

Group formation

The gain of a risky borrower pairing with safe borrower

$$\Pi_{ba}^{njl}-\Pi_{bb}^{njl} = 1/\rho\{acrp_b(p_a-p_b)\} \tag{18}$$

The loss incurred by a safe borrower partnering with an unsafe borrower is:

$$\Pi_{aa}^{njl}-\Pi_{ab}^{njl} = 1/\rho\{acrp_a(p_a-p_b)\} \tag{19}$$

As $p_a > p_b$, therefore, loss is higher than the gain. Any re-negotiation between safe and risky borrower is not possible. There will be positive assortative matching in group formation.

> Proposition 2: In SGSY program, "group lending with individual liability" also creates positive assortative matching in group formation. There is homogeneous group formation even in the absence of joint liability.
>
> Under "group lending with individual liability" safe borrowers have higher expected benefit than risky borrowers. To get a small reduction in interest rate, safe borrower is willing to sacrifice lower amount of back-ended subsidy compared to risky borrowers because having safe partners they have higher likelihood of success. Back-ended subsidy makes them cautious about the type of partner. Therefore, safe borrowers will always form group with safe borrowers.

5. Group lending and problem of moral hazard

Let the success of the project depend on the effort level of the borrower, i.e. $p_i = e_i$.

5.1. Individual lending with individual liability

Let output be two values Y^H and 0 with probability p and $(1-p)$, respectively. However, we assume here that the success of the project depends on effort level, i.e. $p = f(e) = e$, and $p \in (0,1)$. Therefore, the cost of disutility is $\gamma p^2/2$.

With progressive lending and back-ended subsidy, the payoff of a borrower under individual lending is:

$$\Pi_i = \left[\{p(Y^H - r) - \gamma p^2/2\} + 1/\rho\{p(Y^{2H} - ar) + (acr)p - \gamma p^2/2\}\right] \tag{20}$$

Let there be perfect information. FI can observe the effort level of the borrower and the social surplus is the surplus of the borrower and "FI". However, FI runs on zero profit condition. Therefore, social surplus comprises only the borrower's surplus:

$$(pY^H - \gamma p^2/2) + 1/\rho\,[pY^{2H} - \gamma p^2/2] \tag{21}$$

Social surplus will be maximized for:

$$p^* = \frac{\rho Y^H + Y^{2H}}{\gamma(\rho+1)} \tag{22}$$

FI (Lender) will force the borrower to put this amount of effort, and the equilibrium rate of interest[10] is:

$$r^* = \frac{\rho(\rho+a)}{p^*\{\rho + a(1-c)\}} \tag{23}$$

In the absence of collateral, lender and borrower do not have the same objective. Due to asymmetry of information, the lender cannot stipulate perfectly how the borrower should run the project. If FI cannot monitor the activity of the borrower, then the borrower will choose p to maximize her private profit taking r as given:

$$p(r) = \arg\max\left[\left\{p(Y^H - r) - \gamma p^2/2\right\} + 1/\rho\left\{p(Y^{2H} - ar) + (acr)p - \gamma p^2/2\right\}\right]$$

$$p(r) = \frac{(\rho Y^H + Y^{2H}) - r\{\rho + a(1-c)\}}{\gamma(\rho+1)} \tag{24}$$

Higher r implies lower p.

If we put this value in the zero profit condition of the FI

$$p_i r\{\rho + a(1-c)\} = (\rho^2 + a\rho) \tag{25}$$

We get:

$$p^2\gamma(1+\rho) - p(\rho Y^H + Y^{2H}) + (\rho^2 + a\rho) = 0 \tag{26}$$

This is a quadratic equation in p and it has two roots consistent with equilibrium. If we choose the highest value of p, then we have:

$$\bar{p} = \frac{(\rho Y^H + Y^{2H}) + \sqrt{\left(\rho Y^H + Y^{2H}\right)^2 - 4\gamma(\rho+1)\rho(a+\rho)}}{2\gamma(\rho+1)} \quad (27)$$

5.2. Group lending with joint liability

If partner of a borrower chooses an action p', then the payoff function of the borrower who chooses an action p is:

$$\Pi_{ij}{}^{C} = \left[pp'(Y^H - r) - p(1-p')r - \gamma p^2/2\right] + 1/\rho \left[p\{Y^{2H} - 2ar\} + (acr)(p' + p - p\,p') + p\,p'(ar) - \gamma p^2/2\right] \quad (28)$$

Now both the borrowers make an agreement that they will take decision cooperatively, i.e. $p = p'$. Due to asymmetry of information, borrowers will maximize their private profit taking "r" as given, and the optimal effort is:

$$p = p' = \arg\max\left(\Pi_{ij}^{C}\right)$$

$$p = p' = \frac{(\rho Y^H + Y^{2H}) - 2r(\rho + a) + acr}{\gamma(\rho+1) - 2r\{\rho + a(1-c)\}} \quad (29)$$

Substituting the value of r in the zero profit condition of the FI, under joint liability, progressive lending, and back-ended subsidy:

$$(2p - p^2)r\{\rho + a(1-c)\} = (\rho^2 + a\rho) \quad (30)$$

We get:

$$\gamma(\rho+1)\{\rho + a(1-c)\}p^3 - [\{\rho + a(1-c)\}\{2\gamma(\rho+1) + (\rho Y^H + Y^{2H})\}]p^2 + [\{\rho + a(1-c)\}\{2(\rho Y^H + Y^{2H}) + 2(\rho^2 + a\rho)\}]p - \{(\rho^2 + a\rho)(2\rho + 2a + ac)\} = 0 \quad (31)$$

This is a cubic equation. Solving the above equation, we get:

$$\tilde{p} = \frac{\left\{2\gamma(\rho+1) + (\rho Y^H + Y^{2H})\right\}}{3\gamma(\rho+1)} \quad (32)$$

See Appendix 1.

As $\bar{p} < \tilde{p}$, therefore, a borrower's equilibrium project choice will be safer compared to the individual liability model. Joint liability reduces the degree of moral hazard in this model. This is in same vein to Ghatak and Guinnane (1999).[11]

5.3. Group lending with individual liability

5.3.1. Cooperative decision

If partner of a borrower takes action p' and borrower takes action p, then the payoff function of the borrower is:[12]

$$\Pi_{ij}^{C*} = \{p(Y^H - r) - \gamma p^2/2\} + 1/\rho[\{p(Y^{2H} - ar) + pp'acr\} - \gamma p^2/2] \quad (33)$$

If borrowers take decision cooperatively then,

$$p = p' = \arg\max\left(\Pi_{ij}{}^{C^*}\right) \quad (34)$$

$$p = p' = \frac{\left[\rho(Y^H + Y^{2H}) - r(\rho + a)\right]}{\gamma(\rho + 1) - 2acr} \tag{35}$$

Zero profit condition of the FI is:

$$2rp + \frac{2arp - 2acrp^2}{\rho} = 2(\rho + a) \tag{36}$$

Putting the value of *r* in the zero profit condition, we have:

$$\begin{aligned} &ac\gamma(\rho+1)p^3 - \{ac(\rho Y^H + Y^{2H}) + \gamma(\rho+1)(\rho+a)\}p^2 \\ &\quad + [\{(\rho Y + Y^{2H}) + 2ac\rho\}(\rho+a)]p - \rho(\rho+a)^2 = 0 \end{aligned} \tag{37}$$

Solving this equation, we get:

$$\widehat{p} = \frac{ac(\rho Y^H + Y^{2H}) + \gamma(\rho+1)(\rho+a)}{3ac\gamma(\rho+1)} \tag{38}$$

See Appendix 2.

Comparing $\tilde{p}$ with $\widehat{p}$, we can see that $\widehat{p} > \tilde{p}$. Therefore, our next proposition is:

> Proposition 3: The problem of moral hazard will be less severe in SGSY "program with group lending and individual liability" than "SGSY program with group lending and joint liability".
>
> Both "group lending with joint liability" and "group lending with individual liability" assume that borrowers can contract on *p* among themselves: i.e. they observe each other's action perfectly and costlessly, and enforce any agreement regarding their levels. Joint liability is being used as a disincentive for moral hazard. On the contrary, in group lending with individual liability model, back-ended subsidy is used as an incentive to put more effort. More effort in this model implies more return, and less moral hazard.
>
> Once a loan has been granted, project's pay off partially depends on borrower's effort. When the information is symmetric, then for each action of the borrower marginal benefit is equal to marginal cost. However, with asymmetric information the feature is different. In the absence of collateral, the lender and borrower do not have the same objectives because borrower does not fully internalize the cost of the project failure. As there is asymmetry of information lender cannot monitor borrower perfectly. It creates an incentive for borrowers to misuse the loan. Therefore, if the severity of moral hazard is declined, then lenders will be benefited. Chance of repayment of loan will be higher. Initially it may appear that borrowers will not be benefited. Poor people do not have any asset. Therefore, FI cannot apply financial sanction against them. It creates the problem of moral hazard, and FIs become unwilling to provide loan to them. Therefore, less severe moral hazard is beneficial for both lender and borrowers.

5.3.2. Non-cooperative decision

If the borrower chooses her action *p* to maximize her individual payoff taking partner's action as given, then her best response function is:

$$p = \frac{\{\rho(Y^H - r) + (Y^{2H} - ar)\}}{\gamma(\rho+1)} + \frac{acr}{\gamma(\rho+1)}p' \tag{39}$$

If borrowers take decisions about project-choice non-cooperatively, then in the symmetric Nash equilibrium,

$$p = p^{/} = \frac{\left[\rho(Y^H + Y^{2H}) - r(\rho + a)\right]}{\gamma(\rho + 1) - acr} \tag{40}$$

See Appendix 3.

If we put this value in the zero profit condition of FI

$$pr(\rho + a - acp) = \rho(a + \rho) \tag{41}$$

then we get:

$$\gamma(\rho + 1)p^2 - (\rho Y^H + Y^{2H})p + (\rho + a) = 0 \tag{42}$$

Solving this equation, we have:

$$\bar{p} = \check{p} = \frac{(\rho Y^H + Y^{2H}) + \sqrt{\left(\rho Y^H + Y^{2H}\right)^2 - 4\gamma(\rho + 1)\rho(a + \rho)}}{2\gamma(\rho + 1)} \tag{43}$$

Therefore, project choice in this model is same as individual lending model.

> Proposition 4: SGSY program with mere individual liability cannot reduce the problem of moral hazard. If borrowers take decision co operatively, then problem of moral hazard will be reduced.
>
> Borrowers take decision non co operatively means borrower does not take into account her actions effect on her partner's choice of action. This is similar to the fact that if the borrowers internalize the effect of the choice of her action on the interest rate under individual lending, she would choose the first best level of *p*.

6. Borrower's welfare

So far we have seen that "SGSY program with group lending and individual liability" is a better version compared with "SGSY program with group lending and joint liability." The former model has higher potential to solve the adverse selection and enforcement problems compared with the latter. Lenders face all these problems when they lend to the borrowers having no assets to pledge as collaterals. Now, we investigate from which model borrowers will be benefitted.

Payoff of a borrower participating in "SGSY program with group lending and individual liability" is $\Pi_{ij}^{njl} = p_i\,(Y^H - r) + 1/\rho\,\{p_i\,(Y^{2H} - ar) + p_i\,p_j\,acr\}$.

Payoff under joint liability is:

$$\Pi_{ij}^{jl} = \left\{p_i(Y_i^H - r) - p_i(1 - p_j)r\right\} + 1/\rho\left[p_i\{Y_i^{2H} - 2ar\} + (acr)(p_i + p_j - p_i p_j) + p_i p_j(ar)\right] \tag{44}$$

If $c \le 1/2$, then $\Pi_{ij}^{njl} > \Pi_{ij}^{jl}$

See Appendix 4.

Then, borrowers become better-off from the proposed model. So our next proposition is:

> Proposition 5: If $c \le 1/2$, then borrowers become better-off from the participation in "SGSY program with group lending and individual liability" than that of "SGSY program with group lending and joint liability".

7. Conclusion

This chapter shows that SGSY program with individual liability is a better option to tackle the "adverse selection," and "moral hazard" problems of credit market than SGSY with joint liability. "The joint liability clause" is increasingly being criticized from different stances. Joint liability sometimes becomes deterrent for loan repayment. On the contrary, "back-ended subsidy" may become an effective incentive mechanism to solve the information asymmetry problems in credit market. Revoking joint liability clause may enhance the performance of SGSY program. The proposed model is also beneficial for the borrowers. The aim of the SGSY program is the betterment of its poor clients. Therefore, revoking joint liability clause from the existing model of SGSY will increase welfare of both lenders and borrowers.

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Notes

1. During our field investigation in 2006, we observed that SGSY-run Self-Help Groups (SHGs) were performing well in terms of repayment capability and other indicators of "group functioning." However, the "group" does not follow "joint liability." It motivates us to see what factors are there behind this scenario.
2. In SGSY program, government's expenditure is higher compared to revenue generated from the program. However, in this paper, we have assumed that government or Financial Institute (FI) does not make any loss or profit. The program runs on zero profit condition.
3. SGSY program is based on group lending with joint liability, progressive lending, and back-ended subsidy. We have replaced here only the joint liability clause with individual liability. "Group lending with individual liability" may sound as misnomer. In the absence of back-ended subsidy "Group lending with individual liability" boils down to individual lending. However, borrowers will get the share of "back-ended subsidy" only when all her partners repay the loan. Members of the group get equal share of "back-ended subsidy". This "back-ended subsidy" creates interdependence between borrowers even in the absence of joint liability. In conventional group lending models, joint liability creates interdependence among borrowers. Therefore, if joint liability clause is removed from the SGSY program, it will not enhance the problem of lenders. "Back-ended subsidy" may be a good proxy of "joint liability".
4. In "SGSY program with individual lending" no group or SHG is formed. Borrowers directly get credit or assistance from the government or FI.
5. We assume that FI earns zero profit from lending. The zero profit condition varies with the type of contract.
6. In joint liability, a successful group member has to repay at least a certain fraction (c) of the debt (r) owed by a defaulting group member, where $c \le r$ (Gangopadhyay, Ghatak, & Lensink, 2005; Ghatak & Guinnane, 1999). However, we have assumed here $c = r$.
7. Expected project outputs (mean) are identical. However, risky project has a greater spread around the mean. This is in the same vein to Stiglitz and Wiess (1981).
8. Rupee is Indian currency.
9. This expression shows that payoff of the borrower "*i*" depends on the probability of success of the borrower "*j*." It implies that there is interdependence between borrowers even in the absence of joint liability. Back-ended subsidy creates this interdependence. Like joint liability "back-ended subsidy" creates peer selection.
10. If we put the value of p^* in zero profit condition $p_i \{r + 1/\rho\ ar\ (1 - c)\} = (\rho + a)$, then we get optimal interest rate r^*. "r" is choice variable of FI. If FI can observe the actions of the borrower, then it can charge higher "r" for lower effort, and lower "r" for higher effort of the borrowers.
11. They have shown that, in group lending, if borrowers take decision cooperatively, then the problem of moral hazard is solved partially.
12. Payoff function of the *i*th borrower depends on the action taken by the *j*th borrower. It creates an incentive for peer monitoring. We have assumed that group members can monitor each other at zero cost. In the absence of joint liability, "back-ended subsidy" creates incentive for peer monitoring.

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Appendix 1

$$\gamma(\rho+1)\{\rho+a(1-c)\}p^3-\left[\{\rho+a(1-c)\}\{2\gamma(\rho+1)+(\rho Y^H+Y^{2H})\right]p^2$$
$$+\left[\{\rho+a(1-c)\}\{2(\rho Y^H+Y^{2H})+2(\rho^2+a\rho)\}\right]p-\{(\rho^2+a\rho)(2\rho+2a+ac)\}=0$$

$f(p)=ap^3-bp^2+cp-d=0$, where a, b, c are the coefficients of p^3, p^2, and p, respectively, of the Equation 3. d is the constant of the above equation. Using Decartes' rule of signs, we can show that the above equation has three positive real roots. We assumed here that these three roots are identical.

Therefore, $f(p)=0$

$f'(p)=0$, i.e. first-order derivative is zero
$f''(p)=0$, i.e. second-order derivative is zero
$f''(p)=6ap-2b$
or $p=b/3a$

Now, if we put the value of a and b, then we have:

$$\tilde{p}=\frac{\left\{2\gamma(\rho+1)+(\rho Y^H+Y^{2H})\right\}}{3\gamma(\rho+1)}$$

Appendix 2

$$ac\gamma(\rho+1)p^3-\{ac(\rho Y^H+Y^{2H})+\gamma(\rho+1)(\rho+a)\}p^2+\left[\{(\rho Y+Y^{2H})+2ac\rho\}(\rho+a)\right]p-\rho(\rho+a)^2=0$$

We can apply the above-mentioned method and get:

$$\widehat{p}=\frac{ac(\rho Y^H+Y^{2H})+\gamma(\rho+1)(\rho+a)}{3ac\gamma(\rho+1)}$$

Appendix 3

If the borrower i chooses her action p to maximize her individual payoff taking partner j's action as given, then her best response function is:

$$p=\frac{\left\{\rho(Y^H-r)+(Y^{2H}-ar)\right\}}{\gamma(\rho+1)}+\frac{acr}{\gamma(\rho+1)}p'$$

Similarly, best reaction function of borrower j is:

$$p=\frac{\left\{\rho(Y^H-r)+(Y^{2H}-ar)\right\}}{\gamma(\rho+1)}+\frac{acr}{\gamma(\rho+1)}p'$$

From the above two equations we solve for p and p', we have Nash equilibrium as:

$$p=p'=\frac{\left[\rho(Y^H+Y^{2H})-r(\rho+a)\right]}{\gamma(\rho+1)-acr}$$

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Appendix 4

$$\pi_{ij}^{njl} - \pi_{ij}^{jl} = p_i(1 - p_j)r + \frac{p_i ar + p_i p_j acr - acr(p_i + p_j - p_i p_j) - p_i p_j ar}{\rho}$$

As there is positive assortative matching, therefore, $p_i = p_j$, and above expression becomes $p(1-p)r + \frac{(1-p)arp(1-2c)}{\rho}$. This is strictly positive for $c \leq 1/2$.