

# Debt Traps - A Risk Participative Loom for Reduction of Default Risk using Numeric Game Theory



Pinakapani Peri, Bhaskar Narasimha Rao Garimella, B.Mohan Kumar

**Abstract:** Collaboration modeled as risk participation tends to reduce default risk and measures achievement within volatility parameters. This stimulates stakeholders to ensure regular repayment and build capability to create sustainable livelihoods for borrowers and profitable credit portfolios for lenders. This study attempts to create a working model of knowledge and education delivery system (Dr. Amartya Sen's "Capability Maturity Model") which not only analyzes credit default from a borrower's perspective, but also seeks to mitigate a larger evil "SOCIAL EXCLUSION" (associated with loan default) that causes disequilibrium in poor tribal lives (Women). The model capitalizes associated variables using an analytical method to reduce default risks and applies the same to arrive at an equilibrium as per game theoretic approach. Using numerical analysis, the model seeks to identify risk dependency reductions in tribal Microfinance.

**Key Words:** Poverty, Game Theory, Capability Approach, Numerical Analysis, NRLM, Tribal Women, Risk Participation

## I. INTRODUCTION

Default risk in non-collateralized credit spearheaded by Government Microfinance projects, specifically to tribal women oriented Self Help Group(s) (SHG's) is the chosen paradigm as the merits of the credit programs (poverty alleviation) are overshadowed by the perils of default in these projects. These projects involve poor tribal women absorbing high cost loans for enabling activity based livelihoods. When the established activity does not take off, loan repayment is defaulted due to various factors, viz., borrower's socio economic condition, low level of literacy, limited knowledge of forward market linkages and mismanagement of the chosen activity (Demont, 2016) and (Thorat, 2017). This study asserts that an educational program or knowledge sharing is pivotal between the stakeholders about a plethora of microeconomic factors that are factored prior to extension of the loan.

This knowledge gap decreases the potential to generate income and the loan is exposed to systemic risks and loan default acts as a prime deterrent for future or additional credit delivery.

Subsequent to default, the major "outcome" this study chooses to highlight is the plight of these poor tribal women, who are burdened with high cost debt with "nil" income, subjected to recovery mechanisms from the lender, and social exclusion from their regular fabric of life. The adverse impact of this "outcome" can be eased by implementing Dr. Amartya Sen's "Capability Building Model" (Altman, 2012) in-terms of a systematic delivery mechanism of a tailor-made educational program (prior to loan extension) comprising of themes from social arrangements, managing money (savings & loan servicing), choosing a vocation, managing business in villages, networking for forward linkages, taxonomy methods, balanced score card method of review, and managing both family and business as a primary set of factors (Jean-Marie Baland, 2017).

Dr. Sen's approach to evaluate poverty as an inability to achieve wellbeing due to lack of socio-economic opportunity is adopted by this study. "Capability Approach" can assist in the development of tribal women. This "Capacity Building" approach advocates initiatives to provide participants (tribal women) with an opportunity to attain a better bargaining position to negotiate for better terms with lenders. (Goldmann, 2016).

Enumeration of the capabilities of the poor and collation of information can improve results ahead of other social indicators and this in turn can crystallize the key variables which can build capacity of SHG women. Requirements (as adopted by this study) by all individuals according to Dr. Sen are: Access to knowledge, freedom to choose, access to economic support projects and civic opportunities, rational and transparent distribution of resources and presence of tangible safety-nets. This study focuses on ensuring the realization of some of Sen's factors and enables the capability building of the poor to avail favorable economic facilities like loans (non-collateralized), which can improve their financial position and enable a sustainable livelihood (Thierry Demals, 2014).

The manuscript is presented as: S-II submits the quantitative aspect of the poverty paradigm, S-III introduces game theory concepts with some background and description. Section-IV describes an analytical model which introduces the interplay of determined factors for risk participative credit lending.

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S-V presents the application of numerical methods on the output of the analytical model of S-IV. Section-VI concludes with a few observations on socio-economic impact and relationally of Dr. Sen’s “Capability” development of tribal women oriented SHG’s.

II. POVERTY

a. Multidimensionality

In India, poverty has multiple dimensions; tribal women face socio economic challenges that uproot their livelihoods. The government has initiated several institutions to help fight poverty since independence. The heavyweight of which is the program National Rural Livelihoods Mission (NRLM). The NRLM as India’s premier institution of the poor has managed to significantly reduce poverty and provide education, income, and employment for the poor, but in certain worst case scenarios (tribal women); they are pushed into abject poverty and debt traps.

The Indian Planning Commission for 2016-17, has allocated for NRLM a 218 per cent allotment increase from the Financial Budget Allocation for poverty alleviation to Rs. 4,500 Cr. For past Five years, NRLM has had great success in South India in terms of overall credit needs met and percent of families who have been registered as SHGs under the NRLM (India, 2017).

Table 1: Top THREE Successful Women SHG groups as a percentage

Indian State	Families who’s credit needs are met (% of total)	Families registered under NRLM (% of total)
Kerala	25%	92%
Tamil Nadu	36%	81%
Andhra Pradesh	83%	90%

Source: <https://data.gov.in/catalog/>

As of 2017, Andhra Pradesh has 5.9 lakh SHGs in 32,000 village organizations who have built a strong framework which enhance the livelihood and create employment. 800 administration units have also set up as “Mahila Mandal Samakhyas” (MMS) to head activities brought in by NRLM. Because of them, Andhra Pradesh has managed to achieve 96 per cent of the covenants of the Millennium Development Goals. The total of loans given to SHGs in AP is Rs 14,000 Cr, and a repayment rate of 88 per cent. Out of this the Non-Performing Assets (NPA) of tribal people is at Rs. 508 Cr.

Table 2: SHG Non Performing Assets for Two States (Andhra & Telangana) as on 31-Mar-2019

Regional	31/03/2019		NPA (4 & 5)		IRAC-2		IRAC-3		Total	
	Accs	Amt	Accs	Amt	Accs	Amt	Accs	Amt	Accs	Amt
AshokNagar (TS)	312	238.70	399	396.86	1068	2751.40	419	901.70	1886	4049.96
Bhadrachalam (TS)	315	455.76	715	1450.22	2806	6893.12	1072	2535.18	4593	10878.52
Khammam (TS)	697	543.36	888	834.59	1900	5338.88	909	2499.75	3697	8673.22
Mahaboobnagar (TS)	443	384.43	623	634.89	1258	2559.53	903	1521.26	2784	4715.68
Nalgonda (TS)	312	328.17	447	533.24	1534	4342.58	867	1990.89	2848	6866.71
Parvathipuram	75	80.66	102	183.67	1283	2453.74	262	473.92	1647	3111.33
Sangareddy (TS)	467	437.53	704	833.22	1250	3227.27	639	1417.95	2593	5478.44
Srikakulam	94	91.73	129	194.51	1710	4805.63	429	1016.56	2268	6016.70
Visakhapatnam	182	123.48	324	353.32	1807	4127.18	777	1429.95	2908	5910.45
Vizayanagaram	81	85.81	88	94.69	1529	4340.92	525	1004.86	2142	5440.47
Warangal (TS)	342	318.24	521	867.69	1992	5571.71	917	2340.40	3430	8779.80
	3320	3087.87	4940	6376.90	18137	46411.96	7719	17132.42	30796	69921.28

\* Each Account Comprises of 15 Married Women aged 18 to 60

Source: Author Compiled

The participants are economically weaker section who have been sanctioned with a loan of Rs. 75,000 each to facilitate the initiation of their journey out of poverty. The intervention is supposed to yield a profitable venture of sustainable livelihood.

In the above Table 2, the total column, it can be interpreted that, prior to absorbing a loan, 461,940 women were in poverty without any debt. However, these women are now debt ridden and would be socially excluded too, owing to the recovery mechanism which would be initiated by the Banks, as the money forms part of public deposits.

To curb this, NRLM needs to link the functioning of banks and SHGs so share risk and ensure that banks receive the repayment and tribal SHGs, especially women create income, repay their loans, and escape poverty.

b. Importance of tribal poverty

Given the socio-economic context of tribal SHG accounts, where an SHG group’s (10-members) monthly income is Rs. 10,720/- (@35.76 per head / per day), is made to absorb a loan of Rs. 5 Lakhs with a monthly payment of Rs. 15,351/- per month. This mismatch renders the account as an NPA primarily due to limited information dissemination, inadequate training programs, impact of the multidimensionality of poverty, lower opportunities, landlessness, group marginalization, low access to safety-nets and weak institutional support. The Rs. 508.095 Crore NPA is a consolidation of 1,328 tribal SHG groups comprising of 14,692 poor tribal women borrowers who have been subjected to social exclusion and alleviation measures are resulting in debt traps, which this study seeks to highlight and possibly mitigate.

c. Identification of Equilibria

In the business context, collaborations occur between firms for sharing costs, investments in R&D and possible product development. This is in order to address the increasing competition that occurs through globalization. Besides cost, collaboration also includes sharing of knowledge, infrastructure, and facilities. As an assimilation of these variables, the study proposes a single key success factor i.e., risk participation which is the aspect of default risk shared by the borrower and lender.

This constant if occurs with the borrower (failure in terms of the business established) gets transferred to the lender (borrower(s) failure leading to loan default). Game theory is used to investigate the conflicts and parameters of risk participation that are encountered in the market place. This study adopts an analytical method that can profit both the parties and identify the conditions required by them in order to do so.

The impact of risk participation is more than just about the profit earned by the parties (Christine Altenbuchner, 2017). It includes factors which can’t be quantifiably measured like level of knowledge sharing, trust, innovation. etc. an analytical method will structure these factors to factor into risk participation.



Firstly, the model can only be implemented by negotiation to attain equilibrium. Secondly, it describes how lenders and SHG's can work together by joining knowledge, technology, trust, and coordination assurance which can ameliorate overall process effectiveness.

Game theory can address challenges of risk participation inherent to non-collateralized lending where the loan is guaranteed by group (tribal women) performance in an unstable market with a high propensity for default risk. The following section explains game theory and its implementation in risk participation. The next introduces an analytical method for reducing risk dependency.

### III. GAME THEORY

#### a. Background

Group formation and collaboration are common aspects identified as the factors of a problem in game theory (John von Neumann, 1944). The postulations of Game theory and integration with numerical analysis was first introduced by von Neumann and Morgenstern (Talay, 2009). It applies axioms and principals of mathematics into fields like economics, politics, management, and group behavior (Velupillai, 2009) (Genserik Reniers, 2009) created a model using game theory to describe the formation, managing and completion of strategic ventures. (Ela Ozkan-Canbolat, 2016) used interdisciplinary approach of game theory, strategic venture, and institutional learning to record the performance and life time of collaboration in a dynamic market.

Several literatures have been released on how collaborations occur within the institutions of the poor so created for the purpose of alleviating poverty. These studies brought forth the model for lender-borrower business relationships with non-cooperative and cooperative games (M. El Moufid, 2017), customer-retailer ventures with game theory. These have been used as a basis for risk dependency research studies on partnerships and analyses cost sharing and pricing have been done in plenty. But there has been limited literature game theory used for is participation between banks and SHGs. (Robert F Nau, 1990) modelled a relationship between engineers using principles of game theory to help in decision making and understand how it affected the competency of their designs and freedom to operate.

(Rahim Khanizad, 2017) modeled the behavior of a party that's opportunistic within a prisoner's dilemma. (Christoph Adami, 2016) also used an approach similar to the prisoner's dilemma to analyze the party's collaboration which proved that collaboration reduces as reputation increases. (Fanelli, 2017) used game theory to find whether two parties should or shouldn't collaborate and to what extent they should collaborate and this was done with the use of prisoner's dilemma and other game theoretic strategies like social punishment.

(Bryan L. Mesmer, 2016) defined three collaborative models for revenue, investment, and innovation sharing along with equilibrium points using Nash bargaining game. (Nash, 2002) explored extreme programming in prisoner's dilemma framework that can be applied to the one-dimension approach applied in this study (Talay, 2009)

Rendered applications for application of game theory on strategic partnerships to observe the amount of control of resources due to collaboration. Equilibrium in partnerships has been analyzed and modelled using non cooperative games. (Rahim Khanizad, 2017) also studied the effect the number of networks competing has over the product development, technological alternatives, and market elasticity to investments in firms partnering using game theory principles. (Fanelli, 2017) in her scholarly work on interest rate modelling, applied game theory methodology to identify behaviors in horizontal or vertical function alliances, this has been unequivocally applied to this study. (John von Neumann, 1944) looked into collaborations for knowledge creation purpose and identify the resource conditions needed to continue to maintain collaboration and investigated the effect of spillover of knowledge in similar framework, the theme which this study is heavily dependent on.

#### b. Risk Participation Process

Risk participation is different from collaborations it is focused on the propensity for banks to give out loans and receive the repayment and avoids defaulters. (Badar Alam Iqbal, 2017) suggest that the stability of a network will depend on less obvious issues like communication, knowledge sharing, and trust and goal oriented-ness. From this four dimensions are used to examine the collaboration process: trust, coordination, learning, innovation. Similarly, in the context of sharing risk between banks and borrower, to create the analytical model, four dimensions will be determined which affect the risk participative venture's success.

A relationship between the lender (banks) and borrowers (SHG-tribal women) is firstly based the capacity of the SHG's member to repay. The member may engage in business or manufacturing to earn profit and repay the loan (Jean Drèze, 2017). But the person must be of Capacity intention to do so. When the tribal women members engage in business they must ensure that it is profitable enough for them to make money and to also repay the loan. The bank and NRLM can help educate the poor of how to perform business in a sustainable manner. SHG members derived as borrower(s) who are made capable of creating income will be more capacitated and Capacity to pay the loans. This can increase the possibility of successfully implementing a ready to lend loan portfolio which leads to a productive long term relation between banks and SHGs (Icía García-Pérez, 2017). **Capacity to repay** is a factor of risk participation success.

For each loan cycle, an approach can be developed which begins with exchange of vision, agreement associated with negotiations (Jean-Marie Baland, 2017). **Margin** determination from the lender's side is a vital factor for risk sharing. The borrower (SHG) will put their own funds (margin or contribution) up to a certain extent and the rest of the loan requirement is extended by the lender bank (Wu, 2017). This portion of borrower placing their own funds is the margin requirement. The smaller the margin requirement would result in greater interest/ demand by the borrower to avail credit through a loan.



The extent of margin agreed upon by the lender and borrower is a factor in determining the risk participation. In order to increase the borrower's capacity to repay, the goods and services offered must be able to sell at highest possible price (Karla Hoff, 2016). Hence the lender bank and other institutions of the poor must inform the borrowers SHGs of the location of the closest designated *village shandy*. It is where all the produce of all the nearby SHGs will be gathered and traded for more handsome prices. Thus increasing their access to market and profits. When this happens, their capacity to pay also increases (Goodman, 2017). Thus the **Forward integration** performed by banks and NRLM is a key factor in risk sharing with SHGs Demand and supply are macroeconomic variable from both borrower and lender. These variables dynamically transport from the market yard to the interest income of the lender. Other macroeconomic variables are assumed to be non-interfering and the variable demand and supply are constant across each credit cycle. The demand forms the market for the SHGs goods will determine whether the SHG is Capacity to take a loan. The supply of credit by the bank must be made available and informed to the SHGs. Demand and supply together are the **Market conditions** which is a key factor in determining the extent of risk participation by the bank and SHG.

IV.MATHEMATICAL METHOD

Risk participation is designed as a function of profit and both the lender and borrower(s) must decide on their requirement of policy, planned activities with the loan, capacity to return the money. The model includes the four dimensions of the risk participation: Capacity to repay, Margin requirement, Market conditions and Forward integration aspects. Only two parties are considered, Lender (l) and Borrower (b). Both these constructs and variables are correlated in the establishment of a model.

**Axiom 1:** Risk participation adds value and reduces risk of default in non-collateralized financial lending for livelihood enablement

**Axiom 2:** Risk participation results in a collaborative cost due to efforts of coordination between lender and borrower (tribal women). When development is realized, costs are incurred although marginally.

The derived model is a summation of four stochastic models drawn from (Elmar Lukas, 2016), (George Cairns, 2016), (Jie Lu, 2016) and (John Duffy, 2016). These four established empirical methods, are fused and synergized to result in desired dimensions of the risk participative approach.

Initially, a risk participation quantum A is identified, and when A=0 it would be nil risk participation and A=1 would be 100% risk participation. Both participants have a direct proportional relation in that, revenue yields as profit and income improve for the borrower (from their business activity) gets translated to lender in the same quantum

increase as in the case for the borrower. i.e., the more intense the participation function A, the more the increase and vice-versa. It is expected that the lenders investment will increase as more effort is put in by borrowers to repay the loan. Similarly, it is also estimated that the borrower's incremental income shall be higher as more cohesiveness leads to a consolidation of the equilibrium resulting in development.

When the lender coupled with the borrower(s) participate in risk, they both are in a position to lose money through Non Performing Asset's and incapacity to repay leading to a debt trap respectively. "Capacity to repay" constructs are derived from the analytical method presented by (Jie Lu, 2016). Total Capacity to pay is calculated as the total investment incurred by the lender and the borrower to make income to repay loan, it defined as follows:

$$y = W^l + W^b + A[\lambda(W^l, \Phi)W^{l'b} + \lambda(W^b, \Phi)W^{b'l}] \dots\dots\dots (1)$$

Capacity to repay is modelled as a function determining the outcome as having a quotient of profit as an output of the borrower's business. represented by the Nash Vector (knowledge).  $W^l$  is a function of the lender which encourages the borrower to repay the loan and  $W^b$  is the Capacity to repay function within the accepted tenor.  $\lambda$  is a function of  $W^l$  as well as  $\Phi$ , where  $\Phi$  is the factor complimentary to making a borrower improve the Capacity to repay function. "lb" represents the margin requirements set by the bank. A borrower is more Capacity to repay the loan when the margin requirement is high. This is because when the borrower puts in his own money, the risk participation increase alongside the bank. A's Margin requirement increases, so does the Capacity to repay. Past research (John Duffy, 2016) has shown that a positive correlation between trust and information sharing is vital for robust risk sharing, and business continuity of both lender and borrower in the livelihoods paradigm. Hence, in risk sharing activities, the study assumes that Capacity to repay diminishes as margin requirements decreases. Also, margins are not reciprocal and each bank personally assigns a level of margin to each SHG. Consequently,

$$\lambda(W^l, \Phi)W^{l'b} + \lambda(W^b, \Phi)W^{b'l} \dots\dots\dots (2)$$

Capacity to pay that occurs from the risk participation. It establishes that, as A improves over time, it being a market determinant, higher the A the borrower will seek for higher loan quantum and the lender will be flexible as the sharing of risk "A" can be quantified over multiple cycles of lending and repayment (Jean-Etienne de Bettignies, 2009). As A improves, it establishes that the borrower and lender are successful in terms of knowledge sharing and capacity building of the borrower(s) i.e., poor tribal women. Income for both lender and borrower from the informed partnership can derived in the form of risk sharing represented as below:

$$P^l = \Pi * (v + zya) \dots\dots\dots (3)$$



$$-(\sum W^l + (1-k)s(A) + \sum t^l(y)) \dots\dots\dots (4)$$

$$P^b = (1-\Pi) * (v + zy a) \dots\dots\dots (5)$$

$$-(\sum W^b + kj(A) + \sum_i t^b(y)) \dots\dots (6)$$

Revenue from the risk participation is derived from (Yongjun Li, 2016). The revenue is the total sum of the product value plus the value created through risk sharing when  $v = 0$ , the aspect of finance for a new livelihood venture (activity) and when,  $v > 0$  it can be assimilated that it is successful (Yongjun Li, 2016).

$Z$  is an Nash Vector (Value Creation) and  $Z * y$  can be identified as income created by operating at business and management of demand and supply for credit. “ $a$ ” represents lower understanding of market dynamics and the risk participation be modeled as

$$Z * y * a \dots\dots\dots (7)$$

Both participants share the profit variable  $\Pi$  as it gets translated from the borrower to the lender. At real-time, although risk is shared, the lender gets a lesser portion of  $\Pi$ . And the borrower’s new venture for livelihood enablement gets a fraction  $(1-\Pi)$ . The model assumes that partners share all developmental costs. Risk Participation is the same for both parties and represents the forward integration dimension as a transferable process. Therefore  $j(A)$  is a convex function representing risk participation which is shared by both lender and borrower. Default component of quantum risk shared by lender and borrower are marked as

$$k \ \& \ 1-k \dots\dots\dots (8)$$

Risk Participation post transfer of profit is derived as a convex function.

$$t^c(y^c) \cdot \frac{\gamma t^c(y^c)}{\gamma^c} < 0 \quad \text{and}$$

$$\frac{\gamma^2 t^c(y^c)}{\gamma^2 y^c} < 0 \cdot t^c(0) = C_0 < \infty \quad \text{and} \quad t^c(\infty) = C_N \dots\dots\dots (9)$$

As the derived functions are yielding only factors that are above the NULL (i.e., profit),

It can be proved that knowledge sharing and forward linkage enablement between lender and borrower will improve risk participation and the Capacity to repay, which can achieve sustainable livelihood enablement without the risk of Social Exclusion.

### V. NUMERICAL ANALYSIS

For the analysis, the factor “Capacity to repay” is taken, as this factor drives the borrower to ensure that the chosen activity would be profitable and these profits can be shared with the lender as a timely repayment of the equated monthly installment.

Hence is one-dimensional. The Value at Risk in the participation event is derived to be  $j(A) = M * A^2$ . Absorption capacity of borrower is adapted from (Lucas, 2016) and it is

$$\gamma(W, \Phi) = W * \Phi + (1-\Phi) \dots\dots\dots (10)$$

Total Capacity to pay, is the sum of Capacity to pay before lending plus Capacity to pay after risk participation efforts, can be expressed as follows:

$$y = W^l + W^b + A[(W^l \Phi + 1 - \Phi)W^{b^l} + (W^b \Phi + 1 - \Phi)W^{l^b}] \dots\dots\dots (11)$$

For simplification purposes, we set margin requirement as

$$y = [(W^l \Phi + 1 - \Phi)W^{b^l} + (W^b \Phi + 1 - \Phi)W^{l^b}]. \dots\dots (12)$$

Risk participation cost is expressed as

$$(t^c - e^c * y) \dots\dots\dots (13)$$

That the lenders risk sharing cost decreases as margin requirements increases. As represented in Figure 1 presented below.

Expected value of variable (random) “ $a$ ” is  $\frac{a+1}{2}$  and is

assumed to be distributed uniformly and continuously over the entire cycle of the loan (i.e., 36 months). The derived profit of both participants can be:

$$P^l = \Pi(v + z(\frac{a+1}{2})y) - (W^l + (1-k)MA^2 + (t^l - e^l yA)) \dots\dots\dots (14)$$

$$P^b = (1-\Pi)(v + z(\frac{a+1}{2})y) - (W^b + kMA^2 + (t^b - e^b yA)) \dots\dots\dots (15)$$

For this sectional analysis as asserted, the study considers the same axiom that the risk sharing is a constant function and the lender needs to ensure that borrowers book a decent profit from their activity, which gets translated into the interest payment for the lender.

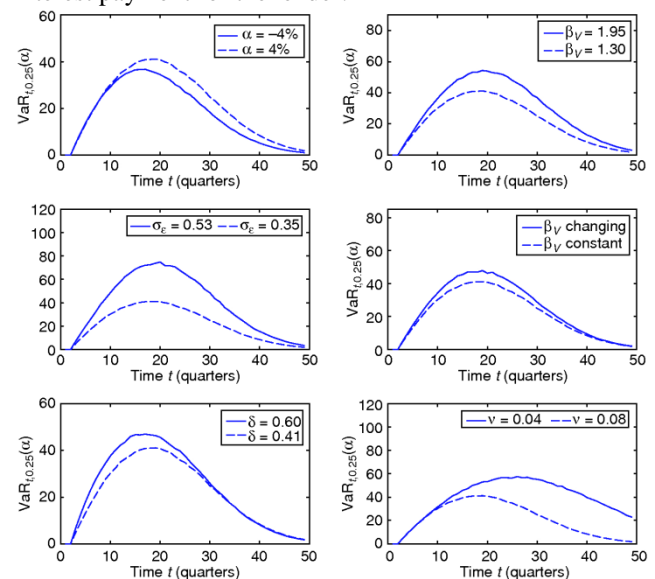


Figure 1: Numerical Analysis of Variables deployed for this study compared against time in intervals of 3 Months (A Quarter) and the associated Variance.



**Source:** Author Compiled from Matlab 9.1 (R2016b) at NIT, Surathkal on 12-Aug-2019

Hence the aspect of risk participation is a constant and equal. i.e.  $e^b = e^l = e$  and  $t^b = t^l = t$ . Moreover, we consider a new-revenue project, therefore  $v = 0$ . Both party's investments are equal and  $W^b = W^l = W$ . Capacity to pay and repay of both parties is at its maxima,  $u = 1$ . Factors complimentary to make a borrower Capacity to pay are assumed to be  $\Phi = 0.5$ , which results in  $y = W(W + 1)$ .

Both  $z$  and  $(\frac{a+1}{2})$  are now similar and have a shared value of unity, hence

$$y = z \frac{a+1}{2} = 1 \quad \dots\dots\dots (16)$$

It is assumed that the lender makes the decision on the risk participation level. Given that the lender initiates the risk sharing mechanism, it is uniform to assume that, the greater quantum of knowledge transferred and business opportunities for booking profits within the dynamic market are shared with the borrower in the entire cycle of the loan, the aspect of "Capacity to Repay" gets reinforced with the borrower. This method of "Capacity Building" in the chosen activity at real-time directly leads to the optimal profits of the lender and the calculation can be.

$$A^* = \frac{W(W + 1)(e + \Pi)}{2M(1 - k)} \quad \dots\dots\dots (17)$$

The risk participation quantum  $A^*$  is now computed into the possibility of booking a profit from the activity chosen by the borrower. To enable estimation and calculation of the level of profit the borrower can book from operations in the chosen activity (business), the factor iteration which as defined in (8) can be represented as the borrower's profit, that does not get translated to the lender in terms of the equated monthly installment. The propensity to book a profit can be represented by

$$k^* = \frac{e + (2 - 3\Pi)}{3e + (2 - \Pi)} \quad \dots\dots\dots (18)$$

It is obvious that  $k^*$  is feasible if and only if  $\Pi < \frac{2}{3}$ .

The desired outcome for participating in the risk function when factored into the profit/income level for both the participants (lender and borrower).

The achieved profit translated into the lender " $\Pi$ " is an optimal Game Theoretic Solution (Nash Equilibrium)

$$\frac{\max \pi_B}{0 \leq \Pi \leq 1} = \pi_l \pi_b \quad \dots\dots\dots (19)$$

The study sets  $W = \frac{1}{10} = 10$  and  $t = 100e = 1$  as the highest profit from the risk participative approach as per NASH and when  $\Pi^* = 0.5$ .

Then the yield is  $k^* = 0.341$  and  $A^* = 0.4198$ . These results, assert that, given the parameters of the establishment of a business involving the extension of non-collateralized loans, it is pivotal that the repayment is regular and profit translation enables risk participation, channels efforts to educate, handhold, and by ensuring timely training mechanism, as per the numerical results when systematic delivery of the knowledge sharing variables is consistent, the borrowers make a third of profit after the repayment of the loan principle to the lenders.

## VI. CONCLUSION

The study integrates multiple dimensions of the risk participation process and derives an analytical method that evidenced desired results of profit sharing by lenders and borrowers (tribal women). The derived method provides an explanation on how the educational dimension works in the risk participation approach. The method visualizes the impact of risk participation on profit and expenditure in contrast to a predicament without risk participation between the lender and borrower.

This tested econometric model can help in establishing that, improving the capabilities required of those considered to be in the lower strata of the socio-economic chain, as postulated by Dr. Amartya Sen. All the Sen factors, otherwise components of Risk participation and its negotiation brings banks or lenders within the reach of attaining equilibrium (NASH) with borrowers either concentrated in one specific area or on a dispersed set across multiple geographies.

Enablement of this model and by structuring suitable educational and training programs involving both the stakeholders (Borrowers & Lenders) people in India will be deemed as capable (either Rural or Tribal) to interact with economic facilities and improve their bargaining position. A risk participative model may very well bring forward development in the country to expand capabilities of the poor. Further studies can be extended to multiple dimensions with co-linearity determination approach and yield measurement. Investments to improve capacity and Capacity to repay, forward integration expenditure, tailor-made training programs are going to change the output against expected losses. This method will be scalable to all sets of lenders and borrowers. These cases must be looked into to investigate if the model that has been developed matches the requirements of real life risk participative activities.

The need for segregation of the borrowers set, comprising of uniformed poverty stricken population who are made to absorb millions of debt (high cost) has an impact on their very livelihood and as can be linearly forecasted, the propensity to make a loss and default does not only have an economic effect, but also pushes the already poverty stricken population into abject poverty and with huge debts with no means of repayment.



This loss translates to the lender who also has to suffer, and this situation can be improved, by raising the standards of the borrower (Capability – Capacity Building). This need is emphasized by the Rs. 508.095 Crore NPA distributed among 1,328 tribal SHG groups comprising of 14,692 poor tribal women borrowers in Andhra Pradesh who can be alleviated from social exclusion.

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