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DISCUSSION
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Risk-Sharing Networks among Households in Rural Ethiopia

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Abstract

We apply the set-up of limited commitment model to empirically test the role of informal risk-sharing networks using panel data on informal credit transactions from rural Ethiopia. The empirical estimates provide convincing evidence for the belief that enforcement problem limits the direct role of credit transactions in risk-sharing arrangements between rural households, whether the villages are ethnically homogeneous or not. We also find that households with more land have better access to the informal credit market and access is significantly improved through their participation in small group networks. But the informal credit market and the networks under consideration serve little purpose to the land poor households. These results, therefore, imply that full risk-sharing does not appear to materialize at the village level.

Keywords: Risk-sharing; Limited commitment; Informal credit; Consumption smoothing

JEL classification: D91; O12; Q12

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1 Introduction

In developing countries opportunities for own savings are very limited partly due to low per capita income even during fat years. This stylized fact suggests that self-insurance is by far short of providing sufficient shield against the risk of fluctuating income. In the absence of formal insurance and other intertemporal markets chiefly due to high information costs, an alternative *ex post* mechanism is to resort to informal risk-sharing schemes in order to stabilize consumption particularly in the face of idiosyncratic shocks. There is growing empirical evidence that informal risk-sharing schemes do exist and function reasonably well in a number of developing countries; some instances are informal credits and gifts among friends, relatives and neighbours; borrowings from local moneylenders; rotating savings and credit associations (roscas); interlinkages in agricultural contracts; and so forth. Grimard (1997) has attributed the relatively better performance of informal arrangements in rural villages to proximity of geographical locations and family ties among agents that, in turn, significantly reduce monitoring and enforcement costs. In a nutshell, risk pooling through informal insurance arrangements among households in rural villages can play an undeniable role so as to lessen consumption fluctuations in spite of idiosyncratic income shocks. The performance of these informal institutions at the village and regional level has, therefore, relevant implications on various forms of policy interventions. Ravallion and Chaudhuri (1997) indicate that the need for "safety net" policies such as transfer of cash or food, credit subsidies, and public employment schemes heavily relies upon the effectiveness of the pre-existing informal insurance arrangements.

Mace (1991) was among the first to re-derive the major proposition that if markets are complete - with private information and liquidity constraints omitted - then a Pareto optimal allocation of risk-sharing implies that individual consumption should not respond to idiosyncratic income shocks. It should rather vary positively with aggregate consumption.[1] This consumption insurance that follows from first best allocation involves full income pooling and hence it is referred as full insurance. Mace (1991) and Cochrane (1991) have empirically tested the implications of full insurance using household panel data from the United States. They obtained mixed results. Full insurance is rejected for some specifications of preferences and types of idiosyncratic shocks, but it is a good benchmark implying a considerable comovement of household consumption with aggregate consumption. This evidence suggests the existence of adequate sources of insurance.

[1]The basic theoretical proposition of complete insurance was derived by Wilson (1968) and Diamond (1967).

It goes against the belief that imperfect and incomplete markets are important elements in explaining consumption allocations.

Recently there have been several theoretical and empirical studies on informal insurance arrangements in developing countries. The very first studies concentrate on testing the availability of full insurance in village economies under a full information environment. Townsend (1994) used longitudinal data on household consumption and income from three poor, high-risk villages in India to test the implications of the full insurance model. More specifically, he tested the hypothesis that under perfect risk-sharing consumption at the household level is not influenced by contemporaneous own income, sickness, unemployment and other individual specific shocks, but it rather depends only on the realization of village-wide risks. Townsend's results suggest that full risk-pooling is a surprisingly good benchmark although household income is found to have a significant explanatory power on household consumption. There indeed exists a significant comovement of household consumption with village average consumption. However, Ravallion and Chaudhuri (1997) re-examined the robustness of this potentially essential piece of evidence using an alternative measure of consumption and their results reflect the failure of complete consumption insurance in the three Indian villages. Udry (1994) has drawn similar conclusions using data on informal loan transactions from rural households in northern Nigeria. A fully efficient income pooling equilibrium is found to be a remote possibility although loan transactions significantly depend on the realizations of random shocks by both borrowers and lenders.

An important issue that has been overlooked in the empirical tests of the full insurance model is the need for identifying appropriate groups within which the informal scheme operates. Some recent studies have attempted to address this issue using data from different developing countries. Based on literature from anthropology and geography, Grimard (1997) identified ethnic ties as a possible risk-sharing group, but the hypothesis of complete risk-sharing within ethnic groups is rejected. Jalan and Ravallion (1999) provide evidence that the rejection of full insurance is strongest for the poorest households along wealth lines in rural China. Similarly, Lund and Fafchamps (2000) argued that risk-sharing does not take place at the village level but rather between friends and relatives due to low cost of monitoring; even then fully efficient risk-pooling within networks of friends and relatives is not achieved in the rural Philippines.[2] De Weerdt (2002) finds similar results for smaller networks of self-selected households in a Tanzanian village.

[2]Rosenzweig (1988) also finds that kinship ties tend to be sustained over space and time in implicit transfers for the purpose of consumption smoothing using longitudinal data from six villages in India.

Efforts have been made by different authors to find explanations for the failure of full risk-pooling in the context of developing countries. To overcome the shortcomings of complete market models at various forms of insurance units, researchers have suggested to relax the assumption of full information and then to replace it by a regime of private information which, in turn, excludes some contracting possibilities due to moral hazard and adverse selection problems (see the references in Ligon, 1998). Ligon (1998) developed a set of restrictions to test the implications of complete markets and permanent income models against consumption allocations explicitly constrained by private information using data from the three Indian villages studied by Townsend (1994). The results indicate that private information restriction provides the best explanation of consumption allocation in two of the three villages. In the third village consumption allocation for some of the households is consistent with the restriction of private information while other households follow the prediction of permanent income hypothesis.

However, it has been argued that information asymmetry among insiders is not a serious bottleneck in rural village economies. The setting of rural villages is such that the assumption of full information is not a strong one, as the degree of information asymmetry within villages or families is actually small (Udry, 1994 and Kocherlakota, 1996). Hence, recent papers appeal to the theory of limited commitment to explain the observed positive relationship of individual consumption with current and lagged individual income. In order to model such phenomena it is instructive to use repeated game theory because informal agreements are used to enforce mutually beneficial arrangements without any written and legally binding contracts. Mutual risk-sharing schemes without commitment will only be sustainable if current generosity is justified by long-term benefits through credible promises in the form of expected future reciprocity.

Kimball (1988) was among the first to formally establish the possibility of mutual assistance pacts under a limited commitment environment as a risk-sharing mechanism in medieval England. Coate and Ravallion (1994) work on the theoretical framework of Kimball (1988) to characterize the conditions under which first best allocations are subgame perfect in a symmetric two-player game, and they further investigate various suboptimal informal risk-sharing arrangements in rural societies. Their model is, however, restricted to pure (stationary) insurance arrangements by which transfers at any date depend only on the realized current income. Ligon, Thomas and Worrall (2000b) call this the static limited commitment model, whereby possible credit elements are ruled out in the informal insurance arrangements.

However, the direct role of credit in pooling risks between households in which the

repayment depends on the realization of output by both the creditor and debtor has been emphasized by several researchers in the area (e.g., Rosenzweig, 1988; Eswaran and Kotwal, 1989; Udry 1990, 1994; Platteau and Abraham, 1987; and Lund and Fafchamps, 2000). These studies noted the quasi-credit nature of loan transactions that are undertaken in traditional societies since they lack important attributes of standard credit markets. Ligon, Thomas and Worrall (2000b) take this important feature into account and show the benefits of using non-stationary transfer schemes that depend on past history of transfers; they call this the dynamic limited commitment model.[3] Results show that efficient arrangements under dynamic limited commitment model can be best described by a simple updating rule similar to that of a simple loan contract with occasional forgiveness. It can thus be interpreted as a model of reciprocal borrowing and lending. They then use data on three Indian villages to test the dynamic commitment model. The empirical results are more consistent with the dynamic limited commitment model than with the alternative models; namely, the full risk-pooling and the static limited commitment models.

Foster and Rosenzweig (2001) incorporate altruism into the model of Ligon, Thomas and Worrall (2000b) to test the role of both altruism and commitment in determining the extent of informal insurance arrangements. Their work is motivated by the fact that transfers in many countries often take place between family members. They use rural panel data surveys from India and Pakistan to test whether transfer partners are altruistic. Their empirical evidences suggest that imperfect commitment substantially limits informal transfer arrangements and also show that altruism plays a significant role in ameliorating sustainability constraints. Lund and Fafchamps (2000) also tested the implications of dynamic commitment model using data from rural Filipino households on credits and gifts among friends and relatives. They provide evidence consistent with models of quasi-credit where problems of enforcement limit the use of stationary transfers. They also show that the quality of networking is a possible explanation for the failure of full insurance arrangements in village economies. However, they found hardly any evidence that risk-sharing is motivated either by altruism or by collateral considerations.

Furthermore, Ligon, Thomas and Worrall (2000a) analyzed the effect of individual savings under a dynamic limited commitment model of mutual insurance. The theoretical

[3]Kocherlakota (1996) has also undertaken a similar work. He demonstrates that the way history matters in a dynamic limited commitment model can be used to distinguish it from efficient allocations in environments with asymmetric information and full commitment. It is clear that in both cases there is a positive correlation between household consumption and household income.

framework of this study has more dynamic elements than previous studies in the sense that it allows intertemporal transfer of endowments between periods by individual agents. They use a simple linear technology of storage as a proxy for savings to address its effects on the implementability of mutual insurance arrangements. They show that the overall effect of savings opportunities on welfare is ambiguous. Under certain conditions savings enhance the use of mutual risk-sharing as a subgame perfect equilibrium, while under other conditions it encourages agents to renege by tightening their sustainability constraints as it increases utility derived from autarky.

In Ethiopia informal institutions consist of a variety of financial activities both in urban and rural areas, though their extent varies from place to place. Institutions and activities in the informal sector include rotating savings and credit association (e.g. '*iqqub'*), mutual aid associations (such as '*iddir'*) and local moneylenders. *'Iqqub'* and '*iddir'* are usually formed among persons united in family and friendship, by place of work, by living in the same area and so on. The main aim of '*iddir'* is to provide some sort of insurance for the participants in the case of demise of a member or one of his relatives. On the other hand, the rationale for taking part in '*iqqub'* is to utilize the fund for consumption and planned investments such as small business development and construction and reconstruction of houses. Finally, the 1974 land reform has to some extent done away with local moneylenders. Peasants nowadays borrow mainly from friends and relatives at zero interest rate (Dessalegn, 1984).[4]

Furthermore, there are other forms of networks in rural Ethiopia. They take the form of labour and oxen sharing arrangements. These arrangements create long-term relationship among individuals in the village through promises of future reciprocity among member participants. As a result, they reduce monitoring and enforcement costs among members who would like to involve in insurance arrangements. Ethnic ties and religion might also play an important role in activating informal insurance undertakings.

The main objective of this study is to examine the extent of informal networks in risk-pooling among rural households in Ethiopia using panel survey data from 15 villages. It uses the set-up of dynamic limited commitment model without storage to derive testable implications of risk-sharing among households. This study, therefore, combines enforcement problem with informal networks - '*iqqub'*, labour sharing, oxen sharing and sharecropping arrangements, and ethnic ties - as appropriate groups within which mutual insurance takes place. Another important caveat worth exploring is whether relatively

[4]The reform, however, does not completely abolish the practice of local moneylenders in rural Ethiopia as can be seen from the data in Table 2.

poor households do manage to benefit from the existing informal arrangements.

The rest of the paper is organized as follows. Section 2 presents a theoretical framework to test the impact of networks in risk-sharing among households in the face of income shocks. Section 3 presents the specific form of the regression equation, the problems of the estimation procedure and the remedies. Section 4 explains the data used and provides descriptive statistics. Sections 5 and 6 give the empirical specifications and results, respectively. Section 7 summarizes the main findings. Finally, tables and figures are presented at the end of the paper.

2 Framework of Analysis

This paper heavily relies on the theoretical model studied by Kocherlakota (1996), Ligon, Thomas and Worrall (2000b) and Attanasio and Rios-Rull (2000). It is a theory of informal insurance arrangements with limited commitment that assumes a closed village economy without any type of storage technology. In line with the underlying assumptions of the model we consider a single perishable good and H identical, infinitely lived risk-averse households, with preferences represented by

$$E_0 \sum_{t=0}^{\infty} \beta^t u(c_{it}); \tag{1}$$

u is an increasing, strictly concave and twice continuously differentiable function, c denotes household consumption and $\beta \in (0,1)$ is a common discount factor. It is assumed that $\lim_{c\to 0} u'(c) = \infty$, guarantying the non-negativity of household consumption at each and every period. In each period t household i receives an endowment of consumption good (or exogenously given risky income) $y_{it}(s) > 0$ that can not be stored or saved, where $s \in \{1, 2, ..., S\}$ is a state of the world drawn from S finite set of states.[5] The endowment process is assumed to be Markovian, designated by $\pi(r \mid s) > 0$ a conditional probability of moving from state s to state r given the initial realization with probability one. At time t, the household experiences a history of endowments $h_t = (y_t, y_{t-1}, ..., y_0)$.

The risk aversion nature of households provides a strong incentive to involve in risk-sharing arrangements as long as their endowments are not perfectly, positively correlated. An arrangement will then specify a transfer level $\tau_{it}(h_t)$ - a net transfer received by

[5]Note from the specification that the exogenously given risky income depends only on the state of nature, but not on the period.

household i - for every period t and for each history h_t upto and including the state realized in period t.[6] Note that the resource constraint can be represented as

$$\sum_{i=1}^{H} c_{it} = \sum_{i=1}^{H} y_{it}(s), \tag{2}$$

where $c_{it} = y_{it}(s) + \tau_{it}(h_t)$ and $\sum_{i=1}^{H} \tau_{it}(h_t) = 0$.

If the transfer mechanism is enforceable then a standard dynamic programming is applicable, and the second fundamental welfare theorem gives conditions under which a Pareto optimum allocation can be supported. Accordingly, Pareto optimal allocations can be found by solving a weighted sum of expected discounted utilities

$$\max_{c_{it}} E_0 \sum_{t=0}^{\infty} \beta^t \sum_{i=1}^{H} \lambda_i u(c_{it}), \text{ for all } i \text{ and } t \tag{3}$$

for positive Pareto weights λ_i satisfying $\sum_{i=1}^{H} \lambda_i = 1$, subject to the resource constraint (2) given the initial conditions. Thus, the first order condition for Pareto optimum can be written as follows

$$\frac{u'(c_{it})}{u'(c_{jt})} = \frac{\lambda_j}{\lambda_i}, \text{ for all } i, j \text{ and } t. \tag{4}$$

Pareto efficiency requires that the ratio of marginal utilities of households must be equalized across states and time, and hence the current transfer scheme is chosen to keep the marginal ratio equal to the previous period. This, therefore, shows that optimal consumption paths depend only on aggregate consumption and Pareto weights irrespective of the realized level of household income.[7]

The above results rely heavily on the assumption that the planner has all the means and ways to enforce the proposed transfer scheme and that all agents respect their commitments. In the context of developing countries, however, such a contract cannot be fully implemented due to lack of the necessary institutions and the inefficiency of the legal system. We, therefore, assume that the contract is not legally enforceable, and contravention of the contract by any of the participants leads to a reversion to autarkic position. This is a situation whereby households consume only their own endowment

[6]Net transfer can be positive or negative signifying the flow of resources to or from household i with respect to the rest of the village.

[7]Household consumption may depend on initial wealth distribution because Pareto weights may be correlated with endowments. It is highly likely that households with high initial endowments will be given high Pareto weights and then will receive high consumption allocation (Cochrane, 1991).

streams in all the subsequent periods, and the resulting outcome is, indeed, a subgame perfect equilibrium. In the face of limited commitment to the contract by households, the allocation has to be self-enforcing or sustainable in such a way that the allocation they receive by staying in the arrangement at each point in time should outweigh the autarky value, $v_i^a(y_t) = E_t \sum_{t=0}^{\infty} \beta^t u(y_{it})$. Hence, the planner has to take into consideration the following intertemporal participation constraints

$$E_t \sum_{t=0}^{\infty} \beta^t u(c_{it}) \geq v_i^a(y_t), \text{ for all } i, t. \tag{5}$$

The introduction of the intertemporal participation constraints that apparently depend upon future decision variables imposes a limit on the applicability of the standard dynamic programming techniques. Marcet and Marimon (1998) have provided an approach that deals with the difficulties encountered in solving a large class of economic models with similar settings.[8] They show that a saddle point problem that arises from the expansion of the state variables by including new co-state variables has a recursive formulation, and it has a solution identical to the original planning problem. The original problem can, therefore, be transformed into a saddle point problem after writing it in a Lagrangian form, with γ_{it} the Lagrange multiplier of household i at time t associated to the intertemporal participation constraints (5). The planner's problem can then be rewritten recursively as

$$V(y_t, \mu_t) = \min_{\gamma_t \geq 0} \max_{c_t} \left\{ \sum_{i=1}^{H} ((\lambda_i + \mu_{it+1}) u(c_{it}) - \gamma_{it} v_i^a(y_t)) + \beta E_t V(y_{t+1}, \mu_{t+1}) \right\}, \tag{6}$$

subject to the resource constraint (2) and the newly introduced co-state variable which is defined recursively as

$$\mu_{it+1} = \mu_{it} + \gamma_{it}, \text{ for all } i \tag{7}$$

for $t > 0$ with initial condition $\mu_{i0} = 0$. Notice that the co-state variable μ_{it} is the sum of the past multipliers on the intertemporal participation constraint of each household i, and hence it increases whenever the constraint is binding. Accordingly, the interpretation of the optimization problem (6) is quite straightforward. It simply shows how the planner assigns time varying weights to each household depending upon whether the participa-

[8]See Kehoe and Perri (2000) for the application of the approach to an international business cycle models and Attanasio and Rios-Rull (2000) on informal insurance and public policy.

tion constraint is binding, given the initial Pareto weights λ_i. The optimal solution is characterized by the following first order condition

$$\frac{u'(c_{it})}{u'(c_{jt})} = \frac{\lambda_j + \mu_{jt+1}}{\lambda_i + \mu_{it+1}}, \text{ for all } i,\ j \text{ and } t. \tag{8}$$

This condition clearly states that the weight assigned to a particular household increases if its participation constraint is binding, by the magnitude exactly equal to the corresponding Lagrange multiplier. A household with a binding constraint is motivated to stay in the constrained efficient contract by an increase in its consumption not only in the current period but also in the subsequent periods. This circumstance brings in persistence into the optimal allocations, implying that the current additional consumption allocated to the household with a binding constraint because of limited enforcement needs to be smoothed over time which, in turn, leads to an increase in promised utility. Therefore, optimal consumption paths depend on past histories conditional upon a particular realization of aggregate endowment and initial wealth distribution. See for similar interpretations Marcet and Marimon (1998), Kocherlakota (1996) and Ligon, Thomas and Worrall (2000b).[9] This result signifies the quasi-credit nature of transfers as a household that received transfers today is less likely to receive transfers in the next period than a household that provided transfers with a binding participation constraint.

To characterize the property of optimal allocations through numerical computation we consider a particular example with only two households i and j. This is because of the fact that the set-up of the problem hardly allows us to derive analytical solutions. For this purpose, we borrow the algorithm of Attanasio and Rios-Rull (2000) and Kehoe and Perri (2000) that has been widely implemented in discrete state, stochastic dynamic programing problems with occasionally binding constraints. The procedure requires parameterization of the processes that describe income shocks and household preferences.

We make use of a simple specification of an income process with a stationary transitory probability matrix such that the distribution of income remains unchanged with the passage of time. Income for each household is assumed to take only two values, $\{2, 4\}$, with equal unconditional probability. This specification results in four possible states of the world $s \in \{(2,2),(4,2),(2,4),(4,4)\}$ where the entries within the parenthesis are the incomes of households i and j, respectively. We consider two cases, namely, uncorrelated

[9]Kocherlakota (1996) for instance proved that in any efficient allocation there is a nonnegative correlation between individual consumption and current and lagged income conditional on aggregate consumption under limited enforcement.

and positively correlated income shocks owing to the fact that incomes are likely to be positively correlated in agrarian economies. This could be easily captured by unconditional probabilities $\{1/4, 1/4, 1/4, 1/4\}$ and $\{3/8, 1/8, 1/8, 3/8\}$, respectively, for the two cases under consideration. The latter set of probabilities guarantees a positive correlation of 0.5 between the incomes of the two households, allowing for both idiosyncratic and aggregate shocks in the endowment process of individual agents.

We then assume that preferences are represented by an exponential utility function $u(c_{it}) = -\frac{1}{\sigma}\exp^{-\sigma c_{it}}$ with absolute risk aversion parameter $\sigma = 0.75$ and common discount factor $\beta = 0.85$. This specification has an advantage as it allows to disaggregate household consumption into its transfer and income components. The results of the numerical solutions are given in Figures 1-4.

Figures 1 and 2 plot the optimal consumption of household i and minus the log of the relative weight that household j gets into the problem, $-\log(\frac{\lambda_j+\mu_{jt}}{\lambda_i+\mu_{it}})$[10] for each and every possible states.[11] Each panel contains optimal consumption path for the different scenarios, namely, first-best, autarky and the case of enforceable contract. As can be seen in these figures, the first best optimal path coincides with the enforceable outcome over some intervals. The overlapping region, however, varies with income correlation when the two households face different income shocks. The upper limit of the overlapping region in terms of the co-state variable decreases as the household under consideration encounters bad income shock and vice versa when the realized level of income is good. Moreover, there exists a possibility that the relatively luckier agent receives transfers from the unlucky agent contrary to the first best outcome. This situation is observed for sufficiently high levels of co-state variable when the household under consideration is at the good state. Attanasio and Rios-Rull (2000) and Ligon, Thomas and Worrall (2000b) concluded that such a phenomenon reflects an essential point that the debt repayment element might outweigh the static risk-sharing component of the contract.[12]

Figure 3 shows the degree of risk-sharing measured by the difference in the optimal consumption share received by household i at state $(4, 2)$ and that received by the same household at state $(2, 4)$. In the case of first best outcome this difference is zero, as optimal consumption depends upon only aggregate income irrespective of idiosyncratic

[10]It is simply the ratio of the co-state variables attributed to households j and i given the planner's initial weights.

[11]The log is just for the sake of symmetry around zero and the minus is just to express the relative weight with respect to household i and for the sake of monotonicity.

[12]See Attanasio and Rios-Rull (2000) for similar results based on a power utility function that describes the preferences households.

shocks. On the other hand, the difference is 1/3 under autarky. As revealed by the figure, the introduction of the intertemporal participation constraints in general reduces risk-sharing opportunities using full risk-sharing as a benchmark. It also shows that positive income correlation further lowers the magnitude of risk-sharing, all other things remaining constant. Finally, notice that risk-sharing tends to increase when the relative Pareto weight approaches to zero, implying that relatively equal weights assigned to the agents facilitate risk-sharing. The rationale behind this relationship is quite simple as it can be clearly observed from the trajectories of the optimal consumption paths depicted in Figures 1 and 2. Specifically, it is highly likely that the participation constraint would be binding at relatively unequal levels of Pareto weights and then a further increase in the difference between the weights would lead to divergent paths for first best and feasible outcomes. These results in general suggest that households may be able to achieve only partial risk-sharing under limited commitment.

Last but not least, Figure 4 demonstrates the level of history dependence of optimal consumption. We measure the degree of history dependence by the difference between the consumption share of household i at equal income state given the preceding state was $(4, 2)$ and $(2, 4)$.[13] This measure is zero in the case of Pareto efficient allocations. The figure clearly displays a non-negative history dependence - the better the income outcome today the higher the consumption share in the subsequent period. Positive income correlation shifts the history dependence curve upwards. Besides, the level of history dependence decreases when we move towards a more equal relative weight. The intuition is that households with a better outcome transfer resources in the anticipation of reciprocity in the next period. Those who received transfers today will pay back tomorrow even if they are at the same state of the world. This gives rise to the notion of quasi-credit into the transfer mechanism which is a direct consequence of the introduction of participation constraints in the original full risk-sharing model. We use these results to develop the regression equation in the next section that incorporates the possibility of risk-sharing not only at the village level but also at smaller group networks that have been established by some members of the village.

[13]This method is adopted from Foster and Rosenzweig (2001). But note that Figure 4 only presents high equal income state consumption share of household i when the preceding state was $(4, 2)$ minus that when it was $(2, 4)$ without loss of generality.

3 Econometric Implementation

The specific form of the regression equation to be estimated is derived using the insights from the theoretical model presented in the previous section. For the sake of simplicity and tractability, we consider only two households with exponential utility functions. Accordingly, taking the log of the first order condition (8) and then aggregating over households and substituting implies that

$$\tau_{it} = -y_{it} + \overline{y}_t - \frac{1}{2\sigma}\sum_{j=1}^{2} \ln\left(\frac{\lambda_j + \mu_{jt+1}}{\lambda_i + \mu_{it+1}}\right), \tag{9}$$

$\overline{y}_t = \sum_{j=1}^{2} y_{jt}$ is village average income. Unlike the case of Pareto efficient allocation the weights cannot be removed by first differencing because they are time varying, depending on whether the participation constraint is binding or not. As discussed in the previous section, the time varying weights show the importance of past history conditional upon contemporaneous income shocks. It has been also made clear that history depends upon the degree of income correlation. There is, thus, a need to find a good summary measure that can serve as a proxy for past history. From Figure 4, we have seen that past transfers matter and hence we use the sum of previous transfers as a measure of history (see also Foster and Rosenzweig, 2001). Therefore, a linear regression model with an error term ϵ_{it} is specified as

$$\tau_{it} = \alpha_0 + \alpha_1 y_{it} + \alpha_2 \overline{y}_t + \alpha_3 T_{it-1} + \epsilon_{it}, \tag{10}$$

where $T_{it-1} = \sum_{k=0}^{t-1} \tau_{ik}$ is the sum of previous transfers (accumulated obligations or contributions), the α's are constant parameters and ϵ_{it} consists of the unobservable individual specific effect and the reminder error component that are both assumed to be identically and independently distributed. The coefficients on own income and village average income should be, respectively, $\alpha_1 = -1$ and $\alpha_2 = 1$ on condition that the linear specification is a reasonable approximation. Besides if risk-sharing is significantly affected by limited commitment, α_3 should be negative.

In its current form, equation (10) has the structure of a dynamic panel data model that has lagged dependent variables among the regressors through the complete history of transfers, T_{it-1}. The presence of a lagged dependent variable among the regressors, however, causes substantial complications for the estimation of the model because of its correlation with the error term. This makes the fixed and random effects estimators to be biased and inconsistent even if the error terms are not serially correlated. Moreover, T_{it-1}

is not observed by the researcher and poses additional estimation problem. These problems can be partly addressed by first differencing that wipes out individual heterogeneity from the model. To deal with these issues more effectively, let us further introduce the assumption that income has a fixed anticipated and a transitory component.[14] Income thus takes the form

$$y_{it} = \overline{y}_i + u_{it}, \tag{11}$$

where the first term of the right hand side represents the fixed anticipated component and the second term denotes the transitory component assumed to be identically and independently distributed. Substituting equation (11) into (10) and taking the first difference produces

$$\triangle\ \tau_{it} = \alpha_1\ \triangle\ u_{it} + \alpha_2\ \triangle\ \overline{u}_t + \alpha_3 \tau_{it-1} + \triangle\ \epsilon_{it}, \tag{12}$$

where $\triangle$ denotes first difference and $\overline{u}_t = \sum_{j=1}^{2} u_{jt}$ is the village average transitory income component. It is quite straightforward that this procedure removes the fixed components of income and transfers along with the individual specific effect from the estimation.

The above specification can be used to examine the role of transfers as insurance and the extent to which its strength for this purpose is impeded by enforcement problem at a village level. Under the full insurance risk-sharing hypothesis, the coefficient of the lag of transfers should be insignificant while the shortfall in transitory income is fully compensated by an increase in transfers conditional upon village level shocks. Recent empirical evidence tends to lend credence to a model of reciprocal borrowing and lending derived from the theory of dynamic limited commitment (Ligon, Thomas and Worrall, 2000b; Foster and Rosenzweig, 2001; Lund and Fafchamps, 2000). However, the role of participation in small group networks has been largely neglected by most of the formal empirical investigations that take enforcement and monitoring costs into account.[15] Therefore, this study focuses on this issue rather than merely concentrating on efficient risk-sharing vis-à-vis enforcement problem at a village level.

To empirically investigate the role of networks in risk-sharing, we modify equation (12) by introducing a variable that measures participation in different small group networks conditional upon individual income shocks. The modified version that includes the

[14] Rural households in Ethiopia live under a stationary environment with little access to irrigation and hardly any change in their production technology. This suggests that income shocks are mainly transitory in nature.

[15] Lund and Fafchamps (2000) have attempted to investigate the role of networks of friends and relatives in dealing with income and expenditure shocks, but their focus is mainly based on the set up of full insurance model.

network variable interacted with the transitory income component is

$$\triangle \tau_{it} = \alpha_1 \triangle u_{it} + \alpha_2 \triangle \overline{u}_t + \alpha_3 \tau_{it-1} + \alpha_4 \triangle u_{it} \times N_{it} + \triangle \epsilon_{it}, \tag{13}$$

where N_{it} is an index[16] that measures participation in small group networks such as whether the household has participated in labour sharing arrangements, in rotating savings and credit associations and so forth. If risk-sharing takes place only at a village level, then the interaction term should not have any significant effect on the magnitude of transfers. Specifically, it should be that $\alpha_4 = 0$ if networks do not matter at all in risk-sharing.

Finally, the first differenced model still has some problems because the lagged dependent variable is correlated with the error term by its first-order moving average disturbance. This correlation together with any measurement error in transfers will result in a bias and inconsistency in the OLS estimator. Without the individual effect, the standard approach in the transformed specification is then the use of instrumental variables technique. We use τ_{it-2} and a set of other variables as instruments for the lagged dependent variable, τ_{it-1}. These instruments will not be correlated with the disturbance term as long as the disturbance terms are not serially correlated. It should, however, be noted that this estimation method might not necessarily lead to an efficient estimate of the parameters (Baltagi, 1995).[17] Details of the estimation procedure are given in the next sections.

4 Data and Descriptive Statistics

The data used in this study come from the three rounds of the rural household survey of Ethiopia over the period 1994 and 1995. It is a panel data survey jointly undertaken by the Department of Addis Ababa University and the Centre for the Study of African Economies of Oxford University. The survey covered a total of 1477 households from 15 rural villages, which were selected taking the main agro-ecological zones and the different types of ploughing cultures of the country into account. The attrition rate in this panel is very low, accounting for less than 1 per cent per annum. The survey has detailed

[16] A detailed explanation of the construction of the index is given in Section 5.

[17] In this respect, Arellano and Bond (1991) suggested the use of a GMM estimator that uses additional instruments that can be obtained from a dynamic error component model - lagged levels of the dependent variable and the predetermined variables and the differences of the strictly exogenous variables. However, the three period panel of our data restricts us from using the GMM estimator.

information on various socio-economic variables including household demographics, income and assets, consumption, health, education and participation in different types of markets both formal and informal. Besides, it has also information on the incidence of random production and livestock shocks.

For this study we need information on transfers over at least three consecutive comparable periods and household and/or environmental characteristics that allow estimation of income shocks. Besides, information is required on the participation of households on different informal risk-sharing networks. With regard to transfers there is only comparable information on the participation of households in credit markets particularly in informal credit markets. We do not use data on gifts and remittances as the information is not comprehensive enough for a sound empirical analysis.[18]

Households in rural Ethiopia derive most of their income from agricultural activities. Dercon and Krishnan (1996) found out that crop agriculture contributed about two-third to the total income of surveyed households. There are also possibilities of off-farm activities even if the degree varies from site to site, accounting a bit less than a quarter of their total income. The other important income source is revenue derived from livestock and livestock related products. But rental incomes are almost non-existent.

Livestock is a very important asset in rural Ethiopia. Sampled households identified investment in livestock as the most common form of savings. As can be seen in Table 1, it is highly popular both in terms of mean value and number of households who reported that they owned livestock. Almost all the households possessed farm tools and implements, but the mean value in Ethiopian Birr is small. There are also other forms of assets such as wooden and other household furniture, radio, tape and jewelry and so forth. However, only few households reported that at least one household member had a bank account during the time of the interview. Overall, the figures suggest that farm households have hardly any linkages with the formal financial sector.

This fact is reinforced by the type of credit transactions that had been undertaken in the sampled villages. Table 2 clearly depicts that credits from the banking sector are rare, on the average accounting for close to one percent of the total loan transactions during the three rounds. This may be a direct consequence of the nature of the credit markets in developing countries that are segmented and stringent against farm house-

[18]The available information on gifts and remittances is only whether the sampled households received such transfers from friends and relatives and from any other source. There is, however, no data on the transfers made by these households to their trading partners. That is the very reason that we do not use the data on gifts and remittances on the estimation of the model.

holds. Farm households have limited access to formal financial institutions because they cannot meet the exorbitant collateral requirements from their meagre harvest and labour income. Along with this, future harvest and labour incomes cannot be used as a guarantee to get loans from these institutions. The situation might also be partly explained by the rudimentary stage of the financial sector in developing countries like Ethiopia. As a result, the vast majority of credit transactions are mainly between friends and relatives. More than two thirds of the loans over the three rounds were from friends and relatives. Village based informal institutions, namely, local moneylenders, '*iddir*', credit associations, traditional organizations and service cooperatives also bridged some of the gaps created by the lack of formal credit. These results reflect that households are not able to smooth their consumption through credits in the face environmental uncertainties that are positively correlated, as credits from friends and relatives could only be available during household specific shocks.

Most of the credits are taken for consumption rather than investment purposes. As shown in Table 3, more than a third of the loans were used to buy food items, while only about 10 percent were used to buy livestock and farm implements. We use data from the fourth round, which was undertaken in 1997, to describe the nature of credit contracts and the characteristics of credit partners (see Tables 4 and 5). About one third of the reported cases indicated that a fixed repayment schedule was not specified at the time of receiving the loans. Besides, about a third of them disclosed that they borrowed at zero interest rate. Moreover, most of the credit transactions were among individuals who lived in the same village (60 percent of total loans). Village based institutions accounted for about 10 percent of the reported cases.

Finally, Tables 6, 7 and 8 provide valuable information on household participation in various types of networks, and ethnic and religious ties of household head, respectively. Households in the survey villages participated in work parties (about 40 percent), oxen sharing arrangements (nearly 50 percent), sharecropping practices (close to 30 percent) and informal rotating savings association '*iqqub*' (around 15 percent). The information on ethnic ties reveals that most of the survey sites have homogeneous groups in terms of ethnic lines. We observe only some diversities in three of the 15 surveyed sites, namely, Sirbana Godeti, Tirufe Ketchema and Dinki. There are similar results with regard to the religion of household head. Religious diversity exists only in the Southern sites - Tirufe Ketchema, Imdibir, Adado and Doma.

5 Empirical Specifications

To estimate equation (13) through instrumental variables procedure we use data from the three rounds. Table 9 lists the variables used in the empirical analysis. The dependent variable is the change in net borrowings from friends and relatives, and other village level sources between round three and two. Loan transactions from the formal financial institutions, government ministries, and non-governmental organizations are excluded from the analysis as the attempt is to model reciprocal borrowing and lending in a village economy. Consequently, net borrowings are calculated from the data on all informal loans given and received, and on repayments paid and received prior to each round,[19] and it is defined as new loans received less repayments paid, minus new loans given less loan repayments received. The problem with the credit information is, however, that the recall period varies from one round to the other, because of the difference in the duration between rounds. To make the data comparable across rounds we assume that loans were evenly distributed during the recall period of each and every round. Accordingly, we divide net borrowings by the number of months between rounds to get a monthly series. Notice that there is no correction for price changes across rounds.

The change in an unanticipated income component, which captures idiosyncratic income risk, is approximated by self reported shocks that had affected crops and livestock production. These shocks are represented by indices of negative events for each household in each period. The use of these shocks in the analysis of informal loan transactions heavily relies on the assumption that the negative events are observable to the village community and are exogenous to the individual agents.[20] The first index measures farm specific adverse events with respect to the timing and variability of rainfall at different stages of the crop production cycle. The second index is a measure of negative events such as flooding, animal invasion, insect attacks as well as possible wind, bird and weed damages on crops. Thirdly, an index whether livestock is affected by lack of grazing land, drinking water and diseases is constructed.[21] To capture family labour supply shocks

[19] In-kind credit transactions are also included in the calculation of net borrowings.

[20] It should, however, be noted that the self reported shocks reflect the subjective experiences of farmers and hence capture only their evaluation of different negative events that adversely affect crop production and livestock.

[21] The indices are averages of the number of events for each category, namely, farm level rain shocks, crop shocks and livestock shocks. In the case of farm level rain and crop shocks, the responses to the negative events are coded as either the household encountered no shock (a value of 0) or encountered adverse shock (1). The code is a bit different in the case of livestock shock: not at all affected (0), moderately affected (1) or severely affected (2). The responses to the negative events in each category

we use the number of working days lost by male and female adults due to illness as a percentage of male and female adults in the household. The differential effect for shocks to male and female labour is for the apparent reason that agricultural and other activities are segmented by gender in subsistence economies. Finally, dummy variables are used to capture imperfections in the oxen market and its effect on farm outputs. As indicated in Table 9, the first difference of each index is used in the estimation.

In a rain-fed agriculture, the influence of negative events on farm level income depends on land size and ownership status. In the Ethiopian context, land is a state property and farmers have only usufruct rights. As a result, this variable becomes exogenous to the behaviour of farmers and hence their investment and savings decision do not directly influence landholdings. But Dercon and Krishnan (2000) found out that land is highly correlated with other measures of wealth. Based on this fact they form the hypothesis that land could be used as a good proxy for liquidity constraints. This study closely follows their approach by employing the per capita distribution of land to address the fact that returns to land depend on environmental factors. Specifically, the indices of self reported shocks are interacted with dummy variables whether the household is in the lower or upper half of the per capita distribution of land.

Village level dummy variables are used to capture community specific effects. These variables account for social and infrastructural differences that affect the availability of information and enforcement mechanisms necessary to support credit transactions. Besides, they capture the effect of village level shocks. Hence there is no need to look for other exogenous variables to instrument village average unanticipated income component in the estimation.

An index is constructed to allow for the participation of members of households in small group informal risk-sharing networks and induced institutions established in response to market imperfections in various sectors. We consider four small group networks, namely, rotating savings and credit association ('*iqqub*'), labour sharing arrangements, oxen sharing arrangements and sharecropping arrangements. Information is available on whether any member of the household has been participating in these informal risk-sharing networks. The responses to the participation in these small networks are com-

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are combined using the following formula

$$Index = \frac{Score - Min\ Score}{Max\ Score - Min\ Score}.$$

The index varies from 0 to 1. It takes a value 0 if the household had not faced any negative event at all and 1 if the household had faced all the negative events with a maximum score.

bined by the formula used to construct the indices of self reported negative shocks. The index, therefore, varies from 0 to 1 with a value of 0 if no member of the household did participate, and on the other hand it takes a value of 1 if members of the household did participate in all the four small group networks. In the empirical implementation the index is interacted with the first difference of the household specific shocks and the per capita distribution of land.

We use the two period lagged value of the dependent variable and a set of exogenous variables to construct valid instruments for the lagged dependent variable. The set of exogenous variables pertaining to period $t-2$ includes household level characteristics and family structures that capture access to information and enforcement mechanisms which, in turn, facilitate loan transactions. The likely variables include landholdings per capita, age of household head and number of male and female adults in the household. Besides village level rainfall shocks interacted with the distribution of land are used to predict the lagged dependent variable in the differenced equation. Village level rainfall shocks are defined as the proportional deviations of rainfall from the long-term average in the cropping season related to the harvest relevant to the survey period.[22]

Finally, owing to the likely interactions between asset holdings and credit transactions equation (13) is supplemented by including the lag of the change in the value livestock, which is apparently the most important liquid asset in rural Ethiopia. This variable should also be treated as endogenous because the household's desire to save and its ability to smooth consumption through transfers affect its wealth position. We, therefore, use the variables that are used to predict the lag of the dependent variable combined with the previous period change in the value of livestock as valid instruments.

6 Results

In this section, we empirically investigate whether informal loans play an insurance role in rural Ethiopia. That is whether informal borrowings rise when the household faces a severe shock and whether being a member of small group networks affects this relationship. In order to deal with this, estimates of equation (13) using instrumental variables estimation procedure are reported in Table 10. Hetroscedasticity-robust standard errors

[22]Monthly rainfall data from the nearest weather stations to the surveyed villages are used to construct the series.

are computed to correct for any general kind of hetroscedasticity.[23] The F-statistics for the overall performance of the different specifications show the joint significance of the estimates, and the Hansen J (Sargan) statistics do not reject the overidentifying restrictions test on the validity of all instruments.

The results in the first two columns of Table 10 show little evidence for credit transactions playing an insurance role within the village particularly in the case of poorer households.[24] After controlling for community wide shocks via village level dummies, the estimates do not support the hypothesis that transfers in the form of informal credits contribute to reducing the effects of idiosyncratic adverse shocks on households with small landholdings. Participation in small group networks also does not improve the situation of these households in terms of providing access to the credit market in the face of adverse income shocks.

In contrast, households in the upper half of the per capita land distribution are in a much better position as compared to those in the bottom half of the distribution with regard to access to the informal credit market. Adverse shocks associated with livestock tend to trigger a significant amount of transfers in the form of loans from village sources. The significant negative coefficient of illness shock on male adults seems unreasonable, but its effect is highly counterbalanced by participation in small group networks. The negative effect is even reversed if members of the household have participated in more than two risk-sharing networks. A constraint in the oxen market is also shown to significantly increase informal borrowings on condition that members of the household have been participating in various forms of networks. These results reflect the role played by informal networks and induced institutions in risk-sharing most notably for relatively land rich farmers.[25]

The above results suggest that full insurance model at a village level may not be a correct specification for the sampled households. This remark is reinforced by the observed fact that current net borrowings are significantly and negatively related to outstanding

[23]This variance estimator produces consistent standard errors even if the residuals are not identically distributed.

[24]Covariance of the shocks across households might partly explain the insignificant coefficients on the farm specific rain variable and crop related negative events. This is for a straightforward reason that negative events such as the timing and variability of rainfall, plant disease, flooding and insect infestation have community wide effects even though the magnitude might differ from one household to the other.

[25]We do not claim to have comprehensively addressed the empirical link between networks and risk-sharing among households in rural Ethiopia. The data, for example, does not allow us to control for the quality of networks and characteristics of network partners which will importantly influence the flow of funds among members.

loans. This statistically significant negative coefficient indicates history dependence predicted by the theory of limited commitment. The most striking conclusion one can draw from these results is that the nature of transactions undertaken in the survey sites capture the essence of pure loans with a marginal occasional forgiveness rather than taking a form of quasi-credit as in Platteau and Abraham (1987) and Lund and Fafchamps (2000). The participants in these transactions are mainly the land rich households; they partially insure themselves against idiosyncratic income risk. Loans, however, do not play an insurance role for the land poor farmers even though they live in a precarious situation owing to their limited capacity to effectively deal by themselves with adverse dramatic events.

We now turn to the analysis of the institutional efficiency of the villages covered by the survey in terms of facilitating credit transactions. The main focus here is to assess whether homogeneity of the village encourages risk-sharing activities in the face of idiosyncratic income risks. It is hypothesized that homogeneity lowers information and monitoring costs and hence provides incentives to the village to involve in risk-sharing arrangements. In order to address this issue, a measure of ethnic diversity is used on the assumption that divisions along ethnic lines may increase polarization and thereby impede risk-sharing within the village. We constructed an index of ethnolinguistic fractionalization (ELF) applying the formula of Taylor and Hudson (1972) which is defined as

$$\text{ELF} = 1 - \sum_{i=1}^{I} \left(\frac{n_i}{N}\right)\left(\frac{n_i - 1}{N - 1}\right) \tag{14}$$

where n_i is the number of people in the i^{th} group, N is total population and I is the number of ethnolinguistic groups in the village. ELF varies from 0 to 1 and measures the probability that two randomly selected persons from one village will not belong to the same ethnolinguistic group. Thus the higher the index, the more fragmented the village.

The specification of the transfer function is then allowed to vary with the degree of homogeneity of the villages. Accordingly, the ELF index interacted with the lagged value of the dependent variable is added as a right hand variable. Assuming that the extent to which villages are fractionalized along ethnolinguistic lines is exogenous, the ELF index interacted with the instruments that are used to predict lagged dependent variable are used as valid instruments. The results of this specification are given in the last two columns of Table 10. The estimates indicate no statistical differences between the specifications with and without the ELF interaction term, except that the coefficient

of the lagged dependent variable is now more precisely estimated. The coefficient of the interaction term is not significantly different from zero and hence it implies that homogeneity of the village does not have an important effect in reducing the problem of enforcement in the village economies.[26]

7 Conclusions

In this paper we have analyzed the role of credit transactions and the effects of informal networks on risk-sharing between rural households in Ethiopia. For the empirical analysis we derive the regression equation in line with the set-up of the limited commitment model that has recently been widely used in this area of study. The numerical solution of the limited commitment model clearly shows the importance of past history in determining transfer contracts. Moreover, lack of commitment reduces risk-sharing opportunities as compared to the benchmark case of Pareto optimal allocation.

The empirical application suggests that full risk-sharing does not take place at a village level because of enforcement constraint. The results indicate little occasional forgiveness between loan partners thereby attenuating the direct role of credit transaction in pooling risks. In spite of the presumption that homogeneity of the village may facilitate the extent of risk-sharing, the results also provide hardly any evidence for ethnic homogeneity to abate the degree of commitment constraint in the informal credit market.

The results of this study do complement the findings of Dercon and Krishnan (2000) that land poor households in rural Ethiopia are unable to smooth their consumption over time, clearly indicating the presence of liquidity constraints. On the other hand, farm households with more land have better access to the informal credit market in the face of some idiosyncratic shocks and they also improve their situation through their participation in informal risk-sharing networks. But these networks do not work for the land poor households. The results, therefore, underpin the need for policy actions to provide improved access to credit and insurance options for the poor on the basis of both equity and efficiency grounds. However, it should be noted that any public action does not occur in a vacuum as there will be interaction with the existing informal risk-sharing institutions.

[26]For comparison purposes a similar exercise has been done for all types of loans and the results are given in Table 11. This specification indicates greater history dependence than the estimates given in Table 10.

Finally, further research is needed to obtain a better understanding of rural households in Ethiopia and the role of small group networks in consumption smoothing. This, however, requires detailed information on the set-up and characteristics of informal risk-sharing networks. It is also quite appealing to extend the empirical application to gifts and remittances that are not addressed in this paper due to data limitation.

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A Appendix

Table 1: Asset Composition of Households in 1994

Assets	Mean Value in Birr*	Number of Households	Percentage from Sampled Households
Livestock	2181	1154	78
Farm Tools and Implements	49	1307	89
Wooden and Other Furniture	112	1100	75
Cooking Materials	140	345	23
Radio, Tape, Jewellery, Watch	66	305	21
Guns, Spear, etc.	158	186	13
Cart	535	18	1.2
'Gotera' (Grain Storage Basket)	391	6	0.4
Others	120	22	1.5
Sampled Households		1477	
Holders of a Bank Account		12	0.8

Source: Ethiopian Rural Household Survey

*The exchange rate at the time of the survey was 5 Ethiopian Birr per US dollar.

Table 2: Sources of Loan

Sources of Loan	First Round		Second Round		Third Round	
	Number	Percent	Number	Percent	Number	Percent
Friends and Relatives	542	62.9	619	68.9	446	73.7
Moneylenders	138	16.0	129	14.4	48	7.9
'*Iddir*'	33	3.8	71	7.9	49	8.1
Village Associations*	57	6.7	48	5.4	41	6.8
NGOs	46	5.3	14	1.6	4	0.7
Church	13	1.5	0	0	5	0.8
Banks	4	0.5	5	0.6	8	1.3
Other	29	3.4	12	1.3	4	0.7
Total	862	100	898	100	605	100

Source: Ethiopian Rural Household Survey

*Includes credit association, traditional organizations and service cooperatives.

Table 3: Reasons for Taking Credits

	Reasons	First Round		Second Round		Third Round	
		Number	Percent	Number	Percent	Number	Percent
(1)	Consumption Related	457	53.2	549	61.5	333	55.5
	Food and Other Goods	292	34.0	379	42.4	226	37.7
	Health Expenses	60	7.0	79	8.8	71	11.8
	Education Expenses	3	0.3	7	0.8	0	0
	Travel Expenses	12	1.4	21	2.4	14	2.3
	Cermonial Expenses	90	10.5	63	7.1	22	3.7
(2)	Farm Expenditures	269	31.3	267	29.9	147	24.5
	Buy Livestock	52	6.1	26	2.9	22	3.7
	Buy Farm Implements	37	4.3	73	8.2	46	7.7
	For Seeds and Fertlizers	160	18.6	142	15.9	50	8.3
	To Pay for Labour	11	1.3	20	2.2	8	1.3
	Rent and Taxes	9	1.1	6	0.7	21	3.5
(3)	Off-farm Business	20	2.3	28	3.1	26	4.3
(4)	Building Materials	41	4.8	20	2.2	37	6.2
(5)	To Repay Loans	8	0.9	6	0.7	3	0.5
(6)	Others	65	7.6	24	2.7	54	9.0
	Total	860	100	894	100	600	100

Source: Ethiopian Rural Household Survey

Table 4: Nature of Contracts (Fourth Round, 1997)

Terms of the Loan	Yes		No		Number of Cases*
	Number	Percent	Number	Percent	
Fixed Repayment Period	720	67.7	343	32.3	1063
Interest Payment	456	72.0	177	28.0	633

Source: Ethiopian Rural Household Survey

*It excludes missing values.

Table 5: Characteristics of Loan Partner (Fourth Round, 1997)

Trading Partner	Number	Percent
Individual Living in the Same Village	599	55.9
Individual Living Outside the Village	294	27.5
Government and NGOs	24	2.2
Bank	5	.5
'*Iqqub*'	2	.2
Church	5	.5
Service Cooperatives	75	7.0
'*Iddir*'	67	6.3
Number of Observations	1071	100

Source: Ethiopian Rural Household Survey

Table 6: Participation in Various Networks (Round Two)

Type of Network	Percent
Participate in Work Parties (Labour Sharing)	41.3
Participate in Oxen Sharing Arrangements	47.7
Participate in Sharecropping	27.6
Participate in '*Iqqub*'	15.1
Number of Observations	1462

Source: Ethiopian Rural Household Survey

Table 7: Ethnicity of Household Head

Village	Amhara	Oromo	Tigre	Gurage	Gedeo	Gamo	Kembata	Other	Total
Heresew			81						81
Geblen			63					3	66
Dinki	37							49	86
D. Birhan	175	3							178
Yetemen	61								61
Shumsha	140								140
S. Godeti	20	75	2						97
A. Keke	1	95							96
K.degaga		109							109
Tirufe K.	13	59	19	1			2	8	102
Imdibir				67					67
A. Deboa							75		75
Adado				1	125			4	130
G. Godo								93	93
Doma	3					66		4	73

Source: Ethiopian Rural Household Survey

Table 8: Religion of Household Head

Village	Ortho.	Muslim	Catholic	Prot.	O. Chri.	Trad.	None	Other	Total
Yetemen	61								61
S. Godeti	96		1						97
A. Keke		95	1						96
Tirufe K.	36	49	6	6	5				102
Imdibir	24	10	32	1					67
A. Deboa			1	74					75
Adado	36	6	1	74	8		4	1	130
Doma	17			33		9	11	3	73

Source: Ethiopian Rural Household Survey

Table 9: Variables used in the Regression

Variable	Definition
	Dependent Variable
Net Borrowings*	New loans received minus new loans given, plus loan repayments received minus loan repayments paid. Used as first difference.
	Self-Reported Household Level Shocks
Rain Shock	Index of farm specific negative shocks related to the timing and variability of rainfall at different stages of the crop cycle. The higher the worse. Used as differences of indices.
Crop Shock	Index of farm level adverse events, such as waterlogging, insect attacks, animal trampling, etc. The higher the worse. Used as differences of indices.
Livestock Shock	Index whether livestock is affected by lack of grazing land and drinking water, and animal diseases. The higher the worse. Used as first difference.
No Oxen	Dummy variable. 1 if the household could not obtain oxen at the right time for plowing. Used as first difference.
No Labour	Dummy variable. 1 if the household could not obtained outside labour at the right time. Used as first difference.
	Family Labour Supply Shocks
Lost Working Days by Male/Female Adults	Number of male/female adults working days lost due to illness in the last 28 days preceding the survey as a percentage of male/female adults in the household. The higher the worse. Used as first difference.
	Network Variables
Network	Index of participation on different small group networks,namely, '*iqqub*', labour sharing, oxen sharing and sharecropping arrangements. It ranges between 0 and 1.
ELF	Index of ethnolinguistic fractionalization. ELF varies from 0 to 1 and the higher the index the more fragmented the village.
	Household Assets
Livestock Change*	Change in the value of livestock at $t-1$.
Land Poor	Dummy variable. 1 if household owns less than the median land per capita.
Land Rich	Dummy variable. 1 if household owns more than the median land per capita.

*Note that these variables are per adult equivalent units.

Table 10: IV Estimation of Informal Net Borrowings with Robust Standard Errors
Dependent Variable: Change in Informal Net Borrowings at t and $t-1$

Variables	Coefficient	t-Value	Coefficient	t-Value
Constant	−.5380	−.26	−.6226	−.35
Net Borrowings, $t-1$	−.9030	−2.88***	−.7951	−3.60***
ELF × Net Borrowings, $t-1$			−1.2452	−.93
△Livestock, $t-1$	−.2691	−.75	−.1218	−.55
Village Dummies[a]	Included but not shown.			
	Farm Level and Livestock Shocks			
Land Poor ×				
△Rain Shock	2.3645	1.10	2.7209	1.27
△Crop Shock	.4028	.10	.7285	.19
△Livestock Shock	3.1654	1.29	2.4445	.95
△No Oxen	−.9700	−.58	−.9771	−.55
Land Rich ×				
△Rain Shock	−6.5725	−1.06	−5.0970	−1.09
△Crop Shock	3.9229	.41	3.0671	.45
△Livestock Shock	12.7958	2.29**	8.6579	1.82*
△No Oxen	−3.6949	−1.53	−3.8314	−1.70*
	Labour Supply Shocks			
Land Poor ×				
△Male Adult Working Days Lost	.0702	.33	.0918	.47
△Female Adult Working Days Lost	.0597	.53	−.0560	−.23
Land Rich ×				
△Male Adult Working Days Lost	−.4308	−1.90*	−.3641	−1.65*
△Female Adult Working Days Lost	.1873	.54	.1059	.55
	Network Variables			
Network × Land Poor ×				
△Rain Shock	−.6185	−.16	−2.0019	−.47
△Crop Shock	.3700	.06	−.5508	−.10
△Livestock Shock	−6.8109	−1.35	−5.3791	−.88
△No Oxen	1.7586	.56	.8602	.20
△Male Adult Working Days Lost	−.1294	−.42	−.1554	−.52
△Female Adult Working Days Lost	.0781	.26	.5238	.59
Network × Land Rich ×				
△Rain Shock	13.2261	1.01	10.8296	1.04
△Crop Shock	−8.5140	−.43	−6.3541	−.44
△Livestock Shock	−19.5913	−1.01	−11.2714	−.82
△No Oxen	8.2389	1.61*	7.6441	1.66*
△Male Adult Working Days Lost	.7704	1.91*	.6509	1.69*
△Female Adult Working Days Lost	−.3350	−.63	−.1918	−.63
Number of Observations	1454		1454	
R-Squared	.7483		.7566	
Joint Significance F(.,.)	8.3800	p=.0000	3.0600	p=.0000
Hansen J Statistic χ^2(.)	.3770	p=.9959	4.1400	p=.9668

* significant at 10 percent level,
** significant at 5 percent level,
*** significant at 1 percent level.
[a]The village dummies are jointly significant for both specifications.

Table 11: IV Estimation of (All) Net Borrowings with Robust Standard Errors
Dependent Variable: Change in (All) Net Borrowings at t and $t-1$

Variables	Coefficient	t-Value	Coefficient	t-Value
Constant	−.3415	−.16	−1.0737	−.63
Net Borrowings, $t-1$	−1.2738	−3.20***	−1.0254	−5.21***
ELF × Net Borrowings, $t-1$			−.8117	−.62
△Livestock, $t-1$	.0621	.17	.0683	.33
Village Dummies[a]	Included but not shown.			
	Farm Level and Livestock Shocks			
Land Poor ×				
△Rain Shock	2.8280	1.35	3.2263	1.52
△Crop Shock	1.0769	.27	.8318	.22
△Livestock Shock	2.9470	1.00	2.7025	.94
△No Oxen	−1.6655	−.85	−1.5348	−.85
Land Rich ×				
△Rain Shock	−3.3401	−.61	−3.7259	−.86
△Crop Shock	−4.8701	−.54	−1.8028	−.28
△Livestock Shock	15.6202	2.86***	11.7176	2.46**
△No Oxen	−2.7336	−1.14	−3.2218	−1.42
	Labour Supply Shocks			
Land Poor ×				
△Male Adult Working Days Lost	.2079	.93	.2048	1.00
△Female Adult Working Days Lost	.0802	.49	.0213	.09
Land Rich ×				
△Male Adult Working Days Lost	−.4465	−1.90*	−.3929	−1.76*
△Female Adult Working Days Lost	−.0670	−.23	−.0284	−.16
	Network Variables			
Network × Land Poor ×				
△Rain Shock	−3.0906	−.78	−3.6454	−.85
△Crop Shock	−2.5441	−.40	−2.3383	−.41
△Livestock Shock	−8.5426	−1.21	−7.3561	−1.04
△No Oxen	3.0794	.74	2.3022	.52
△Male Adult Working Days Lost	−.3157	−.96	−.3068	−.98
△Female Adult Working Days Lost	.1092	.21	.3300	.39
Network × Land Rich ×				
△Rain Shock	3.4033	.29	5.5731	.56
△Crop Shock	8.8430	.48	2.8186	.20
△Livestock Shock	−37.7960	−1.91*	−24.0915	−1.78*
△No Oxen	5.8005	1.16	6.1242	1.38
△Male Adult Working Days Lost	.7767	1.88*	.6703	1.73*
△Female Adult Working Days Lost	.0393	.09	.0163	.06
Number of Observations	1454		1454	
R-Squared	.6982		.7809	
Joint Significance F(.,.)	2.9300	p=.0000	4.7600	p=.0000
Hansen J Statistic χ^2(.)	.5050	p=.9919	3.9350	p=.9718

* significant at 10 percent level,
** significant at 5 percent level,
*** significant at 1 percent level.
[a]The village dummies are jointly significant for both specifications.

Figure 1: Optimal Consumption of Household i under Different Contracts (Independent Income Shocks)

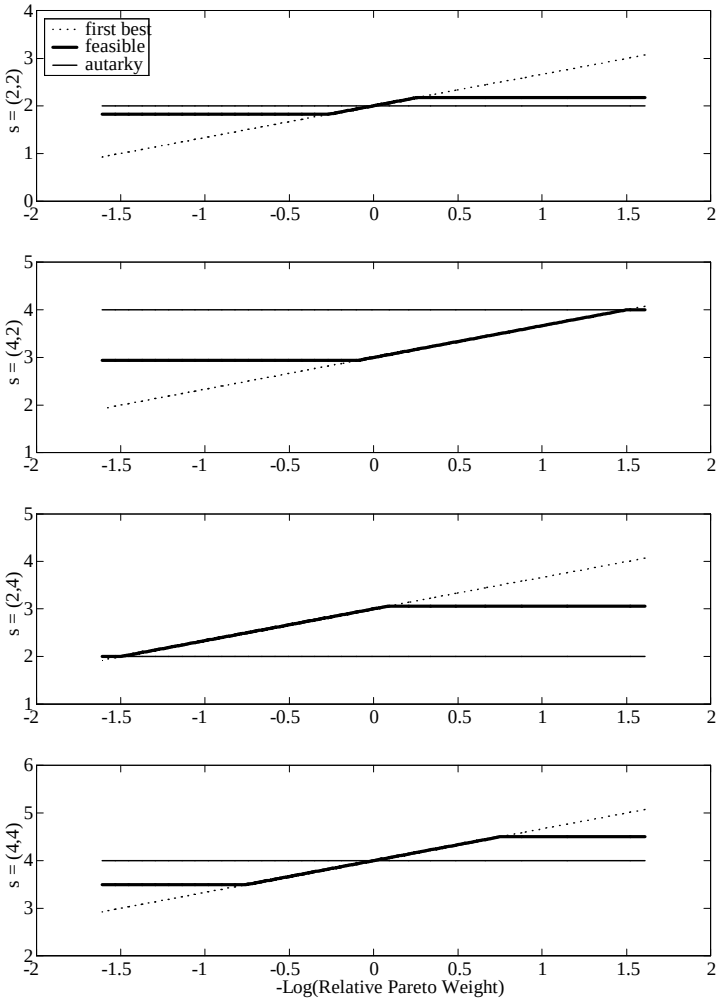

Figure 2: Optimal Consumption of Household i under Different Contracts (Positive Income Correlation)

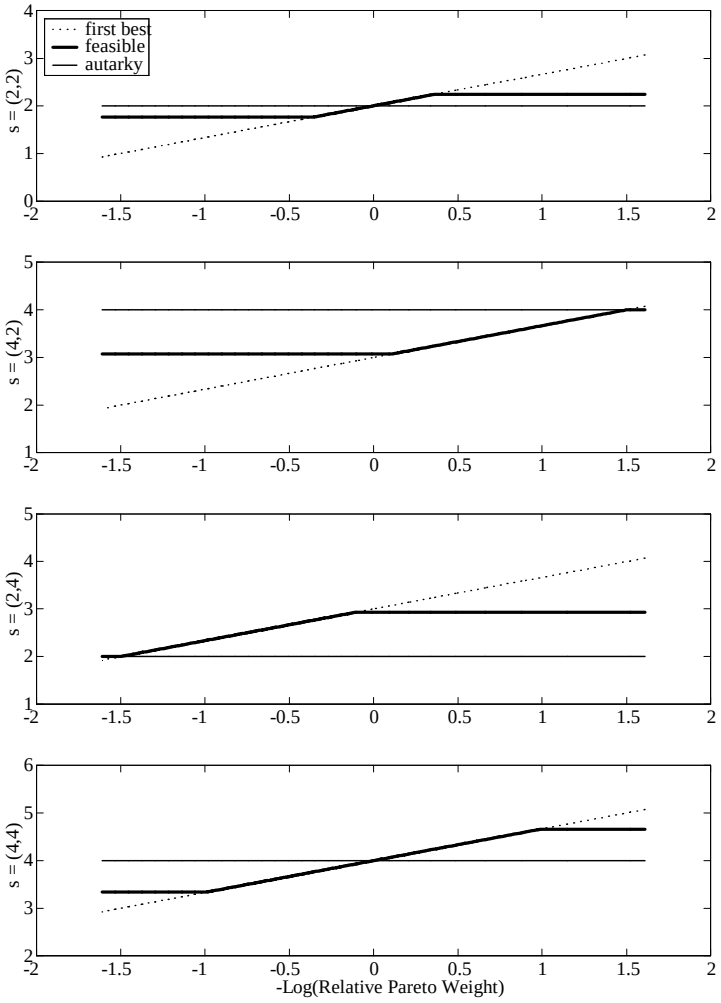

Figure 3: Difference in Consumption Share between High and Low Income States by Income Correlation

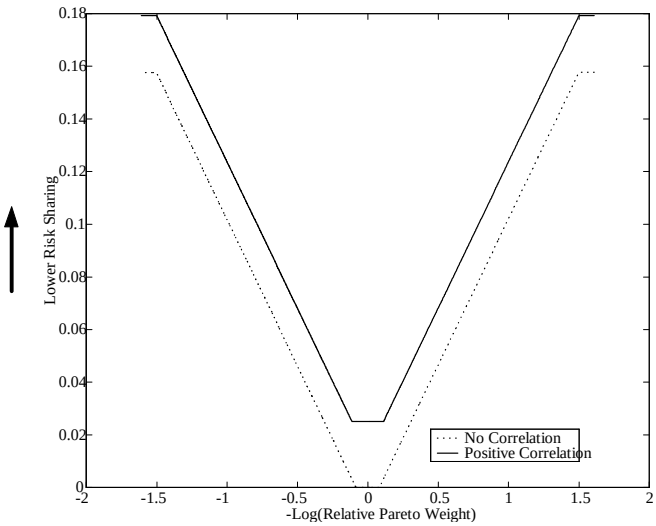

Figure 4: History Dependence of Consumption Share by Income Correlation