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Effect of Microfinance on Vulnerability, Poverty and Risk in Low Income Households

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Abstract

Uncertainty and unpredictability faced by low-income households increase their vulnerability making poverty even more unbearable. India's National Bank for Agriculture and Rural Development (NABARD)-initiated Self-Help Group (SHG) program, which is currently the largest and fastest growing microfinance program in the developing world, has been aggressively promoted as a way of combating poverty. This paper investigates whether or not SHG participation results in reducing poverty and vulnerability. A theoretical framework is developed to examine the mechanisms through which the pecuniary and non-pecuniary effects of the SHG program on the beneficiaries' earnings and empowerment, influence their households' ability to manage risk. Going beyond the traditional poverty estimates, we use a vulnerability measure which quantifies the welfare loss associated with poverty as well as different types of risks like aggregate and idiosyncratic risks. Applying this measure to an Indian panel survey data for 2000 and 2003, we find that SHG members have lower vulnerability as compared to a group of non-SHG (control) members. Furthermore, we find that the poverty contributes to about 80 percent of the vulnerability faced by the household followed by aggregate risk.

JEL Classifications: D14, G21, I32.
Keywords: Microfinance, Vulnerability, Poverty, Risk Coping.

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1. Introduction

In recent years, there is a growing concern on the extent of vulnerability among low-income households. Much of this concern is related to the effect of market liberalization policies that accompanied globalization trends. Since the early 1990s, India reversed the state-led economic policies that had characterized its economy in previous decades (Little and Joshi 1994). Precipitated by the 1991 balance of payments crisis and high levels of debt, the Indian government opened up the economy, gave the market a greater role in price setting by liberalizing interest rates, and increased the private sector's role in development and market competition, following the loan conditionalities of the World Bank and IMF. The intent of these reforms was to speed up growth and thereby reduce poverty (Sen and Vaidya 1997, World Bank 2000).

Thus far, these expectations have not been fulfilled, given the persistence of poverty amidst the economic growth experienced by India in recent years. Moreover, there is increasing concern that the impact of these policies have adverse distributional consequences. The Gini index has risen from 30 to almost 38 from 1991 to 1997. In 2005, the Gini coefficient for India was calculated at between 0.37 and 0.42, according to varying estimates. The distributive allocation of risk associated with market liberalization is likely to be more problematic for poor households. The insecurity of incomes in the current macroeconomic environment has far-reaching effects in terms of inducing vulnerability especially among rural, asset poor households. Income variability that arises from fluctuations in harvests, farm input and output prices and informal, non-farm employment affects the households' ability to manage risk. Thus, even though average household incomes do not fall into poverty levels, their degree of vulnerability can be high, creating problems of borrowing, repaying debt and managing risk.

In this regard, there has been an increased interest on the role of community-based organizations such as microfinance programs to address these concerns and needs of poor households that markets and governments fail to adequately meet. More specifically, a growing number of studies have examined the extent to which self-help microfinance groups characterized by decentralized manner of interaction as well as

participatory decision-making processes enable them to be receptive to the needs of women in poor households and thereby help alleviate poverty (Goetz 1997, Ackerly 1997, Pitt et al. 1998, Morduch 1999, Mosley, 2001, Amin, Rai and Topa 1999, Puhazhendi and Badatya 2002, Sebstad and Cohen 2001, De Aghion and Morduch 2006). The issue of women's empowerment has also been addressed in studies on women-focused microfinance programs (Mayoux 2002, Rankin 2000, Bali Swain 2007). There remains, however, the question of whether, by providing financial and other related services to rural households, these groups are effective in reducing their vulnerability thereby enabling households to make productive investment and not withdraw critical resources in times of income or expenditure shocks. Microfinance organizations can affect household outcomes through a variety of channels. These include the direct income effect, *indirect income* effect through non-financial benefits such as added training and education and, *non-pecuniary effects* such as strengthened social networks and better self-esteem (de Aghion and Morduch 2006). Recent studies have expressed concerns regarding the adequacy of income-poverty measures alone in understanding vulnerability (Glewwe and Hall 1998, Calvo and Dercon, 2005, Carter and Ikegami 2007, Ligon and Schechter 2002, Dercon and Krishnan 2000, Dercon 2005). The cumulative impact of microfinance organizations on household vulnerability may therefore not be captured by standard income poverty measures alone.

Our objectives in this paper are two fold. One is to examine an important dimension of household welfare that conventional measures of poverty do not address, namely the ability of households to cope with risks, idiosyncratic as well as aggregate or covariant. In particular, we want to understand the realities pertaining to the economic situation of rural low-income households by exploring the determinants of vulnerability. Vulnerability in our study is defined as a high degree of exposure to risks, shocks and proneness to food insecurity that can undermine the household's survival and the development of its members' capabilities. Our second aim is to explore directly the link between self-help microfinance (SHG) groups and vulnerability.

The paper contributes to the literature by developing a theoretical model that explains the risk-coping mechanism through which SHG participation may result in the decline

of the household's vulnerability. We take into account the varied sources of vulnerability in order to better understand the impact of self-help microfinance groups on the economic situation of women in rural households. Our construction of the vulnerability measure draws from the work of Ligon and Schechter (2003). Their measure of vulnerability allows for the quantification of the welfare loss associated with poverty as well as from aggregate and idiosyncratic risks that expose households to consumption shocks. Furthermore, the analysis is based on a unique household survey panel data that includes information on SHG member households and a control group.

India's National Bank for Agriculture and Rural Development (NABARD) has initiated a self-help group (SHG)–bank linkage program in 1996 and since then has become the largest microfinance program in the developing world. Mainly targeting women, it has reached an estimated 121.5 million individuals by March 2005, using a network of 41,082 bank branches and 4,323 non-governmental organizations (NGOs). The SHG program survey data of 1025 household sample offers detailed information on consumption, variability in incomes, credit, and relevant household and individual characteristics for two time periods namely 2000 and 2003. Its sampling design enables us to compare the economic situation between SHG beneficiaries (treatment group) and non-SHG beneficiaries (control group).

Section 2 discusses the notion of vulnerability and the varied measures used in a number of studies. By examining the pecuniary and the non-pecuniary effects of SHGs, we then develop a theoretical model that explores why and how participation in the SHG program may influence a household's ability to manage risk, thereby resulting in declining vulnerability. Section 3 provides the context of our study and discusses the Ligon and Schechter vulnerability measure that we utilize. Section 4 provides an overview of the sample data used in the analysis along with the main empirical results. We show that vulnerability is significantly lower among households who belong to SHG (treatment group) compared to those who are not (control group). The paper concludes with policy implications and suggestions towards a better understanding of vulnerability.

2. Vulnerability and Risk

2.1 Understanding Risk and Vulnerability

While vulnerability is defined in a number of ways, we define it here in terms of the household and its members' ability to deal with risks, shocks and proneness to food security and hence their attitude towards undertaking risks.[3] When households face such multitudes of risks, they are prone to severe hardship so that the subjective probability attached by household members towards adverse outcomes is likely to be high.

Vulnerability is prevalent in rural low income households as several studies have shown because the magnitude of risk that they face is striking, particularly for those who live in the rain-fed areas and their subjective judgment regarding the likelihood of shocks is high. The threat of loss of or decline in farm earnings is brought about by environmental conditions that affect their output such as weather leading to drought or floods, pests, and by market fluctuations that lead to changes in input and product prices. Yield risks are especially significant when agricultural price and other supports are inadequate or non-existent. There are other types of risk as well, induced by the possibility of income decline in non-farm activities. In addition, unexpected shocks due to illness, death, etc are anticipated given the health-related environment and poor medical services situation they face. These shocks can lead to substantial loss of income, wealth and/or consumption. These variety of risks translate into such commonplace concerns as being able to eat three meals a day, afford to pay school fees for children, to seek medical assistance when ill, to buy inputs and even to repay loans. Vulnerability therefore relates to the claims or rights over resources in dealing with risk, shocks, and economic stresses.

It is now widely acknowledged that a major aspect of people's livelihoods involve mechanisms to cope with risk and shocks. Hence, households will make certain decisions in anticipation of or to mitigate the threat to its well-being of failure or

[3] In the literature on risk and poverty, there is a distinction made between precautionary strategies towards risk and *ex-post* strategies after a shock or economic crisis. Both *ex ante* strategies (precautionary) and *ex- post* strategies (managing a loss) for dealing with risk involve a mix of intra-household measures (self-insurance) and inter-household measures (informal and formal insurance).

occurrence of shock. Rural, low-income households in particular have developed a number of mechanisms to buffer themselves from or at least minimize the effects of shocks (Zimmerman and Carter 2003, Dercon 2005 to name a few). These include reciprocity agreements; the use of assets as buffer stocks; and multiple cropping, and other livelihood diversification strategies. First, households have mechanisms to cope *ex-post* with shocks, to smooth consumption and nutrition when shocks happen, even if formal credit markets and insurance are not available. They may use savings, often in the form of live animals, built up as part of a precautionary strategy against risk, or engage in informal mutual support networks, for example, clan or neighborhood based or even more formal groups such as funeral societies.

As Zimmerman and Carter (2003) have shown in their study on asset smoothing, low-income households will even do some trade-off between a higher income involving greater probability of income failure (and higher debt) and a lower income involving smaller probability of income failure. In other words, there is tendency to be risk averse, which means that the households/individuals are prepared to accept lower income for greater security, when the risk of having a bad outcome can seriously undermine household survival.

The presence of self-help microfinance groups such as those linked with the National Bank for Agriculture and Rural Development NABARD in a given village can help to some extent, the member-households in the face of risks especially in the absence of social protection or insurance schemes. For instance, members of a SHG may share each other's risk through the institutionalized arrangements, by loans to those members whose income temporarily is relatively low. Recent studies on the effects of negative shocks or crises on poor households have demonstrated that microfinance schemes can play a role in consumption smoothing and in managing loss from shocks (Puhazhendi and Badatya 2002). The loan provision component of self-help groups is one part of the risk management and income generation feature that enable households to cope with the basic requirements and contingencies of life.

In addition to the *income effect* of loan provisioning, SHGs can promote or help strengthen those social networks providing mutual support by facilitating the pooling of savings, regular meetings, etc. The *non-pecuniary effect* of SHGs can help reduce

the vulnerability of the members and by association, that of their households in ways that may not be adequately captured by change in household earnings. A growing number of studies on micro-credit have highlighted, for example, the empowerment effect on women members (Bali Swain and Wallentin 2007). This involves a significant change in attitude, changes in working practices and challenging prevailing norms that constrains the ability of women to pursue income-generating activities or other interests. Such constraints may be directly due, for example, to cultural ascriptions that prohibit women from working outside the home. But even without explicit constraints of this kind, the socially assigned roles of women to household responsibilities suggest that their ability to participate in income earning opportunities outside the household or farm is likely to be more circumscribed or conditional than is the case for men (Bali Swain 2007).

Regular meetings and exchanges of SHG members can modify the constraints and options of members and their families by reinterpreting or challenging social prescriptions on permissible courses of action that women can take. SHGs provide a regular forum for women to come together to discuss their concerns and interests. Since questioning of prevailing norms does not happen automatically, it is the regularity of collective sharing of information and organizational skills/coping strategies that eventually can bring about change in attitude, including dealing with risks. The impact of SHG therefore goes beyond provisioning of loans to meet any liquidity constraints faced by the household. To the extent that SHGs also provide other non-financial services such as training and the use of group meetings to discuss communal issues can affect the ability of households to undertake risk in productive investment. The overall effect of SHG on both the means and the manner in which households deal with risk can significantly affect the capabilities and entitlements of the household members in ways that are not captured by strictly finance-oriented program evaluation.

The effect on vulnerability is further captured by the *non-pecuniary effect* in the form of added resilience of SHG members, where resilience means the ability to deal with risk, particularly idiosyncratic risk, given the strengthened social support scheme. Hence, NABARD–sponsored SHGs are likely to reduce the vulnerability of the members' household not only through the *income effect* that increases total

consumption levels but also through *their non-pecuniary effect* that are not captured by focusing on changes in incomes.

On the other hand, the characteristics of rural livelihoods in developing countries like India often exhibit high correlations between risks faced by households in the same village or area. Hence when farm prices decline, or there is a drought or flood in the area, all households are adversely affected simultaneously. Group-based systems including SHGs are found to be ineffective in the face of 'covariate' shocks, including flooding or problem of declining crop prices or lack of demand for their produce.[4] Thus while SHG groups can be of help in cases when a household faces an idiosyncratic shock, the protection afforded by SHG in dealing with aggregate shocks is likely to be weak or partial. Moreover, the impact of SHGs on socially ascribed rules that limit or constrain women in their choices and economic participation may depend on the tenacity of such norms. The prevailing social institutions through which women's decisions and choices are mediated may be overwhelmingly strong and resilient that they can still suppress opportunities for women. This social embeddedness of individual or household actions need to be kept in mind when acknowledging the non-pecuniary impact of self-help microfinance groups. In this case, one may observe that the resulting effect of SHG on vulnerability is limited.

2.2 Theoretical Framework

We present a theoretical framework in this section that explains the decline in vulnerability in the presence of uncertainty; and to show that SHG member households are likely to respond to risks or behave differently towards productive opportunities as compared to the non-SHGs (control households). Based on the discussion in the previous section, we present a simple analytical framework for understanding the effect of SHGs on household vulnerability. More specifically, we examine why and how a household's participation in a SHG may influence a household's ability to manage risk using a von Neumann-Morgenstern-based utility

[4] Surveys of this literature are in Townsend (1995), Bardhan and Udry 1999, Dercon 2005, Zimmerman and Carter 2003, Deaton (1997), Morduch (2004).

function to capture risk preferences.[5] To make our model comparable with the Ligon-Schechter methodological approach to measuring vulnerability, we adopt some features of their utility function, specifically the idea that household welfare (or expected utility) is an increasing, concave function of consumption expenditures, c.

We assume that each household 'i' is an economic actor that makes decision on how much risk to undertake, given its propensity to manage it.[6] We examine whether, for a given level of earning, a SHG-member household (S), is better able to cope risk compared to a similar household who is not a SHG member (N). Consider the following household objective function in a two-period model which is strictly increasing, weakly concave function:

$$U^i = U[c^i_t)], \qquad t = 1, 2 \tag{2}$$

where U^i refers to a household's *welfare or utility*,[7] c^i is a vector of goods and services consumed by household 'i' at period t. In the first period, c^i_1 is given by:

$$c^i_1 = Y^i_1 - R^i_1 \tag{3}$$

where Y^i_1 is income in the first period and R^i_1 are resources used to cope with any income shock or unanticipated expense.

Household consumption in the second period is given by:

$$c^i_2 = Y^i_2 + R^i_1 (1 + \sigma) \tag{4}$$

[5] Recent studies including Ligon and Schechter (2003) have used some variant of the "expected utility" function as the basis for measuring vulnerability.

[6] The model presented here follows the work by Leland (1968) and Sandmo (1970).

[7] Our study focuses more on the notion of household welfare rather than on household utility. While the latter is defined as an abstract measure of satisfaction, welfare is defined as the physical, social, and mental development of human capabilities obtained by means of access to and consumption of basic commodities (such as food, health care, education, and shelter), participation in activities. For a more detailed discussion of this topic, see Floro (1995). Although there are obvious links between economic welfare and utility, they are not necessarily closely connected.

where Y^i_2 is future income which is not known in period t = 1, and σ is the give discount rate. The household's beliefs about the level of future income can be summarized in a subjective probability density function $f(Y^i_2)$ with mean ξ. On this basis we obtain the following expected objective function (in the von Neumann-Morgenstern sense). Substituting (3) into (4), we can obtain:

$$c^i_2 = Y^i_2 + (Y^i_1 - c^i_1)(1 + \sigma) \tag{5}$$

So that the expected objective function is:

$$E[Ui(c^i_t)] = \int A[c^i_1, Y^i_2 + (Y^i_1 - c^i_1)(1 + \sigma)] f(Y^i_2)\, dY^i_2 \tag{6}$$

where integration is over the range of Y^i_2. Maximizing c^i_2 with respect to consumption at t =1, we obtain the first order condition,

$$D_1 = E[U^i_1 - (1 + \sigma) U^i_2] = 0 \tag{7}$$

and the second-order condition,

$$D_2 = E[U^i_{11}] - 2(1 + \sigma) U^i_{12} - (1 + \sigma)^2 E[U^i_{22}] < 0 \tag{8}$$

Differential access to credit as well as to savings facilities, can lead to differences in incomes earned by SHG-member ($i=S$) and non-SHG member households ($i=N$). In particular,

$$Y^N_t < Y^S_t \text{ for household i} \tag{9}$$

If households' perceived future earnings are assumed to be the same, the effect of an increase in income, say of Y^i_1, can be found by implicit differentiation of equation (7):

$$\partial c^i_1 / \partial Y^i_1 = -(1+\sigma) E[U^i_{12} - (1+\sigma) U^i_{22}] / D_2 > 0 \tag{10}$$

This implies that:

$$U_{12} - (1+\sigma) U^i_{22} > 0, \quad E[U^i_{12} - (1+\sigma) U^i_{22}] > 0 \tag{11}$$

Note, however, that the sign of equation (10) cannot be determined *a priori* in the case where the perceived future earnings of households are assumed to differ, on the basis of their SHG participation. It is possible that even at lower levels of income, SHG households use less of their resources compared to non-SHG households in order to deal with shocks. On the other hand, SHG households may use just the same amount or more of their resources if covariant shocks such as drought or floods take place. In the case, the sign of equation (11) will be ambiguous as well.

We next examine the effects of the differences in SHG and non-SHG households' probability density function of future income and household's ability to cope with shocks. The risk coping function can be written as:

$$R^i = a^i + \psi^i Y^i, \quad i=1, 2\ldots.n \text{ households}; \quad i \in S \text{ or } N; \qquad (1')$$

$$\text{and } \psi^i \geq 0.$$

where R^i is the fall-back position level of household 'i' in the face of a shock; a^i is the level of saving, credit and other resources available to the household *i* for coping which do not depend on participation in SHG, ψ^i is the propensity of a household to deal with shock, and Y^i is household income.[8] A higher ψ reflects the household's ability to set aside a larger portion of household income in order to cope with shock. The more a household is able to cope with shocks, that is, the higher the R, the less vulnerable is the household. In this sense, household welfare depends not just on its average income or expenditures, but on the risk it faces as well as its access to resources in dealing with shocks. Minimizing or reducing vulnerability is therefore similar to maximizing utilitarian household welfare function subject to aggregate resource constraints.

Rather than assume that ψ^i is uniform across households, we explore the likelihood that participation in SHG not only leads to differences in household income Y^i due to the earnings effect. It also yields different subjective propensities[9], that *is,* for the

[8] The idea here is similar to the risk coping behaviour addressed in Townsend (1995), Sebstad and Cohen (2001), Bardhan and Udry (1999), Dercon and Krishnan (2000) and Ellis (1998) to name a few.
[9] Vulnerability is treated here as a subjective perception based on the household's experience of both aggregate and idiosyncratic shocks, their resources (social and financial) when shock occurs, as well as the household's perception about its future income flows.

household 'i', the propensity of the household to cope with shock, ψ^i, is greater if household is a SHG member. This is due to the non-pecuniary impact of SHG through strengthened social cohesion and increased empowerment of its members. The reasons for this difference, as discussed earlier, are varied. For illustrative purposes, and without loss of generality, we will focus on only two in this model. These are: a) differences in perceived household income in the future resulting from pecuniary (direct earnings) effect of SHG *(*call this *Π)*, and b) differences in perceived risk resulting from their different levels of social support and cohesion *(*call this *Ξ*). The difference in perceived earnings is reflected in the agency function while the difference in perceived risk is reflected in the ability to cope with unexpected shocks, defined by the (subjective) probability distribution of future income $f(\mathbf{Y}^i_2)$ with mean ξ.

The SHG-member households' strengthened mutual support system and improved access to credit and savings facilities will cause SHG household's probability distribution of Y_2 to differ from that of a non-SHG member. This is demonstrated by two kinds of shifts in the SHG's probability distribution of Y_2. One is an additive shift, θ, which is equivalent to an increase in the mean with all other moments constant. The other is a variance shift, γ^i, by which the distribution is more dispersed (or stretched) around zero. A higher dispersion in the probability distribution of future income, as in the case for non-SHG, is equivalent to a stretching of the distribution around a constant mean—that is, a combination of additive and variance parameter changes in the household's probability distribution.

For the sake of simplicity, let us examine the effect on present consumption smoothing of a decrease in the perceived degree of risk concerning future income for a given household. Holding other factors constant, we then test whether a decrease in the SHG household's uncertainty leads to an increase or decrease in present consumption, and hence, a decrease or increase in risk coping ability. Let the expected value of future income for a household (we now drop the subscript i) be written as:

$$E\,[\gamma Y_2 \;+\; \theta] \qquad (12)$$

where γ is the variance shift parameter and θ is the additive one. Because $Y_2 \geq 0$, a variance shift around zero will increase the mean. This has to be counteracted by an additive shift in the negative direction in order for the expected value to remain constant. Differentiating (12), the requirement is that:

$$dE\,[\gamma Y_2 \;+\; \theta] \;=\; E[Y_2\, d\gamma \;+\; d\theta] \;=\; 0, \qquad (13)$$

which implies:

$$d\theta/d\gamma = -\,E[Y_2] = -\,\xi \qquad (14)$$

We can now substitute (12) into the first order condition (7), and then differentiate present consumption c_1 with respect to γ, which yields:

$$(\partial c_1 / \partial \gamma) \;=\; -\,1(1/D_2)\; E\,[(U_{12} - (1 + \sigma)\, U_{22})\, (Y_2 - \xi)] \quad < \quad 0 \qquad (15)$$

Equation (15) shows that a decrease in perceived risk by a rural household, manifested as a decreased dispersion around future income, is likely to increase its risk coping ability and hence increase its present consumption. (The proof of this result is set out in Appendix A). That is:

$$\partial \mathrm{R}_1 / \partial \gamma > 0 \qquad (16)$$

One implication of the results of this model is that a household's risk coping ability is affected not only by the change in earnings in a given time period, but also by the person's perceived future earnings (*Π*) and perceived risk (Ξ). Insofar as SHG households' perceived future earnings and perceived risk differ from non-SHG households, they are likely to manage or deal with risk differently. This implies that a participation in SHG is likely to affect household consumption smoothing ability so that Ξ is lower and it enhances their perceived future earnings, *Π*.

3. Measurements of Vulnerability

In recent years, a growing number of studies have brought attention to the crucial role played by risk and vulnerability especially in rural households. Dercon and Krishnan (2000) study of rural households in Ethiopia explored the variability in poverty over time, and the risk of low consumptions that many household face. In their analysis of households' vulnerability, they focused on the response of households' consumption expenditures to various observable shocks including droughts or idiosyncratic fluctuations in income. Glewwe and Hall (1998) measure vulnerability on the other hand, in terms of the response of the household's consumption to aggregate shocks, i.e. the changes in the locus of consumption is the measure of vulnerability. Some studies such as Christiansen and Subbarao (2004), and Morduch (2004) view vulnerability as expected poverty whereby poverty is measured by Foster-Greer-Thorbecke indices. More recently, Calvo and Dercon (2005) examines the extent of the famine impact on the consumption of rural households in Ethiopia, as measured by the index of severity of coping strategies, strongly affected consumption growth. This index which used information in 1984/85 was then included in a consumption growth model.

For our purposes, we adopt the approach used by Ligon and Schechter in measuring vulnerability. Ligon and Schechter (2003) chose normalized units for consumption expenditures. Vulnerability for the population is therefore computed by summing household vulnerability across all households. The implication is that if every household consumes the same level for sure and no household bears any risk, then there is no vulnerability (and hence no relative poverty). There are two steps involved in estimating vulnerability. First, they estimated the distribution of future consumption expenditures for every household using a twelve month-time period panel Bulgarian household survey. This is performed by take a strictly increasing concave utility function that compares the utility of expected per capita consumption under certainty, with the expected utility of the actual per capita consumption, U E(c). That is, $U^i(c) = (c^{1-\gamma})/(1-\gamma)$. Note that the parameter γ in their utility function is the same as $(1 - \psi)$ in our model in Section 2.2[10] They then constructed a statistic from this estimated distribution that is used to capture the reduction in household welfare

[10] Estimates of vulnerability, poverty, and risk are sensitive to the choice ofγ, which affects the shape of the $\{U^i\}$. The relative magnitudes of these components are less sensitive as greater concavity reflects greater welfare losses associated with risk and inequality. Based on the estimates of the parameters found in the micro econometric literature, like Ligon and Schechter (2003), we take γ=2.

due to risk in household consumption expenditures. Vulnerability in this case depends not only on the mean of a household consumption but also on variation in consumption. Hence in their model, the difference in vulnerability between two households depends on the differences in the mean and variances of their respective consumption expenditures over time. In other words, vulnerability can be decomposed into distinct components reflecting poverty and risk, respectively. The poverty component involves no random variables and is simply the difference between a concave function evaluated at the mean (referred to as "poverty line") and at household i's expected consumption expenditure. The concavity of U implies that as E(c) approaches the poverty line, an additional unit of expected consumption has diminishing marginal value in reducing poverty.

The second component of their vulnerability is an ordinal measure of the risk faced by household *i*. Now, this risk measure can is further decomposed into two distinct measures of risk, one aggregate, the other idiosyncratic. Let $E(c_i|x)$ denote the expected value of consumption, c_i, conditional on knowledge of a vector of aggregate variables, say *x*. Then we can decompose the risk household *i* faces into the following components namely: a) aggregate risk facing the household, that is the expected value of consumption, conditional on knowledge of a vector of aggregate variables and b) idiosyncratic risk which can be attributed to variation in time-varying household characteristics. They also acknowledge the presence of unexplained risk which can neither be explained by these time-varying household characteristics nor aggregate variables and is due to the variation in unobserved characteristics and measurement error.

Our empirical analysis differs from Ligon and Schechter's study in three ways. First, the time scale over which vulnerability is being measured is between two time periods spanning three years. Hence, the errors involved in our predictions may differ, given the model's underlying properties. Second, we disaggregate the household sample on the basis of their participation (or lack thereof) in self-help groups in the village. The quasi-experimental sampling design takes into consideration the comparability of the household characteristics in these two groups in order to avoid or minimize the problem of attribution. Third, rather than using the average per capita food consumption as the certainty-equivalent consumption to which we base our measure

of relative vulnerability, we use the official poverty line definition in India. Our focus is on minimum necessary food expenditures for rural households, as it is widely agreed that it is a relevant basic capability and an operational basic need indicator to use. Appendix B provides details for this estimation. Finally, we take the log-linear consumption function in our model specification instead of a linear function.[11]

Hence, we adopt the following steps in our measurement of vulnerability. We first adopt the household welfare (or utility) function $U^i(c) = (c^{-\psi}))/(-\psi)$ or $U^i(c) = (c^{1-\gamma})/(1-\gamma)$ since $(1-\psi)$ is equivalent to γ for some parameter $\gamma > 0$. Assume for any household probability distribution of consumption. We estimate a log-linear consumption prediction equation: $\log \hat{c}^i_t = \hat{\alpha}^i + \hat{\eta}_t + \hat{\beta}' x^i_t + \hat{\mu}^i_t$ for two periods. We then use restricted least squares to estimate the following:, $\hat{\alpha}, \hat{\eta}, \hat{\beta}', \hat{\mu}$ in order to construct the conditional expectations. The components of vulnerability are then regressed on pertinent household characteristics. We apply this method using the survey data in the following section to examine the impact of SHG on vulnerability.

4. Impact of Self-Help Groups on Vulnerability

4.1 Data Description

The data used for the empirical analysis in this paper is part of a larger study that investigates the impact of SHG (Self Help Group)-bank linkage program of the National Bank for Agriculture and Rural Development (Nabard) in India. Initiated in 1996, the SHG is the largest and fastest-growing microfinance program in the developing world. Mainly targeting women, it has reached an estimated 121.5 million individuals by March 2005, of which about 90 per cent are women, and has disbursed more than 1.74 billion USD in cumulative bank loans, using a network of 41,082 bank branches and 4,323 non-governmental organizations (NGOs).

[11] Using levels of expenditure with linear prediction equation may sometimes lead to negative levels of consumption.

In this study, we make use sample data on 1025 rural households in ten representative districts, two each in five states[12] in India, collected for 2000 and 2003. To address the likely problem of attrition, the household survey made use of a quasi-experimental design in its sampling method.[13] First, SHG member-households were randomly chosen in each district. Then, members of the control group were chosen to reflect a comparable socio-economic group as the SHG respondents. These were selected from villages that were similar to the SHG villages in terms of the level of economic development, socio-cultural factors and infra-structural facilities, but did not have a SHG program (Bali Swain, 2003).

We focus our investigation on a sample of 1025 households of which 858 are SHG members and 167 belong to the control group. Table 1 presents the characteristics of the rural households in the sample. Nearly all (94.5 percent) of our respondents are women. About two-thirds (66 percent) of the total sample have not attended school at all and only 17 percent have at least secondary education. Overall, the monthly income per capita of the sample households increased between 2000 and 2003 by 25 percent. Likewise, there was a small improvement in average household wealth as indicated by the slight increase in the size of average cultivated land, owned landholding size and in the real value of total household assets during the same time period.

[Table 1 about here.]

Table 2 presents the monthly expenditures and incomes of the SHG member households (treatment group) and the non-SHG households (control group) in real terms. That is, we adjusted the 2003 values using the rural CPI index of India with 2000 as the base year. On average about 48.7 percent (52.5 percent) of the total

[12] These states (districts in parentheses) are Orissa (Koraput and Rayagada), Andhra Pradesh (Medak and Rangareddy), Tamil Nadu (Dharamapuri and Villupuram), Uttar Pradesh (Allahabad and Rae Bareli), Maharashtra (Gadchiroli and Chandrapur).

[13] The "problem of attribution" refers to the difficulty in establishing unequivocally that the observed changes in the economic and social status of the members of the SHGs, are induced by the formation of SHGs and the related component of micro finance, and not as a consequence of other possible causes arising due to the changing economic, political, social, cultural or policy environment. To address this problem, a quasi-experimental design is chosen whereby information is collected on the SHG households and a control group, which contains information on non-participating households of similar household characteristics. The difference in the results of these two groups would therefore reflect the real impact of SHG bank linkage program.

expenditure in 2003 (2000) was on food. Adding the household expenditure to food, this figure rises to 81.5 percent (82.7 percent) of the total expenditure in 2003 (2000). This high percentage of basic expenditure (without even taking the expenditures related to housing (if any), electricity, water etc. into account) shows that majority of the households in rural areas are very close to poverty if not below the poverty line. Although SHG households have lower wealth compared to non-SHG households, the former have higher average food and total expenditures per capita compared to non-SHG households in both years.

[Table 2 about here.]

4.2. Empirical Analysis

We next decompose vulnerability on the basis of its three identified attributes, namely the part that is attributed to income-based poverty (for instance, household's income falls below the poverty line), the part attributed to covariant (or aggregate) risk; and the part attributed to idiosyncratic risk. The idiosyncratic risk in this study is captured by variation in income stream as well as the following time-varying household variables namely: changes in family size which affects the incidence of illness or health shocks and changes in labor resources as proxied by the proportion of household members that are working and the proportion of household members engaged in primary activities. There is also some risk that can neither be explained by the observable household characteristics nor the aggregate variables in our model; hence we also take into account any unexplained risk that is due to variation in unobserved characteristics as well as to measurement error.

As in Ligon and Shechter (2002) study, the poverty measure in our study involves no random variable. In this study however, it is simply the difference between the concave function evaluated at the poverty line for the given period and the household i's expected consumption expenditure. The different risks components rely on variation over time and we estimate the conditional expectations. In other words, the various components of vulnerability are drawn from the deviation from the average consumption or consumption deviation. These are predicted and the mean values of these predictions are the values of vulnerability, poverty, aggregate risk, idiosyncratic

risk and unexplained risk. Based on the above method, we then obtain the calculated percentage welfare loss due to each component of vulnerability.

To compute the household's vulnerability and its components using actual data we follow the Ligon-Shechter utility-based decomposition approach. The log real per-capita consumption is then regressed on real per-capita income and the ratio of the households members engaged in primary activity with respect to the household size. Restricted least squares is used to calculate the various conditional expectations. Simple averages of household panel are then used to estimate vulnerability and its decomposed components of poverty, aggregate risk, idiosyncratic risk and unexplained risk. Note that the consumption and income variables are in real per-capita terms (refer to Appendix C for details). The economic activity status of the respondent household is given by whether the respondent is working in a primary activity or not.

The correlates of vulnerability and its components are then estimated by cross-sectional regressions for each component separately on a set of fixed respondent and household characteristics. These respondent and household characteristics are sex and age of the respondent; her literacy level given by primary, secondary and college education; size of owned land and size of cultivated land (refer to Appendix C for details); and regional state dummies.

Tables 3 and 4 (first row) provide the estimation of vulnerability as well as the decomposition of food-consumption based vulnerability for SHG member households and non-SHG households respectively. Following Ligon and Shechter (2003), the percentage welfare loss from vulnerability is assumed to be equal to the size of the vulnerability.[14] We find that the estimated overall vulnerability in terms of percentage welfare loss for SHG household is lower (0.1708) compared to non-SHG households (.217). In other words, SHG households are only 17% likely to have variation in their food consumption and in falling below the estimated food poverty line while non-SHGs have nearly 22% probability. Note that we have computed the normalized units

[14] Note that the manner in which utility (or welfare) function is defined in their study, the utility (or welfare) from perfect equality (i.e. steady or uniform consumption level) in a riskless society is equal to 1.

for consumption expenditures. Vulnerability for the population is therefore computed by summing household vulnerability across all households.

Next we estimate the contributions of each component of vulnerability. Poverty is the single largest source or component of vulnerability, based on the magnitude of its coefficient or the share of welfare (utility) loss. This magnitude, however, is higher in the case of non-SHG households (0.175) compared to 0.1312 of SHG households). This implies that an important effect of SHG on vulnerability is its contribution in terms of its *income (*poverty reduction) *effect* among SHG households via increased access to credit (or at better terms) as well as to training. In terms of the risk components, unexplained risk (as well as measurement error) is the largest part in both SHG and non-SHG models (Tables 3 and 4), followed closely by the aggregate risk as shown in Tables 3 and 4. However, we note that the difference in the coefficients on aggregate risk between SHG households (.0175) and non-SHG households (.019) is smaller.

The explained idiosyncratic risk in both Tables 3 and 4 is quite small (.0012 and .0015), suggesting that the unobserved idiosyncratic shocks or variations in household attributes may be embedded in the unexplained risk. Overall, our results show that the non-pecuniary effect of SHG on the vulnerability of the household in terms of its ability to cope with idiosyncratic risk is not as strong as its direct income effect.

We next look at the correlates of these vulnerability components. The regression results in Tables 3 and 4 uses the following fixed characteristics namely sex, education and age of respondent as well as some state dummy variables. It can be noted that an increase in education from none to primary level of the respondents does not yield any significant impact on vulnerability nor on any of its components. Among the SHG households however, secondary education on average, significantly reduces (25 percent) the vulnerability of households compared to households where the respondent is uneducated. Among non-SHG households, it is only when the respondent has at least college education is the household significantly (56 percent) less vulnerable compared to a household where the respondent is uneducated. Much of this reduction is due to educated households having higher expected incomes, and to a smaller degree, due to significantly less exposure to aggregate and idiosyncratic

risk. For both SHG and non-SHG households, vulnerability increases significantly with family size by 10 percent. Interestingly, we find that the smaller the number of workers among SHG households, the more (11 percent) vulnerable is the household. This is because more workers per household significantly increases the expected household earnings and hence reduces poverty.

Our results also suggest that wealth proxy variables in the form of total owned landholding and total cultivated land does not affect the vulnerability of the household nor the level of risk. This could be due to the fact that most of the SHG borrowers and control households own or cultivate very small land areas for subsistence purposes. Given their heavy reliance on traditional production methods and rainfall (or weather) dependence, the size of land they operate may be inadequate to protect them from risk and poverty.

Finally, we find that SHG households living in Andhra Pradesh are likely to be 34 percent less vulnerable compared to Uttar Pradesh. While those living in Maharastra and Orissa are likely to be 35 percent and 27 percent respectively more vulnerable (see Table 3). Among non-SHG households, we find that those living in Andhra Pradesh and Tamil Nadu are likely to be 53 percent and 20 percent less vulnerable respectively compared to Uttar Pradesh, while those living in Orissa are likely to be 28 percent more vulnerable. These differences reflect the higher level of development and SHG program development in the southern states of Andhra Pradesh and Tamil Nadu. Compared to the surveyed states the south-eastern state of Orissa is relatively much more backward.[15]

Overall, our tests results show that poverty is the most significant component of vulnerability among our rural household sample, whereas aggregate risk and unexplained risk make a much lower contribution. Idiosyncratic component is relatively minuscule. These findings imply that being poor, based on food consumption poverty measure, itself is the main contributor to vulnerability.

[15] Andhra Pradesh and Tamil Nadu accounted for 48.5 percent and 12.5 percent of the cumulative number of SHGs provided with bank loans upto 2002. They were followed by Uttar Pradesh (7 percent), Orissa (4.1 percent) and Maharashtra (4 percent).

5. Concluding Remarks

This paper explores an important dimension of household welfare that conventional measures of poverty do not address, namely the ability of households to cope with risks, idiosyncratic as well as aggregate or covariant. In particular, we want to understand the realities pertaining to the economic situation of rural low-income households by exploring the determinants of vulnerability. We also examine the likely effect of self-help microfinance groups on vulnerability using an Indian household survey panel data for 2000 and 2003 by comparing treatment or SHG member households with control or non-SHG households.

We then develop a theoretical model that explains the risk-coping mechanism through which SHG participation may result in the member-household's declining vulnerability. We take into account the varied sources of vulnerability in order to better understand the impact of self-help microfinance groups on the economic situation of women in rural households.

Our construction of the vulnerability measure draws from the work of Ligon and Schechter (2003). Their measure of vulnerability allows for the quantification of the welfare loss associated with poverty as well from aggregate and idiosyncratic risks that expose households to consumption shocks. The decomposition method based on a utilitarian approach enables us to capture the effects of risk on the household's agency or welfare. Hence, we are able to assess the likely impact of self-help microfinance groups via the income effect (through access to credit, savings and training services) and non-pecuniary effect on aggregate or idiosyncratic risk. Using the data from SHGs and control households in India, our empirical tests show that SHG's microfinance program respondents are less vulnerable as compared to the non-SHG respondents (control group). Our estimates suggest that food consumption-based poverty still remains the largest component of SHGs' (76.8 per cent) vulnerability as well as the non-SHG households' (80.6 percent) vulnerability. The idiosyncratic risk that results from observable sources (like income shocks and their being not engaged in any economic activity), are insignificant in terms of magnitude and statistical significance. This might be partly due to the fact that our panel contains information on only two time periods.

Our study of vulnerability therefore suggests that poverty is the most significant source of vulnerability among our rural household sample. These findings imply that being poor, itself is the main contributor to vulnerability. Moreover, we find that SHG participation reduces the vulnerability of households, largely through its impact on poverty reduction, and to a much smaller extent, its non-pecuniary effect on risk. The little impact of self-help microfinance groups on the risk component of vulnerability suggests that non-pecuniary impact, if there are any, may take a longer time than what our data captures.

Table 1: Summary Characteristics of Sample Households

	2000	**2003**
Variable	Mean value	Mean value
Age of Respondent	31.5	34.5
No education	65.56%	65.56%
Primary education	14.24%	14.34%
Secondary education	17.07%	16.78%
Post-Secondary education	3.12%	3.32%
Family size	4.6	4.8
Real monthly income per capita	270	338.4
No. of earners per household	-	0.57
# of per capita members engaged in primary activity in the household	0.59	0.56
# of per capita members engaged as workers in the household	0.61	0.57
Cultivated land size (in acres)	1.20	1.32
Total land owned by the household (in acres)	0.86	0.96
Real value of total assets (in Rs.)	97731	124,101

Table 2. Monthly Expenditures and Incomes Patterns, by Household type. (In real terms with 2000 as base year)*

	2000		2003	
Variable	**SHG-member Households**	**Non-SHG Households**	**SHG-member Households**	**Non-SHG Households**
Food Expenditure per capita (Rs.)	246	219	308	285
Food and Basic Household Expenditure per capita (Rs.)	452	387	654	588
Total Expenditure per capita (Rs.)	755	515	1149	859
Per capita total income (Rs.)	3272	3091	4021	4260
Total value of household assets (Rs.)	92932	122,359	118,890	150,839
Proportion below Poverty Line** (per cent)	60.7%	62.3%	44.8%	47.3%

*See Appendix B for information on calculation of cultivable land, income and expenditure.
** Poverty line is defined as the proportion of households with per capita food and basic household expenditure less than Rs. 346.9

Table 3. Correlates and Decomposition of vulnerability in real per capita food and household consumption for SHG Households

Av. value	Vulnerability	Poverty	Agg. Risk	Id. Risk	Unexpl. Risk
(in utils)	.1708*** [.128 , .216]	= .1312*** [.091, .178]	+ .0175*** [.0146, .0203]	+.0012** [.0005, .0025]	+ .0208*** [.016, .026]
Variable	Coef.	Coef.	Coef.	Coef.	Coef.
Sex	0.0164 (.0747)	0.0244 (.0737)	0.00021 (.00098)	-0.00061 (.0005)	-0.0077* (.0043)
Age	-0.00023 (.0024)	-0.00066 (.002)	-.000017 (.000028)	.000045** (.00002)	0.00041** (.0001)
Primary	.017 (.0719)	0.0198 (.0705)	.000051 (.00077)	-.000041 (.00044)	-0.00286 (.0022)
Secondary	-0.259*** (.0571)	-0.2619*** (.053)	-0.003*** (.00069)	.0000019 (.00035)	0.00656 (.0047)
College edu	-0.3339*** (.1214)	-0.3190*** (.1173)	-0.004*** (.0015)	-0.00147*** (.0005)	-0.0087*** (.0032)
Family size	0.104*** (.0153)	0.1010*** (.0153)	0.0012*** (.00019)	0.00024*** (.000096)	0.00113** (.00055)
Ratio of hh members that are workers	---0.119*** (.0388)	-0.1110*** (.0386)	-0.002*** (.00055)	0.00118 (.0008)	-0.0065*** (.0021)
Ratio of hh members engaged in primary activity	-0.00033 (.0568)	-0.0014 (.0548)	0.00018 (.0009)	-0.00163*** (.0004)	0.00256 (.0041)
Total land owned	0.00041 (.01453)	0.0001 (.014)	-.000016 (.00016)	-.000052 (.0001)	0.00032 (.0008)
Total cultivated land area	-0.0107 (.01561)	-0.0102 (.0154)	-0.00012 (.0002)	-.000033 (.00002)	-0.00035 (.0003)
Andhra Pradesh	-0.3499*** (.0530)	-0.345*** (.0520)	-0.005*** (.0008)	0.00035 (.00036)	0.00127 (.0022)
Maharastra	0.35199*** (.0683)	0.333*** (.0678)	0.0036*** (.0008)	0.00048 (.0004)	0.0135*** (.0036)
Tamil Nadu	0.0196 (.0644)	0.0072 (.0631)	-0.0003 (.0008)	0.00035 (.0004)	0.0124*** (.0045)
Orissa	0.2730** (.0622)	0.2560*** (.0602)	0.0034*** (.0007)	-.0001 (.0004)	0.0132*** (.0025)
Constant	-0.2310* (.1338)	-0.2479* (.1288)	0.0137*** (.0019)	-0.00049 (.0011)	0.00402 (.007)
R^2	.31	.31	.37	.08	.06

***** Numbers in parenthesis are bootstrapped standard errors, and those in brackets are 95% confidence intervals. ***- significant at 1% level, **- significant at the 5% level and *- significant at 1% level. Uttar Pradesh is the regional default dummy.

Table 4. Correlates and Decomposition of vulnerability in real per capita food and household consumption for NON-SHG households					
Av. value Risk (in utils)	Vulnerability .217*** [.126 , .326]	= Poverty .175*** [.0817, .28]	+ Agg. Risk .019*** [.013, .026]	+ Id. Risk .0015 [.00012, .0048]	+ Unexpl. .022*** [.0141, .0319]
Variable	Coef.	Coef.	Coef.	Coef.	Coef.
Sex	-0.202 (.2244)	-0.208 (.2153)	-0.0028 (.0024)	.000047 (.0027)	0.00851 (.0086)
Age	-0.0105** (.0045)	-0.010** (.0045)	-0.0001* (.00006)	.000019 (.00008)	-.000075 (.0004)
Primary	0.0984 (.1196)	0.0961 (.1136)	0.0016 (.0017)	-0.0004 (.00092)	0.001 (.0067)
Secondary	-0.0134 (.1185)	-0.006 (.1151)	.000054 (.0016)	-0.0002 (.0016)	-0.006 (.0062)
College edu	-0.560** (.2613)	-0.538** (.2585)	-0.0085** (.0035)	-0.0034** (.0016)	-0.009 (.0108)
Family size	0.115*** (.0367)	0.1129*** (.0352)	0.0012** (.0005)	-0.0001 (.0004)	0.001 (.0019)
Ratio of hh members that are workers	-0.017 (.2183)	-0.0206 (.2120)	-0.0004 (.0027)	-0.0002 (.0027)	0.003 (.0087)
Ratio of hh members that are engaged in primary activity	-0.197 (.2275)	-0.1829 (.2285)	-0.0032 (.0028)	-0.003*** (.0015)	-0.007 (.0066)
Total land owned	-0.064 (.0920)	-0.0623 (.0919)	-0.0007 (.0011)	-.000073 (.0007)	-0.001 (.0037)
Total cultivated land area	0.007 (.0788)	0.0068 (.0771)	0.0001 (.0009)	.000044 (.0007)	0.0003 (.0043)
Andhra Pradesh	-0.529*** (.1285)	-0.523*** (.1265)	-0.008*** (.0019)	-0.001 (.0015)	0.002 (.013)
Maharastra	0.061 (.1214)	0.0531 (.1657)	0.0003 (.0019)	-0.0004 (.0018)	0.008 (.0085)
Tamil Nadu	-0.202* (.1214)	-0.199 (1216)	-0.0036** (.0015)	-0.0019* (.0011)	0.001 (.0077)
Orissa	0.284** (.1372)	0.270*** (.1341)	0.0031* (.0017)	-0.0003 (.0020)	0.01 (.0091)
Constant	0.404 (.3346)	0.367 (.3280)	0.0227*** (.0057)	0.0051 (.0065)	0.009 (.0195)
R^2	.35	.34	.40	.13	.04

***** Numbers in brackets are 99% confidence intervals. ***- significant at 1% level, **- significant at the 5% level and *- significant at 1% level. Uttar Pradesh is the regional default dummy.

Table 5. Percentage contribution to the total vulnerability for model and (in percent)		
	SHG Households	Non-SHG households
Poverty component of vulnerability	76.8%	80.6%
Aggregate risk	10.2%	8.7%
Idiosynchractic risk	0.7%	0.7%
Unexplained risk	12.1%	10.1%

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Appendix A

Mathematical Proof

This appendix provides the mathematical proof of equation (15). The differential of the perceived risk function is:

$$d\left(\frac{-U_{22}}{U_2}\right)=\frac{\partial}{\partial c_1}\left(\frac{-U_{22}}{U_2}\right)dc_1+\frac{\partial}{\partial c_2}\left(\frac{-U_{22}}{U_2}\right)dc_2.$$

This is negative if c_2 increases as c_1 decreases, e.g., so that from equation (5) in the text

$$dc_2 = 1(1+\sigma)dc_1, \quad (1+\sigma)\geq 0.$$

Substituting for dc_1, and dividing by dc_2, we then have:

$$\frac{d}{dc_2}\left(\frac{-U_{22}}{U_2}\right)=\frac{-\partial}{\partial c_1}\left(\frac{-U_{22}}{U_2}\right)+(1+r)\frac{\partial}{\partial c_2}\left(\frac{-U_{22}}{U_2}\right)\leq 0 \ .$$

We now observe that under the continuity assumption, the following holds as an identity:

$$\frac{\partial}{dc_1}\left(\frac{-U_{22}}{U_2}\right)=\frac{\partial}{\partial c_2}\left(\frac{-U_{12}}{U_2}\right).$$

The above inequality can now be written as:

$$\frac{\partial}{\partial c_2}\left(\frac{U_{12}-(1+r)U_{22}}{U_2}\right)<0.$$

We now wish to prove that the increased perceived risk hypothesis implies that the derivative of equation (14) in the text is negative. We first define

$$\overline{c_2}=\left[(Y_1-c_1)(1+\sigma))\right]+\xi$$

From equation (5), we know that:

$$c_2=\overline{c_2}+Y_2-\xi.$$

Because $[U_{12}-(1+r)U_{22}]/U_2$ is decreasing in c_2, we must have that

$$\left[\frac{U_{12}-(1+r)U_{22}}{U_2}\right]\leq\left[\frac{U_{12}-(1+\sigma)U_{22}}{U_2}\right] \quad \text{if } Y_2\geq\xi\,. \qquad \text{(E.1)}$$

Note that the right side of this inequality is evaluated at $c_2 = \overline{c_2}$ and is not a random variable. This implies that:

$$U_2(Y_2 - \xi) \geq 0 \qquad \text{if } Y_2 \geq \xi .$$

Multiplying both sides of equation (E.1) by $_2 (Y_2 - \xi)$, we obtain the following:

$$\{[U_{12} - (1+r)U_{22}](Y_2 - \xi)\} \leq \left[\frac{U_{12} - (1+r)U_{22}}{U_2}\right] \cdot [U(Y_2 - \xi)] \quad \text{(E.2)}$$

if $Y_2 \geq \xi$. Given this, the inequalities in (E.1) and (E.2) will be both reversed so that the expected values holds for all Y_2.

$$E[U_{12} - (1+r)U_{22}](Y_2 - \xi) \leq \left[\frac{U_{12} - (1+r)U_{22}}{U_2}\right]_{\xi} \cdot E[U_2(Y_2 - \xi)]. \quad \text{(E.3)}$$

To prove that the left side of (E.3) is negative, it is sufficient to show that the right side is negative. From equation (10) in the text, the expression in braces is positive so that we have to show that $E[U(Y_2 - \xi)] \leq 0.$ Since $U_{22} < 0$, we must have

$$U_2 \leq (U_2)_{\xi} \quad \text{if } Y_2 \geq \xi \qquad \text{(E.4)}$$

Multiplying (E.4) by $(Y_2 - \xi)$, we can write

$$[U_2 \leq (U_2)_{\xi}] \, (Y_2 - \xi) \qquad \text{if} \qquad Y_2 \geq \xi . \qquad \text{(E.5)}$$

This holds for all Y_2, since inequalities in (E.4) are reversed if $Y_2 \leq \xi$.

Taking the expected values, we then obtain

$$E[U_2(Y_2 - \xi)] \leq (U_2)E(Y_2 - \xi) = 0$$

which implies

$$E[U_{12} - (1+\sigma)U_{22}](Y_2 - \xi) \leq 0. \qquad \text{(E.6)}$$

Therefore, since $D < 0$, it follows that equation (14):

$$\left(\frac{\partial c_1}{\partial \gamma}\right) = -\left(\frac{1}{D_2}\right) E\{[U_{12} - (1+\sigma)U_{22}](Y_2 - \xi) \} \quad \text{(E.7)}$$

is negative. Hence,

$$\frac{\partial R_1}{\partial \gamma} > 0. \qquad \text{Q.E.D.}$$

APPENDIX B
Estimation of Poverty Line-based Z variable

Poverty line is an important part of the analysis and our results are sensitive to the type of poverty line measure used. World Bank defines the poverty line as USD 1 per person per day. However, if this definition of poverty is to be used, according to one estimate about 75 percent of Indian households would be below the poverty line for 2000-01. India's official poverty rate given for that year is 26 percent.

The official poverty line estimations in India are based on the norm of 2400 calories per capita per day for rural areas and 2100 per capita per day for the urban areas.[16] These poverty estimates are derived from the household consumer expenditure data collected by National Sample Survey Organisation (NSSO) of the Ministry of Statistics and Programme Implementation, every fifth year. Using the survey and the methodology of the Planning Commission, the Government of India, has released the poverty estimates for the year 1973-74, 1977-78, 1983, 1987-88, 1993-94 and 1999-2000 released on 22nd February 2001. NSSO also conducts Annual household consumer expenditure surveys but the sample size is much smaller for them, therefore the Planning Commission does not take these annual surveys into account for estimating poverty.

According to the "Household Consumption Expenditure in India 1999-2000", NSS 55th Round, Report No. 454" and "Nutritional Intake in India 1999-2000", NSS 55th Round, Report No. 471" - the rural estimate for the poverty line is 327.5 rupees for All India. According to the 61st round of the NSS covering period July 2004 to June 2005, the estimated Poverty Line in 2004-05 is Rs. 356.3. per capita per month (see Poverty Estimates for 2004-05, Government of India, Press Information Bureau, March 2007). The correct way would be to deflate the 2004-2005 poverty line based on the CPI for agricultural labourers for rural areas.[17] Hence the relevant poverty line for November 2003 was calculated as follows:

A. Official All- India Poverty Line estimate for 2003 = Rs. 356.30
B. CPI for agri. Labourers (at base prices 1986-87) for November 2003[18] = 333
C. CPI for July 04 to June 05[19] = 342

Poverty Line Estimate for November 2003 is then calculated as

$$A * (B / C) = (356.3) * (333 / 342) = Rs.346.9$$

[16] The Task Force on the 'Projections of Minimum Needs and Effective Consumption Demands' (1979) defines the poverty line (BPL) as the cost of an all India average consumption basket which meets the calorie norm of 2400 calories per capita per day for rural areas and 2100 for the urban areas. These calorie norms are expressed in monetary terms as Rs. 49.09 and Rs. 56.64 per capita per month for rural and urban areas respectively at 1973-74 prices. Based on the recommendations of a study group on 'The Concept and Estimation of Poverty Line', the private consumption deflators from national accounts statistics was selected to update the poverty lines in 1977-78, 1983 and 1987-88. Subsequently, the expert group under the Chairmanship of late Prof. D.T. Lakdawala recommended the use of consumer price index for agricultural labor to update the rural poverty line and a simple average of weighted commodity indices of the consumer price index for industrial workers and for urban non-manual employees to update the urban poverty line. But the Planning Commission accepted only the CPI for industrial workers to estimate and update the urban poverty line (Economic Survey of Delhi, 2001-2002)

[17] Calculation of poverty only on the basis of calorie consumption is inadequate and most researchers would agree with this (including us).

[18] I chose to take the November 2003 because most of our data is collected in that month. in 2003.

[19] This was calculated as the average of the CPI for Agricultural laborers at base 1986-87, over the period July 04 to June 05 = (1/12)(338+341+343+345+344+342+341+340+340+341+343+345)

APPENDIX C.

Calculation of the net income of the household
The net income of the household for 2003 and 2000 was calculated separately as the sum of: wage employment of all the members if the household (in cash and kind); net income of all members from own-farm (revenue minus production and hiring cost); net income of all members engaged in self-employed activity; household income from livestock; and wage employment in non-farm activity.

Calculation of food expenditure
The total food expenditure for 2000 and 2003 was calculated separately as the sum of the expenditure on staple grains; fruits and vegetables; meat/chicken/fist and dairy products; cooking oil ; fuel, coal or kerosene oil; sugar, spices, tea and biscuits; plus other miscellaneous food items.

Other household expenditure includes spending on children and adult clothing and footwear; soaps, washing powder and cosmetics; kitchen and other goods.

Total cultivated area is the sum of the total amount of land owned plus the net amount of land leased-in for cultivation

The *figures for the expenditure, income and total value of household assets for the year 2000 have been inflated using the state-level Consumer Price Index for Agricultural labourers based on the 1986-87* for the months of November 2003 and July 2000. The source for the July 2000 figures is the Annual Report of CPI (agricultural and rural labourers) 2002- 2003, Government of India. For the November 2003 figures the source was the Annual Report on CPI for agricultural and rural labour for agriculture year 2004-05. To construct the inflator the following formula is used

Inflator = (figure in Rs. for the year 2000) * (CPI for 2003/CPI for 2000) (1)

Using (1) the following inflators were calculated for the five states and used to inflate the data on expenditure and income for 2000.

Andhra Pradesh	348/325=1.071
Uttar Pradesh	330/307=1.075
Maharashtra	333/311= 1.071
Tamil Nadu	350/300=1.167
Orissa	320/313=1.022