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Timothée DEMONT

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# Microcredit as insurance: Evidence from Indian Self-Help Groups

**Timothée Demont***
CERDI, University of Auvergne

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**Abstract** In developing countries, most poor households experience extremely variable income because of a large exposure to climatic, economic and policy shocks, combined with a lack of appropriate insurance devices. Extreme weather events, in particular, are projected to become more frequent in a warming climate, leaving rainfed agriculture and large populations in developing countries at risk. In this context, reliable access to finance in general and credit in particular can potentially bring welfare-improving opportunities to smooth household consumption. This paper documents the extent and the nature of the reactions to rainfall shocks that can be attributed to the participation to informal savings and credit groups in villages of Northern India. I exploit first-hand panel data measuring the living standards of member and control households, coupled with meteorological data at the district-level. I find that agricultural production and income are very dependent on the monsoon quality. Interestingly, while the access to credit collapses for control households after a bad monsoon, Self-Help Groups (SHGs) appear to be robust credit sources that offer to member households the possibility to increase borrowing in order to cope with shocks, even when those are largely covariate within the village. This in turn implies a higher degree of food security over the year and a lower need for temporary migration following a large negative shock. Finally, I review some noteworthy features that allow SHGs to withstand covariate shocks, though potentially at a cost in terms of longer-term insurance.

**Keywords:** Microfinance, climate shocks, income smoothing, risk-coping strategies.

**JEL Classification Numbers:** O13, O15, G21, Q54

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# 1 Introduction

It is well-documented that poor households living in rural areas of developing countries often experience extremely variable income because of the combined effect of a large exposure to climatic, economic and policy shocks and a lack of appropriate insurance devices (e.g. Dercon, 2005). Coping with climatic shocks in particular is becoming ever-more crucial given that climate change is expected to result in warmer temperatures as well as increasingly irregular and extreme precipitation patterns, with severe consequences for rain fed agriculture in developing countries (e.g. Yohe et al., 2007).

Indian agriculture, which employs more than 60% of the country's active population, is extremely dependent on erratic monsoon precipitations, especially given that only a small fraction of land used for agriculture is irrigated. For instance, Parchure (2002) estimates that around 90% of variation in Indian crop-production levels is due to rainfall volatility. Using macrodata from 1951 to 2003, Gadgil and Gadgil (2006) find that, despite a substantial reduction in the contribution of agriculture to Indian GDP, severe droughts have resulted in decreases between 2% and 5% of GDP throughout the period. As a consequence, rainfall shocks have been documented to significantly affect agricultural profits, wages and ultimately the welfare of rural households (see for instance Rosenzweig and Binswanger, 1993; Cruz et al., 2007; Gine et al., 2010; Burgess et al., 2011; Cole et al., 2013).

Informal risk-sharing arrangements with neighbors, friends, or family have often been shown to be largely imperfect in smoothing income shocks (e.g. Dercon and Krishnan, 2000a; Fafchamps and Lund, 2003; Skoufias and Quisumbing, 2003; Kazianga and Udry, 2006). This is especially true for rainfall variation, because a bad monsoon is likely to affect virtually every household in a local rural geographic area. Not surprisingly, a range of evidence suggests that many households remain significantly underinsured against weather risk (e.g. Rosenzweig and Binswanger, 1993; Dercon and Krishnan, 2000b; Duflo and Udry, 2004; Maccini and Yang, 2009; Tiwari et al., 2013; Groppo and Schindler, 2014).

In this paper, I exploit long-term panel data measuring the evolution of living standards of households in Jhakhand, rural India, in order to (i) quantify the impact of climatic shocks on different aspects of households' welfare, and (ii) measure the insurance role of informal village microfinance groups (Self-Help Groups, or SHGs). I combine first-hand panel household data with meteorological data, in order to quantify and characterize the differential reaction in face of rainfall shocks of SHG members as compared to other households. Given that most households in our sample depend principally on the cultivation of rainfed rice, rainfall variation is expected to be an important determinant of transitory swings in income and consumption. Although average rainfall is predictably different from place to place, the deviation of each year's rainfall from its local mean is serially uncorrelated and largely unpredictable. Moreover, the context of extreme poverty in the area implies very limited risk-management possibilities. In this context, SHGs present very interesting characteristics that combine savings, credit and linkages with formal banks, which can potentially help members absorbing adverse shocks even when the latter are largely covariate.

First, I find that farmers in Jharkhand are extremely vulnerable to shocks in the quantity of monsoon rains. Average rice yields decrease by more than 50 percentage points following a monsoon that is one standard deviation below the historical average rainfall level in the district. Those dramatic swings are likely to have very serious welfare consequences, since the farmers in our sample - as more than 50 million households in India - rely on rainfed rice as the principal source of caloric intake and income. Microfinance members are not different than other households as far as the vulnerability of rice production is concerned. Second, given that the traditional sources of credit are relatives, bigger farmers or small businessmen from the same community, credit access virtually dries up for nonmembers after a bad shock. By contrast, SHG members enjoy a steady access to credit, and are even able to borrow more than average during the bottleneck period one year after a bad monsoon. This is made possible thanks to the large pool of savings of SHGs, which collect 'forced' weekly savings from their members, and their linkage with formal banks. Although I are unable to measure any direct consumption smoothing because of a timing issue, I believe that this countercyclical borrowing helps SHG members to absorb rain shocks over the year. However, I also argue that the design of the SHG system does not allow much of inter-year smoothing, which is likely to limit the insurance power of SHGs. Finally, I present some evidence that SHG credit allows some investment towards the diversification of the crop mix. In particular, I show that SHG members progressively decrease their reliance on rice and increase the relative share of vegetables, which are shown to help to smooth agricultural income.

This study is one of the few studies exploiting long-term panel household data to quantify the direct impact of objectively-measured, exogenous, shocks. It is also the first one studying in detail the insurance capacity of Indian SHGs, which represent the dominant model of microfinance in India and one of the world largest. Our study relates to the literature on informal insurance in developing countries and, more recently, on index-based insurance. Section 2 provides a brief survey of this vast literature. Section 3 gives some background information and describes in more details the SHG intervention. Section 4 describes the household and rainfall data that I use and section 5 our empirical strategy. I then present our results, starting with agriculture in section 6, followed by credit in section 7, consumption in section 8 and finally agriculture diversification. I discuss further the validity and robustness of our estimates in section **??**, before concluding.

## 2 Shocks, consumption smoothing and the role of microfinance

In the face of transitory income shocks, households are expected to (seek to) smooth consumption for different reasons. First, individuals have relatively stable preferences over time and therefore prefer to maintain consistent levels of consumption if they can[1]. Second, most households are risk averse, especially if they are poor and closer to the survival point. Third, relatively wide variations in expenditures can be extremely harmful, especially if one lives close to the subsistence level.[2]

Within a village, though part of the risk is common to all families, another important part is specific to the circumstances of specific households. In a seminal paper, Townsend (1994) observed that incomes of different families within Indian villages have ups and downs at very different times. This had led to the idea that, within a village, the poor should be able to insure each other at least partially. Whether households are actually able to smooth consumption or not depends on the context (institutional, informational, social, economical, personal). The empirical literature about the effects of income shocks on household consumption in developing countries provides relatively mixed results. Nevertheless, the consensus from the existing empirical literature seems to be that "most households succeed in protecting their consumption from the full effects of the income shocks to which they are subject, but not to the degree required by either a Pareto efficient allocation of risk within local communities or by the permanent income hypothesis" (Kazianga and Udry, 2006).

To understand why consumption smoothing may be incomplete and why the ability to smooth consumption may vary, it is important to understand the mechanisms used to smooth consumption. The literature has traditionally distinguished ex-ante risk-management from ex-post risk-coping strategies. Under the first category falls income diversification (that is, for agricultural households, diversification of crops and cattle, as well as seasonal wage work) or making conservative employment choices. After the realization of adverse shocks such as a bad monsoon, households can rely on different mechanisms, including engaging in inter-temporal transfers (borrowing / lending, selling / accumulating assets), participating in inter-household transfers or risk-pooling arrangements (formal insurance, informal state-contingent transfers, 'disguised' insurance through labor or credit contracts) and trying to generate a quick alternative income (migration, wage work - including of children, early sowing of the next harvest). All those methods are not equally efficient, and their relative availability will determine the optimal strategy and welfare cost for stricken households. A fairly large number of papers provide evidence about the use of each of those channels in developing countries to smooth income after shocks occur (less evidence is available about ex-ante mechanisms). In particular, several papers have used rainfall shocks to proxy or instrument variations in transitory income and have suggested at least

[1] The oldest and most extreme version of this idea is the permanent income hypothesis first formulated by Milton Friedman (1957), which posited that individuals do not make their consumption choices based on their current earnings but on their expectations of future long-term income.

[2] For instance, even short episodes of child undernutrition can cause long-lasting damages in health and human capital, not affording school expenses for a prolonged period can lead to school drop-out or social stigma, and delaying the treatment of illness can increase the morbidity and future health costs. For Morduch (1995), how often children go to bed hungry matters at least as much as whether they are well-fed on average. As a matter of fact, several studies have showed that uninsured income shocks can lead to adverse human development outcomes such as health and education (e.g. Jacoby and Skoufias, 1997; Jensen, 2000; Hoddinott and Kinsey, 2001; Alderman et al., 2006; Maccini and Yang, 2009; Burke et al., 2011; Groppo and Schindler, 2014) and long-run poverty (e.g. Skoufias and Quisumbing, 2003; Dercon, 2004; Dercon et al., 2005; Premand and Vakis, 2010).

some smoothing. However, in the words of Gine et al. (2010), "the literature studying the effect of monsoon quality on consumption, health, savings, labor supply, and so on is still very much incomplete. Much more needs to be understood about exactly how rural households respond to an event like a severe drought, how large the welfare consequences are, and how those costs are distributed among households. I believe that further careful, systematic research on these questions would be very valuable, especially given the potential for climate change to amplify weather variation in future years and decades". In particular, few papers showed the role of microfinance in the respect. This paper aims at contributing to the issue thanks to a particularly rich panel household database.

Given imperfect risk-sharing mechanisms, microfinance is expected to be potentially beneficial for clients' welfare in face of income shocks. In existing studies, the ability of households to insure against such shocks has often been shown to crucially depend on their wealth and access to financial markets (e.g. Udry, 1990; Fafchamps et al., 1998; Jalan and Ravallion, 1999).[3]

In presence of credit constraints, microfinance can help beneficiaries to invest in profitable enterprises as well as to cope with negative shocks more effectively, by allowing households to borrow in order to smooth consumption rather than liquidate assets for instance. Hence, it is reasonable to believe that microfinance could positively impact consumption smoothing as well as longer-term livelihoods. This is especially true for microfinance institutions (MFIs) that are readily accessible like Indian Self-Help Groups (see section 3.2).

Thus, it is quite surprising that there is not much empirical evidence about the insurance aspect of microcredit. Most experimental studies conducted in recent years are short-term studies and do not focus specifically on the topic of consumption-smoothing.[4] Though not microfinance per se, one exception is Macours et al. (2012), who provide experimental evidence on the impact of a cash transfer program in rural Nicaragua and explicitly analyze whether these impacts differ

[3]The term microfinance that is universally used nowadays can refer either to credit, savings, payment or insurance services. While the others are developing fast, credit was the first to appear and remains the most prevalent throughout the developing world. However, microcredit has usually been conceived as firstly a means to start / expand a business or to afford big lump-sum expenses (durables, education, health, marriages, ...). In fact, it is often argued that income risk is a major factor of default on microloans, which has triggered the rapid development of microinsurance products in recent years. To date, however, evidence about the demand for and the effectiveness of microinsurance remains limited (e.g. Karlan and Morduch, 2010; De Bock and Gelade, 2012; Cole et al., 2013).

[4]Yet, some of them address indirectly the issue. Banerjee et al. (2010) do find that households who gain access to very small, joint-liability, female-oriented loans borrow more from MFIs in case of shocks, but mostly at the expense of other sources (i.e. the households in their study in urban India did not seem to be strictly credit constrained). In their study about expensive consumption loans in South Africa, Karlan and Zinman (2010) find that applicants in the treatment group were significantly less likely to experience hunger, more likely to retain their job over the study period and more likely to increase income. The fact that households with access to credit were less likely to report hunger indicates a more steady level of food consumption over the study period, and can thus be consideres as indirect evidence of the impact of credit access on consumption smoothing. Dupas and Robinson (2013) show through a field experiment that providing savings accounts resulted in substantial, positive effects on productive investment levels for women. They also present suggestive evidence that having a savings account enabled female entrepreneurs to cope with health shocks without having to liquidate their inventories. Field et al. (2011) study the impact of increased flexibility in repayment schedules through a field experiment with a large microfinance institution in Kolkata, India. They find that repayment flexibility increased both the level and variability of business income, investment in business inventory, and household expenditures. They argue that increased flexibility, by providing clients a longer time horizon to prepare for the next loan repayment, should also be associated with lower consumption variability, but are not able to test it empirically.

by exposure to self-reported drought shocks (instrumented with exogenous weather information). They show that, when cash transfers were combined with vocational training or a productive investment grant, they completely offset the impact of drought on consumption and income two years after the intervention, thanks to the diversification of economic activities ex ante.

Some quasi-experiments have looked at the issue directly or indirectly. Using panel data from Grameen Bank users in Bangladesh, Morduch (1998) and Pitt and Khandker (2002) find a reduction in the variance of members' consumption over the three seasonal rounds of the 1991-92 surveys (though Morduch and Roodman 2009 importantly challenge the results). They assert, without direct evidence, that it is the ability to smooth income over the year which drives smoother within-year consumption.

Kaboski and Townsend (2005) use the presence of a financial institution in the villages of four provinces of rural Thailand as an instrument for membership such an institution. In a cross-sectional survey, households were asked whether they needed to reduce consumption in a bad year as a measure of ability to smooth consumption over shocks. They find that MFIs that provide savings services and emergency services significantly reduce the likelihood that a household needs to reduce consumption in a bad year. Gertler et al. (2009) use a similar strategy in Indonesia, using distance to a MFI branch office as exogenous variation for the treatment. The authors focus on the relationship between change in consumption and change in health status in Indonesia. They find that greater access to a MFI branch (e.g. closer in distance to a MFI branch) results in greater ability to maintain consumption levels in response to declines in health experienced by working-age adults in the household. Islam and Maitra (2012) look at the same question using a household-level panel dataset from Bangladesh. They find that in general health shocks do not have a significant effect on household consumption, mostly thanks to sales of livestock when faced with adverse health shocks. Interestingly, they find that households having access to microcredit are less likely to sell productive assets in response to health shocks.

# 3 The program and environment under study

## 3.1 The context

The data used in this paper relate to a large microfinance program in North India, initiated in April 2002 by a development NGO called Professional Assistance for Development Action (PRADAN). The main objective of the organization is to promote and strengthen the livelihoods of socio-economically disadvantaged communities, such as indigenous people, women, scheduled castes, landless and the marginal and small cultivators. Central to this broad agenda is microfinance, which is considered as a means for the rural poor to make strategic investments in improving their livelihoods over time(PRADAN, 2002). Yet, unlike other microfinance models in which the NGO develops itself as the alternative credit provider, PRADAN organises women in Self-Help Groups (SHGs) that become microfinance institutions themselves.[5] Those SHGs are small informal village associations, which are engaged in a variety of collective activities out of which savings and credit are the most important (their precise functioning is explained in the next section). By 2009, PRADAN was active in eight states of North India and had around 11,000 running SHGs.

This study focuses on the state of Jharkhand, which is located in Northeast India (see map ?? in appendix). The state was carved out of Southern Bihar in 2000. It is among the poorest of all 27 Indian states, with 46% of its rural population below the national poverty line (according to the latest official 2005 figures available) and a female litteracy rate of 38.9%, fifteen percentage points below the national average (2001 Indian census figures). UNDP's recent Human Development Report for 2010 estimates that 77% of Jharkhand's population is poor, using a multidimensional poverty index based on variables such as access to education, health, electricity, sanitation, drinking water, cooking fuel and assets. The state of Jharkhand is mostly rural (78% of its 30 millions inhabitants) and its population consists of 28% tribals and 12% scheduled castes, which are known to be the most vulnerable groups of the Indian society. The present study focuses on villages only, which are very isolated on average. There, the main source of livelihood is subsistence agriculture and seasonal labor work. rain fed paddy is by large the predominant crop in the state, followed by pulses, maize, wheat and oilseeds. The average yield of paddy is around 9.6 quintals per hectare, which is half the national average. The backwardness of agriculture in the state is contributed by poor water control strategy, largely characterized by erratic rainfall, coupled with low irrigation coverage (9% of net sown area). Those characteristics imply that the food security needs of households can be met through own cultivation for at most six months of the year (Kabeer and Noponen, 2005). As a result, migration to urban centers and especially to nearby states in search of seasonal employment is widespread. Other sources of supplementary income are livestock and non-timber forest produce, especially in forest areas. In its 2008 India State Hunger Index, the International Food Policy Research Institute estimated that Jharkhand was suffering from the second highest level of hunger and malnutrition prevalence in India - higher than Zimbia or Haiti (Menon et al., 2008). Historically, Jharkhand has been lacking lacking well performing local organizations and, today, it combines one the lowest SHGs to population ratio (less than 200 SHGs per 100,000 of population) with one of the highest percentage of poor population nationally (MicroSave, 2011).

## 3.2 Self-Help Groups and PRADAN's intervention

PRADAN's SHG program in the state of Jharkhand started in 2002. According to the Reserve Bank of India,

> A Self-Help Group is a registered or unregistered group of micro entrepreneurs having

[5] Bank-linked SHG is the dominant microfinance model in India, which has been promoted by the National Bank for Agriculture and Rural Development (NABARD) since 1992 and progressively mainstreamed from 1996. PRADAN's SHGs follow closely the official guidelines (RBI, 1999; NABARD, 1992).

homogenous social and economic background, voluntarily coming together to save small amounts regularly, to mutually agree to contribute to a common fund and to meet their emergency needs on mutual help basis. The group members use collective wisdom and peer pressure to ensure proper end-use of credit and timely repayment thereof (RBI website).

This section describes in details how does this general definition translate into the environment under study. Establishing a group usually begins with a PRADAN representative holding a meeting at some public place in a village, such as the Panchayat office or the primary school, where the details of the program are described. Within geographical clusters around the local offices, PRADAN chooses to work with relatively disadvantaged communities and poor villages, where no other NGO has worked before. A study by CGAP found that PRADAN had indeed deeper-than-average outreach: almost all SHG members are tribal people or members of scheduled castes, 85% have no homestead land or only marginal nonagricultural landholdings and almost 90% live in thatched huts or are squatters (CGAP, 2007). After a few such meetings, a group of between 10 and 20 motivated women is formed.[6] One important rule imposed by PRADAN is that there may be only one member per household. If a village is large, or interest in the program is widespread, multiple groups may be created. After some initial training and capacity building from the NGO, the group chooses a name for itself, agrees on a weekly meeting time and determines other group rules such as the minimum contributions per member at each meeting (usually 5 or 10 Rupees - which amounts to about USD 0.5 - 1 per month), the interest rate charged on loans that are given to group members[7], and fines for non-attendance or late payment. Moreover, the group elects three members to take on the permanent positions of president, secretary and cashier, who are also the representatives for the bank. An accountant is also chosen, who attends every group's meetings and is responsible for recording all transactions and maintaining the books of the group.

After a few months of smooth functioning, a savings account is opened at a commercial bank near the village to deposit group savings, and, usually after about a year, the groups showing mature financial behavior are enabled to take bank loans for a variety of income generating activities (the group is then said to be *linked*). At that point, groups are pretty much autonomous and the intervention of the NGO is only required to solve occasional problems (though PRADAN

[6]Because Indian law requires that larger organizations be formally registered, PRADAN SHGs have never more than 20 members and are thus unregistered. Turning to the focus on women, it is interesting to note that the original NABARD SHG model has no built-in gender bias, although NABARD acknowledges a natural focus on women: "As regular meetings and savings are compulsory ingredients in the product design, it becomes more suitable for the women clients - as group formation and participatory meetings is a natural ally for the women to follow (NABARD website)". As a matter of fact, 90% of all SHGs which have borrowed from banks in India only have women members. PRADAN justifies its choice to focus exclusively on women both on equity and efficiency grounds, based on their long field experience: "[women] remain the most disadvantaged sector among the poor. Yet it is the women who prove to be most effective in fostering change in their families and communities (PRADAN website)".

[7]In practice, I observe virtually no deviation from the interest rate of 2% monthly, which is suggested by the NGO. However, interest rates might be higher for very large amounts because they require extra group borrowing from the bank.

keeps track of the financial records of all SHGs through regular reports of the accountants). Bank loans are always made to the group as a whole, without collateral and at market interest rates (fluctuating around 12% per annum).[8] The amount of the bank loan represents an increasing proportion of the group's savings (initially 1:1 or 2:1, it can go up to 10:1 after some years). Similarly, the repayment period is also gradually increased over time, from six months or one year initially up to three or even five years.

At a typical meeting, each member deposits the agreed minimum weekly savings or more, pays the interest on the loan she has taken (if any) and possibly pays back part of the principal. Interest earned on on internal loans remain within the group and becomes part of its corpus. Then, members who don't have a loan yet can require one to the group. Loans are individual but they have to be agreed on by the group and repayment is public. Moreover, there is a strong peer pressure ensuring due repayment, in order to preserve the group's resources. This being said, there is generally a lot of flexibility and understanding within the group when a member is not able to pay the weekly installment and asks, say, to pay double next time or when her cash flows become more favorable.[9] In fact, the affinity among the members provides both the pressure for recovery and the space to adjust repayments when a member has a genuine problem with cash flow. The savings and interest revenues of the group help to cushion irregular cash flows and adjust to urgent and unexpected situations, while keeping with the repayment of bank loans. Yet, if a member fails to repay (or to come to meetings) for a prolonged period, group representatives will visit her house in order to get her back paying. In (rare) cases of actual default, the group first withdraws on the defaulting member's savings and, if this is not enough, eventually pays for her. Finally, every year, the group agrees to distribute a portion of the realized profit to every member, through some kind of dividends that are proportional to savings. The remaining surplus is retained as a general reserve for adjustment against future losses or difficult contingencies.

As a conclusion, the bank-linked SHG model is a very decentralized, cheap and potentially sustainable way of providing access to reliable savings and credit services in rural areas (not to mention other potential benefits from the group structure, such as peer support and other social

[8]Since 2000, SHG loans are considered as part of the priority sector lending of commercial banks, which encourages them to lend at relatively cheap rates. Indeed, the Reserve Bank of India holds that the interest rate charged to priority sectors should not exceed banks' prime lending rate (the rate at which the bank lends to its best customers). Even at those cheap interest rates, SHG lending is highly profitable for the banks, as transaction costs are low and the reported recovery rates are as high as 98% (Dave and Seibel, 2002). Moreover, commercial banks that lend to SHGs are eligible for subsidized refinance from NABARD. However, while this possibility was used extensively at start, "with increased bankers' confidence in SHG banking, banks started using their own resources and NABARD's refinancing dropped from 91 per cent in 1999 to 33 per cent in 2007 (Bali Swain, 2012)".

[9]A recent study by CGAP found that the average Portfolio at Risk $>$ 90 days of PRADAN SHGs was over 20% (CGAP, 2007). They explain that, "although this level of loan delinquency would be disastrous for most microcredit providers, SHGs are surviving despite this. This has to do with the fact that a significant part of the SHG loans are used for crop cultivation and livestock rearing, neither of which offer a monthly cash flow. Yet, loan installments remain fixed at monthly [or even weekly] intervals, [...] sometimes out of a desire to keep a discipline of 'repaying something in each meeting'. Thus the high level of late repayments in SHGs does not always translate into defaults."

services).[10]

Today, the bank-linked SHG model is considered as the largest and fastest-growing financial inclusion program in the developing world, with, as on 31 March 2010, almost 7 millions bank-linked SHGs in India covering about 97 millions families (NABARD, 2010)[11]. This represents a remarkable achievement, especially given the general acknowledgement that standard microfinance products remain more suited to urban and peri-urban areas than the to the rural world. Yet, very few (impact) studies have focused on SHGs.

### 3.3 How can SHGs offer insurance against income shocks?

First and foremost, SHGs allow members to borrow (and save) in face of income shocks. Several features of SHGs are important in this respect. First, SHGs are meeting weekly (or even more often if needed) and there is no fixed order in loan taking (unlike ROSCAs for instance). That is, members can ask any amount at any time - with the important restrictions that (i) the group needs to agree and (ii) the money needs to be available. Second, as already explained, repayment is somewhat flexible. Third, SHGs lend out of a pot of accumulated savings and external bank loans. As a consequence, even though SHGs are essentially village institutions, several members can take loans together and are potentially able to insure against even covariate shocks (like rainfall shocks), at least partly.

Yet, SHGs certainly go beyond mere credit and savings activities. They constitute strong groups of pairs meeting regularly, which gives individuals good information on what others are doing as well as a strong reason to stay together. As a consequence, SHGs can potentially help members to smooth income, not only through self-insurance in the form of borrowing but also through risk sharing among members.

Finally, note that even large rainfall shocks are certainly not fully covariate, since there exists important heterogeneity among members regarding land ownership (from no land to relatively big plots), main occupation, assets, family structure, etc.

[10] CGAP (2007) estimated that the average cost of promoting and supporting SHGs in India is around 18 USD per group member (20 USD for PRADAN groups), and that the average return on assets after adjusting for loan loss provisions is around 9% (16% for PRADAN groups). Deducting the costs supported by the promoting NGO, SHGs break even on average, with an adjusted ROA of 0% (-1% for PRADAN groups). The study concludes that "The Indian SHG model can work sustainably in well-managed programs. Compared to other microfinance approaches, the SHG model seems to be producing more rapid outreach and lower cost."

[11] In Jharkhand, the number of bank-linked SHG is about 80,000. The success of the bank-linked SHG model has clearly been enabled by the dense network of commercial banks in rural India, which is largely due to the ambitious social banking program that created roughly 30,000 bank branches in unbanked rural locations between 1969 and 1990 (Burgess and Pande 2005 document extensively the program and its impact). Today, although it has actually decreased over the last decade, the number of rural branches of scheduled commercial bank is still at 20,773 (RBI 2010), and the number of branches per 1,000$km^2$ is one of the highest in developing countries (Burgess and Pande, 2005).

# 4 Data

## 4.1 Households' living standards

Three rounds of household panel data were collected from 2004 to 2009.[12] The sample was selected using a stratified sampling strategy. The state of Jharkhand was divided into four geographical clusters based on historical differences in ecological and demographic characteristics: Northeastern (Santhal Parganas districts), Central (Hazaribagh and surrounding districts), Southwest (Ranchi-Lohardaga districts) and Southeast Jharkhand (Singhbhum districts). For each cluster, a simple random sample of 6 villages was chosen from the set of all villages with at least one SHG formed in 2002 (the first year of the program). In each of those villages, a total of 36 respondents were randomly selected - 18 being SHG members and 18 being non-members from the same village. In addition, 12 control villages with no SHG were randomly selected in the same districts, in which a random sample of 18 households were interviewed. This constitutes the final sample, which counts 1080 households from 36 villages and 9 districts (see table 18 in appendix). All analysis controls for the resulting sample composition so that the results are representative for the whole population. The surveys were always carried in the same period of the year, namely January-March, which corresponds to a rather slack, post-harvest period at the end of the monsoon season. The questionnaire includes detailed information on many aspects of households' living standards, including: household demographics, recurrent and durable expenditures, consumption, credit and savings, labor market participation, self-employment, migration, food vulnerability, landholdings and agriculture, dwelling conditions, health, education, female empowerment, participation in key activities in and out of the village.

The database presents an important stability, with an average find-out rate across rounds of 94% and a cumulative attrition over the 3 rounds under 4% (or under 3% excluding one village that had to be dropped entirely due to security reasons in the last round). Table 1 gives the membership distribution of the actual sample for the different rounds. It shows that membership status is very stable at around 45% from round 2 to round 4, above the original 40% as some original nonmembers join SHGs over time. Indeed, we observe that changes in membership status across rounds do occur - mainly due to the opening of new groups or the closure of ill-functioning groups - but are limited. Table 2 reports the absolute and relative numbers of exit from and entry into SHGs over time. Regarding new entry, the large majority of the cases concerns the creation of new groups. In fact, entering an existing group is relatively hard due to the size limit of the groups and the requirement that newcomers must contribute to the group an amount equal

[12] In August 2002, a preliminary study (Dewan and Somanathan, 2007) collected baseline data on SHG members and nonmembers, just after groups had formed and before members started receiving any benefits. Though I will occasionally turn to these data, e.g. to check pre-treatment borrowing behavior in section 7, I do not use them in the main analysis because of three major reasons: (1) being essentially an exploratory survey, it collected limited data on a limited sample (notably, it did not include any control villages) and is therefore not fully compatible with later rounds, (2) this first survey was not carried at the same season than the later ones, which is problematic given our focus on rainfall and agriculture shocks, and (3) to the extent that members could not borrow yet, there was no scope for insurance at that time.

to the accumulated savings per member at that time. This deters prospective members from joining existing groups, and they often choose to motivate other people and start a new SHG instead. In addition, some SHGs were created in control villages after 2004. Cumulating the two types of change (i.e. non-member to member of SHG or drop-outs from SHG), the average rate of change of status across rounds is 13%, such that, in the last round, households who were members in round 2 are still much more likely to be part of an SHG than other households.

Table 1: Membership distribution of sample (% of individuals surveyed in each round)

| | Year | | |
|---|---|---|---|
| Status | 2004 | 2006 | 2009 |
| SHG members | 44.2 | 48.3 | 44.8 |
| Non-members in treatment villages | 35.5 | 31.8 | 35.0 |
| Households in control villages | 20.3 | 19.9 | 20.2 |

Table 2: Non-compliance: SHG exit and entry

| | round 3 | round 4 |
|---|---|---|
| SHG leavers w.r.t. previous round | 51 | 88 |
| *percent of members in previous round* | *10.9* | *17.1* |
| New SHG members w.r.t. previous round† | 100 (85) | 44 (33) |
| *percent of nonmembers in previous round*† | *17.0 (14.5)* | *8.0 (6.0)* |

† Figures in parentheses indicate new groups.

Table 3 gives some key descriptive statistics about the demographic, agricultural and poverty profiles of members, nonmembers and controls in the first round of survey. Given that the SHG program had already been active for one year and a half, I stick to broad indicators that are time invariant or slow to change. For the sake of transparency, I distinguish the two categories of non-SHG households at this stage, though I will group them together in the econometric analysis. I observe that SHG households are a bit younger and more educated on average (though the household head completed less than 4 years of schooling on average). They are very largely similar to other households as far as agriculture is concerned, though they are slightly more likely to own some land than other households in their village. SHG households belong more often to scheduled castes, which correspond to the lowest rank of the Indian social hierarchy. They also tend to be more often officially recognized as poor.[13] This is partly due to (i) the targeting of particularly disadvantaged hamlets by the NGO's initial information campaign, and (ii) the fact that SHG that are on the BPL list are eligible to subsidized loans through the SGSY scheme of the Indian government (hence groups often select members based on this characteristics). Despite being poorer, SHG households are less likely to have benefited from financial help from

[13]The BPL status was determined from a census carried out by the Ministry of Rural Development in 2002-03, following an indicator-based scoring approach to classify households as poor and non-poor. The 2002 BPL census had 13 questions on aspects as varied as the size of landholding, type of house, availability of clothing, ownership of consumer durables, food security, access to sanitation, education attainment, migration, indebtedness etc.

the government in order to build their house, possibly because of administrative difficulties in the allocation process.[14]

Table 3: Key descriptive statistics about member, nonmember and control households in 2004

| | members | nonmembers | controls |
|---|---|---|---|
| household size | 5.77 | 5.53 | 5.73 |
| nb. of 0-5 years old | 1.04 | 0.86** | 1.05 |
| nb. of working age | 2.70 | 2.74 | 2.82 |
| age average | 24.0 | 27.2*** | 25.7** |
| head schooling | 3.7 | 3.1** | 2.9** |
| head farming | 0.43 | 0.38* | 0.47 |
| farm income proportion | 0.08 | 0.10 | 0.08 |
| land cultivated (acres) | 1.50 | 1.35 | 1.42 |
| land owned (acres) | 1.79 | 1.74 | 1.69 |
| landless | 0.07 | 0.11** | 0.07 |
| house built under IAY | 0.14 | 0.21*** | 0.10 |
| in official BPL list | 0.52 | 0.50 | 0.44* |
| scheduled caste | 0.13 | 0.07*** | 0.06*** |
| scheduled tribe | 0.38 | 0.40 | 0.43 |
| observations | 428 | 409 | 214 |

*Notes:* ***, ** and * indicate that the variable is statistically different across member and other households respectively at the 1, 5 and 10% levels, using a 2-sided t-test for differences in means.

## 4.2 Rainfall

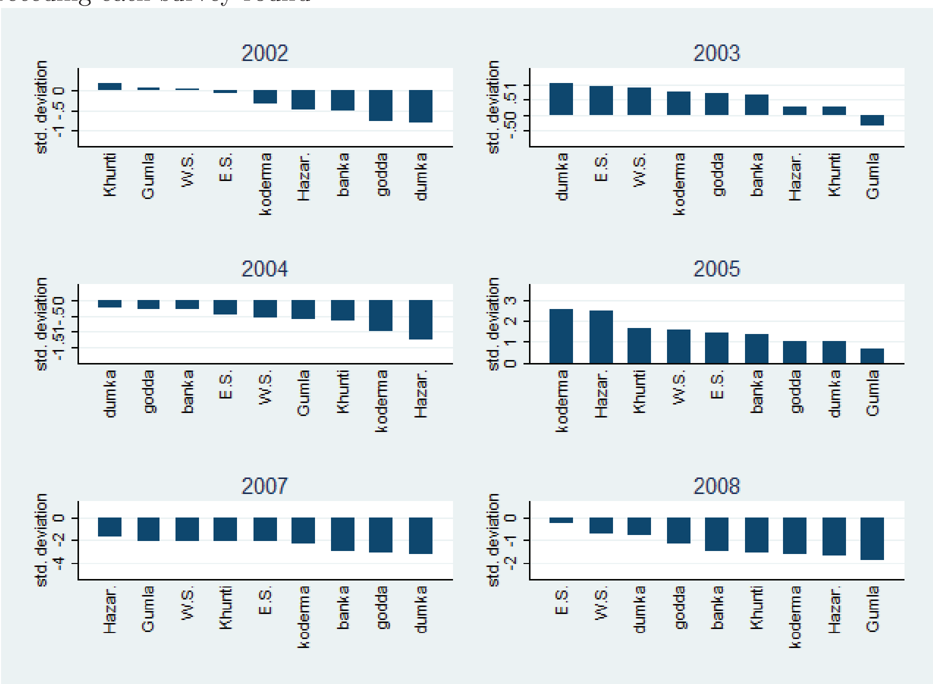
Rainfall data come from the Global Precipitation Archive (Matsuura and Willmott, 2012), which provides monthly precipitation from 1980 to 2010 at 0.5 degree spatial resolution ($\sim$ 50 km, corresponding roughly to the average district size). I retrieve data from 1990 to 2008 for the nine sample districts. This period is chosen to jointly maximize statistical accuracy and empirical relevance as a reasonable recall period for farmers (see next section). Given that households were surveyed between January and March and that Indian rains are mostly concentrated during the Southwest monsoon between June and September, the main reference rainfall episode for each round will be June - September of the previous year. Note that the monsoon period also

[14] The Indira Awaas Yojna scheme has been running since 1986 and provides financial assistance for construction (or upgradation) of dwelling units to the below poverty line (BPL) rural households, with a particular focus on Scheduled Tribes and Scheduled Castes (though non scheduled castes or tribes can get access up to maximum 40% of the total IAY allocation). Note that the number of eligible BPL families is far greater than the funds available in any given year and there are important waiting lists: by 2000, some 6.7 million houses had been constructed under the IAY nationally, amounting to less than 3% of the 260 million BPL households; in my sample, 22% of all BPL families got IAY, and a bit less than 20% of all IAY beneficiaries were not BPL. The final selection of the beneficiaries is done by municipal councils, with a great deal of discretion. To be eligible, applicants must obtain land records from different block-level offices; reports of bribes being demanded by those officials are widespread (Nayak et al., 2002; Johnson et al., 2003). Moreover, beneficiaries have to make their own arrangements for construction and are responsible for the construction, which might prove hard for the poorest. Finally, housing may not always be a high priority among the rural poor, compared to needs such as consumption smoothing and protection from cyclical vulnerability (Nayak et al., 2002).

correspond to the major agricultural season (kharif rice season), which implies that it has a crucial influence on the productivity, income and welfare of rural households (see section 6).

Statistically, the state of Jharkhand is not considered as a chronical drought area, with an average annual rainfall of about 130cm. Nevertheless, it suffers from the extreme concentration and volatility of rainfall: more than 80% of the rainfall comes between June and September, and some years can be extremely wet while others can be extremely dry. Figure 1 shows substantial variation in the sample, both across districts and over time. Roughly speaking, 2003 and especially 2005 were bad monsoon years (the latter being officially recognized as a drought year for the whole state), while 2008 and especially 2007 received very generous rainfall. Nevertheless, we observe significant inter-district variation. Indeed, thanks to the stratification strategy, the sample includes villages in all three main agro-climatic zones that compose the state of Jharkhand (map 7 in appendix). The South Eastern Plateau receives relatively more rain and has the highest cropping intensity, the Central and North Eastern Plateau is the biggest zone and presents a lower intensity, and the Western Plateau is the hilliest region, with an average agricultural profile roughly comparable the the previous region. Rice (predominantly) and maize are cultivated in all three regions, pulses especially in the Central and North Eastern Plateau as well as the Western Plateau, and wheat especially in the Central and North Eastern Plateau.

Figure 1: District-level standardized deficit of monsoon rainfall w.r.t. 10-year average, in the 2 years preceding each survey round




Rainfall is not only volatile, it is also crucial. Most of the households surveyed are small landholders, who by and large practice a subsistence agriculture with limited marketable surplus.

Rice, in particular, often represents the main source of food and income. It is well known that Indian foodgrain production, including rice production, is highly correlated with the amount of summer monsoon rainfall from June to September (e.g. Asada and Matsumoto, 2009). This is partly due to the high poverty and low agricultural investment rates in Jharkhand: "given the high levels of risk and low levels of production, the resources available for inputs such as fertilizers and pesticides are meagre and most households tend to avoid such costly investments (Rao et al., 2000)". Scanty rainfall during the kharif season is therefore likely to depress both agricultural productivity and income during the next calendar year, possibly right until the next kharif harvest. It is often considered that Jharkhand's rural population faces a 'hungry season' from June to October (PACS, 2004).

In the words of Joshi et al. (2003), "the eastern region [of India] is the most backward region with respect to per capita income, growth in agriculture and development of infrastructure. The yield levels are comparatively low because of uncertain production environment and poor adoption of improved varieties and technologies. Overall, the region is food-based and the extent of diversification is relatively low as compared to other regions. This region is largely concentrating in rice. The humid and high rainfall makes cultivation of rice more favorable in this region".

# 5 Empirical strategy

Rainfall shocks are plausibly exogenous income shocks, given that they are essentially unanticipated at the start of the season.[15] Since rainfall shocks are exogenous and spread over space, and since I surveyed both members and nonmembers in each district, their incidence is by definition balanced between SHG members and comparison households. I can therefore examine the treatment effect of microcredit on response to shocks, which is conditional on a shock having occurred. In order to control for self-selection into membership, I include household fixed effects in all estimations. This being said, it is not very likely that the original decision to participate in the SHG program was linked to any shock outcome, as the year 2001 had generous rainfall.

I model rainfall as an exogenous and unanticipated shock to the transitory income of agricultural households, and estimate its differential impact on member and nonmember households. My baseline specification takes the form of the following difference-in-difference equation:

$$y_{idy} = \alpha + \rho D_{dy} + \beta(SHG_i * D_{dy}) + \gamma H_{iy} + \lambda_y + \eta_i + \epsilon_{idy} \quad (1)$$

where $y_{idy}$ is the outcome of interest (farm productivity, credit, consumption etc.) of household i in district d and year y, $SHG_i$ is a dummy variable taking value one if household i is member

[15]As Morduch (1995) points out, if an income shock can be predicted beforehand, then households might sidestep the problem by engaging in costly ex ante smoothing strategies (e.g. diversifying crops, plots and activities). The data in such a situation would (incorrectly) reveal that income shocks do not matter. However, rainfall in Jharkhand is relatively important on average but is erratic. Hence it is the delay in the onset of the monsoon and the distribution of rainfall that chiefly matter. Moreover, rainfall does not appear to be serially correlated (using a Q test, I was unable to reject the hypothesis that rainfall follows a white-noise process over the period 1990-2010 for all districts).

of an SHG, $D_{dy}$ is a measure of rainfall deficit in district d and year y, $H_{iy}$ is the household size in equivalent adults[16], $\lambda_y$ are year fixed effects that account for economy-wide shocks and $\eta_i$ are household fixed effects that account for households' fixed characteristics and average behavior (e.g. due to self-selection into SHGs or fixed village and district features). The definition of the membership variable is driven by two potential sources of bias. On the one hand, it is only if a household participates in an SHG at the date of the shock that it can potentially derive any direct shock-mitigating effect from membership. One the other hand, though actual movements into and out of membership are limited (see section 4.1), those are potentially endogenous. As a consequence, the variable SHG refers to original membership and the $\beta$ coefficients deliver a conservative lower bound for the ATT given imperfect compliance with the assignment to treatment. Throughout, standard errors are clustered at the household level in order to account for the correlation of standard errors and potential heteroskedasticity.

The principal measure of rainfall shock that I use, D, is a standardized precipitation anomaly, which is computed by taking the deviation from the norm in the same district and dividing by the standard deviation of rainfall in each district:

$$R_{dy} = \frac{Rain\_avg_d - Rain_{dy}}{\sigma(Rain)_d}.$$

This measure has the advantage of being continuous and easy to interpret: a positive (negative) value means a worse (better) monsoon than the norm in the same district. Moreover, the slope estimates correspond to a one standard deviation change in rainfall.[17] Mean district rainfall and standard deviation are calculated over a rolling window of the ten years immediately preceding the current year, i.e. 1998-2007 for the year 2008, 1997-2006 for the year 2007 and so on. That is, for each year we consider the relevant rainfall history. I focus on the rain between June and September, which corresponds to the monsoon period and concentrates more than 80% of yearly rainfall on average. It is also the period that is crucial for agriculture (see section 6), residual rains being scattered over the rest of the year. Although the standardization implies that the range of the previous shock variable is limited, I also check for nonlinearities in the effect of rainfall by including its squared value in the regression equations. Indeed, for some outcomes, only extreme shocks could matter.

[16]I use the equivalence scale proposed by Townsend (1994), who computes male-adult equivalent consumption according to the following age-sex weights (estimated from a dietary survey in rural Andhra Pradesh and Maharastra): for adult males, 1.0; for adult females, 0.9; for males and females aged 13-18, 0.94 and 0.83, respectively; for children aged 7-12, 0.67 regardless of gender; for children 4-6, 0.52; for toddlers 1-3, 0.32; and for infants 0.05. Hence this measure reacts very slowly to fertility decisions, but could change quickly over time through migration.

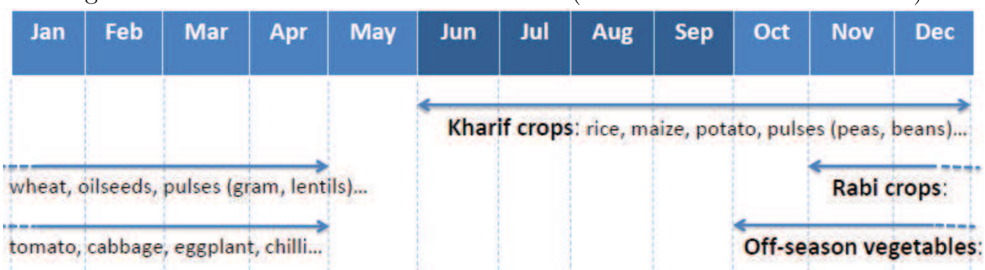
[17]One standard deviation of the sample distribution of monsoon rainfall corresponds to about 25 cm on average (one fourth the average monsoon rainfall). The maximum standardized rainfall deviations observed over the sample period are -3.2 on the negative side and 2.6 on the positive side, see figure 1.

# 6 Agriculture

An obvious starting point is the impact of rainfall on the agricultural sector. This analysis will allow to quantify the importance of the measured rain shocks in the sample and to check how these translate into a reliable measure of income shocks.

The section focuses mostly on rice since it is by far the most important and widespread crop cultivated in the area. It is also the principal staple cereal composing the daily diet of the surveyed households. In our sample, it represents 80% of households' total agricultural production on average (50% of agricultural income) and is cultivated by 95% of agricultural households (76% of all households). Moreover, in the region, only kharif (or winter) rice is cultivated, which is rainfed and thus highly dependent on monsoon rains and is harvested in December, i.e. just before the survey (see figure 2). As a consequence, the very fresh recall about rice production will allow us to identify the rainfall episode that corresponds to the largest income shock for the farmers in the sample. By contrast, rabi crops are harvested in spring and do not rely directly on monsoon rains. In Jharkhand, rabi crops cultivation is relatively limited and is unequally distributed geographically, mainly because of underinvestment in irrigation facilities. As a result, rabi production has only very limited capacity to mitigate shocks to the main kharif production. It also implies a longer recall in the survey and a more complicated shock identification, as rabi crops rely on residual soil moisture from the monsoon season and are partly irrigated. Figure 2 presents the cultivation seasons of the main crops in the area.

Figure 2: Cultivation seasons in Jharkhand (monsoon months are in dark)




For rice cultivation in the study area, it is often considered that the most important rains come in July, when rice is usually transplanted in flooded fields. Asada and Matsumoto (2009) find a significant correlation coefficient of 0.36 between the rainfall in July and kharif rice production in Bihar and Jharkhand, higher than for any other month. Gadgil et al. (2002) find that the monsoon onset (June-July) has a large and significant influence on kharif rice production, but explain that if rain picks up in August, the damage to output can still be limited through delayed sowing. According to the Indian Ministry of Agriculture, the rice sowing season extends from June to October. As a consequence, I tried different time windows, from the monsoon onset to the total annual rainfall, in order to determine the most relevant shock measure. It turns out that the entire monsoon period (June-September) has the strongest and most significant correlation with agricultural outcomes, which confirms that later (scarce) rainfall is essentially useless for agriculture and that deficient rainfall at the start of the monsoon can be mitigated through delyed sowing. Moreover, I also tried to include lagged shock variables and found no shock persistence for agricultural outcomes, reflecting the very basic agricultural model followed by the farmers in the sample including very little irrigation and storage capacity. I thus only report the results corresponding to the entire monsoon window of the preceding year.

I first provide descriptive statistics about rice production following a good or a bad monsoon. It appears clearly that rice production and income depends heavily on the relative monsoon abundance. Average yields and sales drop by respectively one third and more than half in bad years. There does not appear to have much risk-mitigation adaptation at the intensive margin (e.g. in sown area). Rice production is overwhelmingly aimed at home consumption in all years (though even more so after a negative shock).

Table 4: Rice production descriptive statistics

| | good monsoon | bad monsoon | p-value† |
|---|---|---|---|
| Average yields (kg/acre) | 851.8 | 582.0 | 0.00 |
| Total production (kg) | 817.3 | 527.2 | 0.00 |
| Probability of producing a positive quantity | 0.82 | 0.74 | 0.00 |
| Probability of a complete crop failure | 0.01 | 0.05 | 0.00 |
| Total sown area (acres) | 1.29 | 1.16 | 0.03 |
| Total sown area if >0 (acres) | 1.57 | 1.53 | 0.56 |
| Probability of selling on the market if prod. >0 | 0.15 | 0.07 | 0.00 |
| Total quantity sold if prod. >0 (kg) | 76.2 | 31.4 | 0.00 |
| Production for home consumption (%) | 96.3 | 98.3 | 0.00 |
| Observations | 1197 | 1996 | |

*Notes:* Good and bad monsoons refer to June-September rainfall episodes respectively above and below the historical district average. † 2-sided t-test for differences in means.

Table 5 confirms that rice production in the area of study is very sensitive to monsoon quality. Column 1 shows that a sizeable fraction of households react to the observed rainfall at the extensive margin, as the probability of producing a positive quantity decreases by 6 percentage points for a one-standard deviation deficit with respect to the average rainfall in the district. This is especially true for landless households, who have to enter rental or sharecropping agreements if they decide to produce. Looking at the interaction term, I find that SHG members do not react differently. In column 3, I estimate a 28% semi-elasticity of rice yields (kg per acre). Recalling that home-grown rice represents the basis of food consumption, this yields shock implies an important income loss. The significant quadratic term in column 4 indicates that the relation is concave, as yields are increasingly depressed the more severe is the rainfall deficit (the F-tests at the bottom of the table indicate the significance of the quadratic relationship). This suggests the existence of fixed factors limiting the production capacity such as land and household sizes or liquidity to buy inputs. Again, SHG members are as affected as other households. Finally, lack of rainfall also affects negatively market participation (from an already very low level in average times), implying lower cash income.[18]

[18]Hence consumption needs clearly dominate strategic market participation induced by price effects. In the

Table 5: Agricultural production: rice

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | any production | | log yields | | any sale | |
| Rain deficit (D) | -0.0552*** | -0.0416** | -0.278*** | -0.226*** | -0.0303* | -0.0452** |
| | (0.0163) | (0.0170) | (0.0504) | (0.0559) | (0.0155) | (0.0194) |
| D_squared | | -0.00646 | | -0.0558** | | 0.0108 |
| | | (0.00694) | | (0.0231) | | (0.00732) |
| D Xshg | 0.0130 | 0.0147 | 0.0182 | 0.00930 | 0.0107 | 0.0104 |
| | (0.00938) | (0.00940) | (0.0299) | (0.0300) | (0.0101) | (0.0111) |
| D_sq. Xshg | | -0.00400 | | 0.0400 | | -0.000234 |
| | | (0.00844) | | (0.0275) | | (0.00823) |
| Observations | 3088 | 3088 | 2360 | 2360 | 2360 | 2360 |
| Adjusted $R^2$ | 0.021 | 0.022 | 0.136 | 0.139 | 0.052 | 0.053 |
| F_D | | 0.0145 | | 0.000 | | 0.0664 |
| F_D Xshg | | 0.290 | | 0.307 | | 0.517 |

OLS estimation. Std errors clustered at the household level in parentheses (*p<0.10, **p<0.05, ***p<0.01). All equations include a constant, time and household fixed effects, and control for household size.

Though rice is undoubtedly the single most crucial crop for home consumption and income that is also the most dependent on monsoon rainfall, table 6 shows that the conclusion goes unchanged if one looks at other crops. Potatoes are the second most common crop cultivated in the area (though already to a much lesser extent) and is also cultivated during the kharif season. We see that potato yields are also strongly affected by the monsoon, which might translate into an even larger income shock given that potatoes have a higher commercial value. Pooling all crops together, we find a similar concave relationship as above, reflecting the fact that rice is the overwhelmingly dominant component of the crop mix. Columns 5 and 6 confirm that rain shocks also imply lower cash income, as total proceeds from agricultural sales on the market are 18 percentage point lower following a one standard-deviation monsoon deficit.

To sum up, we find that our shock measure indentifies strong income shocks, and that SHG members do not withstand rain shocks better. This is quite intuitive, as there is not much one can do against bad rain when cultivating rain fed rice (except, of course, ex-ante risk-mitigating investments such as irrigation, which are probably too complex and costly for the size and scope of SHGs' operations). In the next sections, I look how a series of non-agricultural outcomes are affected by that shock, and whether SHG members are better able to smooth the associated volatility. Figure 3 presents the timing of the rain and corresponding income shocks, as well as their potential consequences on the non-agricultural outcomes that are the object of the next sections.

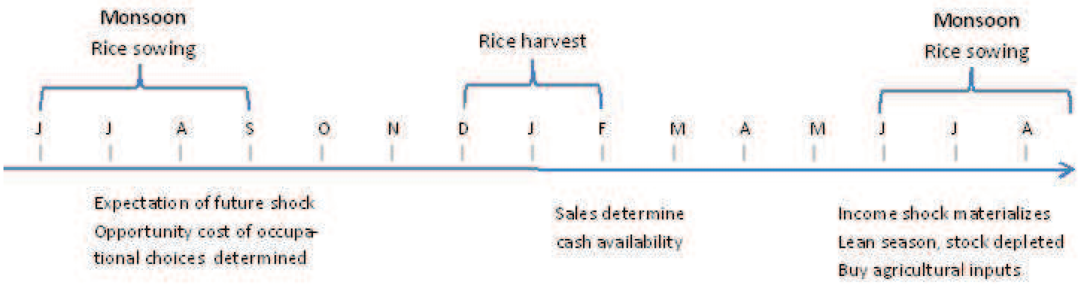
data, I indeed estimate a -14% correlation (significant at the 1% level) between the price obtained on rice sales and my measure of monsoon rainfall deviation, after controlling for year fixed effects, village and household characteristics and clustering of standard errors. This finding thus reflects the low integration of food markets in the study area, as well as the fact that most of the small farmers in our sample lack both the surplus and the technical capacity to store rice from one year to the next.

Table 6: Agricultural production: other crops

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | log potato yields | | log all-crop yields | | log total proceeds (+1) | |
| Rain deficit (D) | -0.298** | -0.0122 | -0.253*** | -0.186*** | -0.184* | -0.354** |
| | (0.130) | (0.207) | (0.0494) | (0.0557) | (0.0974) | (0.173) |
| D_squared | | -0.177** | | -0.0689*** | | 0.0743 |
| | | (0.0820) | | (0.0225) | | (0.0692) |
| D Xshg | -0.0988 | -0.156* | -0.00468 | -0.0176 | 0.0396 | -0.00838 |
| | (0.0760) | (0.0864) | (0.0283) | (0.0276) | (0.0670) | (0.0997) |
| D_sq. Xshg | | 0.0891 | | 0.0500* | | 0.0231 |
| | | (0.0736) | | (0.0258) | | (0.0719) |
| Observations | 605 | 605 | 2491 | 2491 | 3088 | 2360 |
| Adjusted $R^2$ | 0.171 | 0.184 | 0.125 | 0.130 | 0.062 | 0.085 |
| F_D | | 0.0056 | | 0.000 | | 0.122 |
| F_D Xshg | | 0.185 | | 0.133 | | 0.945 |

OLS estimation. Std errors clustered at the household level in parentheses (*p<0.10, **p<0.05, ***p<0.01). All equations include a constant, time and household fixed effects, and control for household size.

Figure 3: Timing of the shocks over the year




# 7 Credit

This section focuses on credit, which is likely to be the main channel through which the insurance effect of SHGs materializes. I thus want to test the hypothesis that SHGs bring easier access to credit, even in periods of bad rain. The survey collected data about loans taken during the two years prior to the survey, so that we can expect rain in both t and t-1 to matter, though t-1 should probably have a higher impact because the income loss due to a bad harvest would then be fully realized. Thanks to the exact date at which loans have been taken, I can verify which is the relevant rain episode for each loan. In table 7 below, I enumerate the relevant combinations of the timing of loans and rainfall that I will explore in the analysis.[19] First, I check for 'immediate' effects that might happen contemporaneously to rain shocks, for instance in order to finance agricultural expenditures to profit from a good monsoon or to the contrary in

[19]Note that I do not use the loans in t-1 because (i) they do not identify additional combinations and (ii) they might suffer from recall bias (which could be different for member and nonmember households).

order to finance risk-mitigation strategies in anticipation of a bad harvest given a bad monsoon. Nevertheless, this is unlikely to be the most important effects as the room to adapt traditional agricultural activities is usually limited. Second, the 'sales' period comes immediately after the harvest, in which credit might be taken to compensate lost revenue in case of bad harvest, or because it can be repaid more easily in the opposite case. Moreover, it corresponds to the lean season during which non-agricultural activities might be performed in order to generate additional income. The third period corresponds to one year after the rain shocks ('stock'). This crucial period corresponds to the hungry season in rural Jharkhand and households are expected to seek credit in order to make the two ends meet before the new harvest, especially following a negative rain shock. At the same time, it might be a period of acute shortage of credit if traditional lenders suffered bad harvests themselves. Moreover, given that traditional lenders often require to start repaying immediately, it might be harder to take credit after a bad shock. Finally, I run a falsification test by regressing credit outcomes in January-May on the rain shock that will be coming in the following months. If our regression strategy is correct and shocks are indeed unexpected, future rain should not have any significant effect.

Table 7: Matching date of credit with relevant rainfall

| Loans ╲ Rain | Jun-Sep $t$ | Jun-Sep $t-1$ |
|---|---|---|
| Jan-May $t$ | falsification (0) | sales (2) |
| Jun-Dec $t$ | immediate (1) | stock (3) |
| All year $t$ | - | sales + stock |

Table 8 provides some descriptive statistics about the borrowing behavior of SHG members and other households. On average, the probability to borrow a positive amount over the year is 78% for SHG members and 49% for other households. On average, the probability to borrow is higher in June-December than in January-May, reflecting the fact that the second half of the year corresponds to main agricultural season (including rice). On the one hand, this period requires the purchase of agricultural inputs and, on the other hand, it requires more food purchases because the previous year's stock of grain is depleted. Total credit follows the same pattern, though the difference between member and nonmember households is less large, reflecting the fact that nonmembers take on average bigger loans but less often. Average amounts borrowed annually correspond to about 13% of members' annual income and 9% of nonmembers' income.

Table 8: Borrowing: descriptive statistics

| | Proba. to borrow (%) | | | Total credit (INR)[1] | | | *For comparison* |
|---|---|---|---|---|---|---|---|
| | Jan-May | Jun-Dec | Year | Jan-May | Jun-Dec | Year | income (INR)[2] |
| Members | 40.8 | 61.0 | 78.5 | 710 | 1,278 | 2,124 | 16,505 |
| Other households | 16.7 | 35.0 | 49.5 | 391 | 835 | 1,407 | 15,517 |

[1] Average value, trimming the top 1% observations.

[2] Median value of the sum of all remunerations received and the net value of agricultural production over the year.

Table 9 regresses a dummy variable for whether or not an individual borrowed during the time window that is considered. As anticipated, I find that there is no much impact of the current rain ('immediate' effect), though members might borrow a bit more often after a bad monsoon. By contrast, I detect large effects in the 'sales' and especially 'stock' periods. Roughly six months after the rain shock, during and immediately after harvest, member households strongly increase their borrowing after a negative shock (about 10 p.p. per standard deficit of rain). Given that this corresponds to the period of the year of relative abundance of food, this extra credit should not be primarily aimed at financing consumption but rather alternative income-generating activities outside (kharif) agriculture. By contrast, other households do not react after a negative shock. The effect is strongest during the period of relative scarcity; nonmembers's probability to borrow decreases by 6 p.p. on average one year after a negative shock of one standard deviation in rainfall. By contrast, the estimate for SHG members is opposite and more than compensates the average effect. That is, the year following a bad monsoon, nonmembers have to strongly reduce their borrowing, while members take *more* loans. In other wors, nonmembers experience a strong procyclicality in their access to credit while members enjoy a stable access to credit and can even borrow countercyclically in the lean season to finance alternative income generation. Table 10 graphs the estimated quadratic relationships that are significant.

Table 11 presents some interesting robustness and validation tests. We first pool the crucial sales and stock periods together and regress the probability to have borrowed a positive amount over the whole year before the survey over the monsoon deficit of the previous year. This confirms that SHG increase their borrowing during the year after a bad shock while other households experience a decrease in their access to credit. Second, columns 3 and 4 present a falsification test by regressing the probability to borrow between January and May over the rain that has yet to come, and find no significant effect. Third, columns 5 and 6 check if there was any pre-treatment difference in the borrowing behavior of SHG members and other households and find no such difference.

The analysis of loan amounts (table 13) delivers very similar results to the previous ones, indicating that most of the action is at the extensive margin.[20] Indeed, conditional on having access to credit, rain shocks have no significant impact on total credit. Therefore, the effect of SHG membership is about giving easier access to credit to more people in periods of hard times, but not increasing debt levels. Note that the previous effect is not due to ever-greening, which could happen if SHG members simply rolled over their loans during difficult periods. Indeed, regressing repayments yield a mirror image than credit, which implies that repayment rates keep up with borrowing rates. This is natural given that repayment has to be regular within the SHG framework.

Given than the need for credit is theoretically inversely related to last year's rainfall, the observed relation reflects credit rationing by the informal lenders. As a matter of fact, most loans to nonmembers come from moneylenders and relatives, who are often larger farmers living

[20]Because the distribution of credit is right skewed and presents an important mass at zero, I regress the log of amounts plus 1. Using a Poisson regression on levels gives very similar results (not shown here).

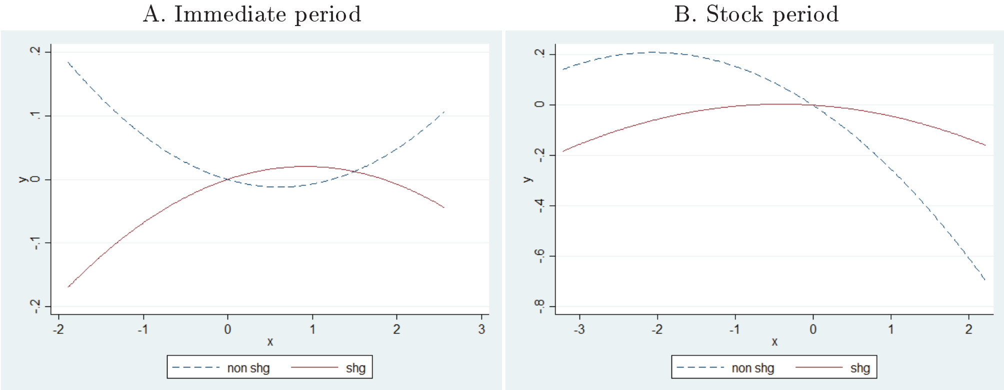
Table 9: Borrowing probability

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Immediate | | Sales period | | Stock period | |
| Rain deficit of last year (D) | -0.0246 | -0.0386 | | | | |
| | (0.0238) | (0.0273) | | | | |
| D_squared | | 0.0314*** | | | | |
| | | (0.0106) | | | | |
| D Xshg | 0.0618*** | 0.0830*** | | | | |
| | (0.0145) | (0.0152) | | | | |
| D_sq. Xshg | | -0.0555*** | | | | |
| | | (0.0120) | | | | |
| Rain deficit of previous year (D_1) | | | -0.00529 | -0.0460 | -0.0566** | -0.204*** |
| | | | (0.0251) | (0.0464) | (0.0275) | (0.0533) |
| D_1_squared | | | | -0.0119 | | -0.0499*** |
| | | | | (0.0135) | | (0.0152) |
| D_1 Xshg | | | 0.0950*** | 0.0405 | 0.113*** | 0.185*** |
| | | | (0.0176) | (0.0593) | (0.0183) | (0.0641) |
| D_1_sq. Xshg | | | | -0.0189 | | 0.0261 |
| | | | | (0.0204) | | (0.0217) |
| Observations | 3088 | 3085 | 3088 | 3085 | 3088 | 3085 |
| Adjusted $R^2$ | 0.023 | 0.033 | 0.020 | 0.021 | 0.033 | 0.038 |
| F_D | | 0.0126 | | 0.609 | | 0.00067 |
| F_DXmb | | 0.000 | | 0.000 | | 0.000 |

OLS estimation. Std errors clustered at the household level in parentheses (*p<0.10, **p<0.05, ***p<0.01). All equations include a constant, time and household fixed effects, and control for household size.

Table 10: Estimated relationship from table 9, over the relevant range of the deficit variable

A. Immediate period B. Stock period




The graphs draw the functions $\hat{y} = \hat{\rho}_1 D + \hat{\rho}_2 D^2$ for non shg and $\hat{y} = (\hat{\rho}_1 + \hat{\beta}_1)D + (\hat{\rho}_2 + \hat{\beta}_2)D^2$ for shg.

Table 11: Borrowing probability: robustness and placebo tests

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Whole year | | Sales period (falsification) | | Round 1 (placebo) | |
| rain deficit of last year (D) | | | 0.0206 | 0.0396 | | |
| | | | (0.0275) | (0.0322) | | |
| D_squared | | | | -0.0229** | | |
| | | | | (0.0102) | | |
| D Xshg | | | -0.00864 | -0.0301 | | |
| | | | (0.0171) | (0.0242) | | |
| D_sq. Xshg | | | | 0.0158 | | |
| | | | | (0.0158) | | |
| Rain deficit of previous year (D_1) | -0.0420 | -0.194*** | | | -0.133*** | 0.113 |
| | (0.0274) | (0.0515) | | | (0.0466) | (0.213) |
| D_1_squared | | -0.0496*** | | | | -0.0972 |
| | | (0.0146) | | | | (0.0843) |
| D_1 Xshg | 0.122*** | 0.158*** | | | -0.0333 | 0.184 |
| | (0.0176) | (0.0608) | | | (0.0586) | (0.277) |
| D_1_sq. Xshg | | 0.0136 | | | | -0.0922 |
| | | (0.0204) | | | | (0.116) |
| Observations | 3088 | 3085 | 3088 | 3085 | 550 | 550 |
| Adjusted $R^2$ | 0.036 | 0.043 | 0.020 | 0.022 | 0.085 | 0.087 |
| F_D | | 0.00079 | | 0.0777 | | 0.0137 |
| F_DXmb | | 0.000 | | 0.450 | | 0.634 |

OLS estimation. Std errors clustered at the household level in parentheses (*p<0.10, **p<0.05, ***p<0.01).
Columns 1 to 4 include a constant, time and household fixed effects, and control for household size.
Columns 5 and 6 include a constant, household and village controls.

Table 12: Log of total credit (+1)

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Immediate | | Sales period | | Stock period | |
| Rain deficit of last year (D) | -0.201 | -0.345* | | | | |
| | (0.176) | (0.200) | | | | |
| D_squared | | 0.233*** | | | | |
| | | (0.0772) | | | | |
| D Xshg | 0.414*** | 0.560*** | | | | |
| | (0.108) | (0.114) | | | | |
| D_sq. Xshg | | -0.356*** | | | | |
| | | (0.0877) | | | | |
| Rain deficit of previous year (D_1) | | | -0.0582 | -0.208 | -0.392* | -1.482*** |
| | | | (0.185) | (0.327) | (0.202) | (0.377) |
| D_1_squared | | | | -0.0397 | | -0.358*** |
| | | | | (0.0977) | | (0.109) |
| D_1 Xshg | | | 0.553*** | -0.0765 | 0.718*** | 1.180*** |
| | | | (0.127) | (0.413) | (0.133) | (0.445) |
| D_1_sq. Xshg | | | | -0.224 | | 0.164 |
| | | | | (0.143) | | (0.154) |
| Observations | 3087 | 3087 | 3086 | 3086 | 3087 | 3087 |
| Adjusted $R^2$ | 0.013 | 0.021 | 0.014 | 0.016 | 0.020 | 0.025 |
| F_D | | 0.0097 | | 0.799 | | 0.000 |
| F_DXmb | | 0.000 | | 0.000 | | 0.000 |

OLS estimation. Std errors clustered at the household level in parentheses (*p<0.10, **p<0.05, ***p<0.01).
All equations include a constant, time and household fixed effects, and control for household size.

Table 13: Credit

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| | Probability of borrowing | | | | Total credit (unconditional) | | | | Log credit if >0 |
| | immed. | sales | stock | year | immed. | sales | stock | year | year |
| *A. Monsoon deviation* | | | | | | | | | |
| rain | -0.000256 | -0.0116 | 0.105*** | 0.0657* | 0.0894 | -0.00941 | 0.261** | 0.146* | 0.0756 |
| | (0.0358) | (0.0337) | (0.0349) | (0.0372) | (0.129) | (0.154) | (0.105) | (0.0878) | (0.0825) |
| rainXshg | -0.0355* | -0.0863*** | -0.0597** | -0.0850*** | -0.0757 | -0.351*** | -0.138* | -0.146** | -0.0108 |
| | (0.0191) | (0.0190) | (0.0267) | (0.0210) | (0.0629) | (0.0990) | (0.0811) | (0.0651) | (0.0727) |
| shg | 0.268*** | 0.286*** | 0.304*** | 0.347*** | 0.634*** | 1.225*** | 0.714*** | 0.675*** | 0.0745 |
| | (0.0252) | (0.0231) | (0.0260) | (0.0243) | (0.0851) | (0.110) | (0.0887) | (0.0747) | (0.0854) |
| *B. Monsoon deficit* | | | | | | | | | |
| rain | -0.00620 | -0.153* | -0.328*** | -0.374*** | -0.0927 | -0.916* | -0.785** | -0.736** | -0.515* |
| | (0.0526) | (0.0873) | (0.113) | (0.119) | (0.177) | (0.485) | (0.348) | (0.293) | (0.294) |
| rainXshg | 0.0336 | 0.234** | 0.318*** | 0.387*** | 0.0696 | 0.780 | 0.643* | 0.434 | -0.0528 |
| | (0.0351) | (0.114) | (0.112) | (0.113) | (0.116) | (0.552) | (0.330) | (0.296) | (0.387) |
| shg | 0.252*** | 0.209*** | 0.229*** | 0.249*** | 0.600*** | 0.917*** | 0.553*** | 0.535*** | 0.0698 |
| | (0.0346) | (0.0250) | (0.0324) | (0.0298) | (0.114) | (0.126) | (0.106) | (0.0888) | (0.0868) |
| Obs. | 3188 | 3188 | 3188 | 3188 | 3143 | 3143 | 3143 | 3143 | 1955 |

Columns 5-8: Tobit model (I report semi-elasticities); other columns: OLS. Columns 5-9 trim the top 1% values of the conditional distribution.
Std errors clustered at the village-year level in parentheses (*p<0.10, **p<0.05, ***p<0.01).
All equations include a constant, time and district fixed effects, and village and household controls.

in the same village or its neighborhood (see table 14) and are therefore likely to be affected by the same rain shock. Moreover, those lenders might anticipate lower repayment rates and be more reluctant to lend. In fact, farmers themselves might want to avoid taking credit in periods in which they will have trouble in repaying. By contrast, member households take most of their loans from SHGs, and their borrowing ability stays virtually unaffected by rain shocks. This is remarkable, in particular during the critical stock period, given that the basic concept underlying SHGs is the pooling of local resources, which could have been expected to dry up in case of adverse rainfall shocks. In conclusion, SHGs do not seem to break down in critical periods. To the contrary, member households are able to borrow more than average in case of negative shocks.

Table 14: Average conditions of different loan options (2002-2009)

| | SHG | Moneylender | Neighbor | Relative | Bank |
|---|---|---|---|---|---|
| interest rate (% monthly) | 2.6 | 8.1 | 3.3 | 2.2 | 2.9 |
| amount (Rs.) | 1,271 | 3,238 | 3,052 | 3,673 | 17,191 |
| duration (months) | 7.0 | 8.7 | 7.0 | 9.0 | 20.3 |
| frequency member households (%) | 87.4 | 3.8 | 3.6 | 3.9 | 0.7 |
| frequency other households (%) | 42.1 | 20.2 | 16.7 | 15.8 | 3.1 |
| number of loans | 3,239 | 473 | 422 | 413 | 73 |

There are different reasons why SHGs are able to keep lending in case of important and largely covariate shocks. As mentioned in section 3.2, the first and foremost reason is that SHG members do not lend to each other out of their *current* money, but out of a pool of savings that is growing over time. Moreover, that pool is being complemented by external loans from commercial banks. That is, while the scope for risk pooling is certainly not infinite due to the limited scale of operation, SHGs work as micro financial intermediaries, which can usually meet individual credit needs thanks to the collection of regular deposits and borrowing from commercial banks.

I first look at the availability of savings as a function of the monsoon quality in t-1 (unfortunately, having no data about bank loans, I cannot check the availability of this subcomponent of SHG funds - though I expect it to be stable). Graph 4 displays the the distribution of the absolute yearly amounts of savings and credit per SHG member (savings being the sum of the regularly deposits over the year, excluding loan repayment).[21] Strikingly, while average and median savings are slightly higher after good rains, the distributions appear very similar in good and bad years. The second striking fact is that the modes of the savings and credit distributions coincide, implying a high frequency of zero net borrowing. Graph 5 illustrates the last point clearly, by plotting the distribution of net borrowers among SHG members, in district-years with good and bad monsoon in year t-1. I define net borrowers as the members who have taken more credit than their cumulated savings. As anticipated, both curves are almost perfectly centered in zero, s.t. the most frequent pattern is to fully collaterize SHG loans over the year. This is because the policy of requiring small deposits at every meeting is usually fairly strictly followed, leading in any case to yearly savings of about 400 Rupees minimum (for weekly deposits of 10 Rupees). Yet, this is by no means true for all members: there is an important mass of net contributors to the group and another, bigger, mass of net borrowers. Hence, it is apparent from the graph that, on average, SHGs are used more as credit instruments than savings instruments. Moreover, the right tail is slightly fatter in case of deficit rain, as more members take credit that outsize their own savings. Nevertheless, it is now clear that the system does not break up after a bad monsoon: though the distribution curve slightly shifts rightwards, members keep saving regularly and the modal behavior remains taking out roughly the same amount of credit than one's own savings.

The second aspect of SHG resilience that I want to check is the evolution of repayment performances (though the previous discussion implies that groups break even only with savings, at least for the modal member). Table 15 displays some statistics about repayment performance. While outright defaults are extremely rare in our data, delays in repayment are frequent. I observe that a bad monsoon affects negatively the promptitude of repayment, of SHG as well as other loans. However, the actual duration of SHG loans does not increase, mostly because the contractual duration stays stable (while it strongly increases for other loans). As a consequence, while the extension of the repayment period might imply some cash shortage for normal lenders, the availability of savings implies that bad rainfall shocks have no major consequence on SHGs'

[21] SHGs keep two separate accounts fro each member, one for the regular deposits and one for the loans taken and repaid. It is only if there is a problem of repayment that the savings account is used to absorb the debt.

Figure 4: SHG borrowing and savings, by monsoon intensity in t-1: Kernel density estimate

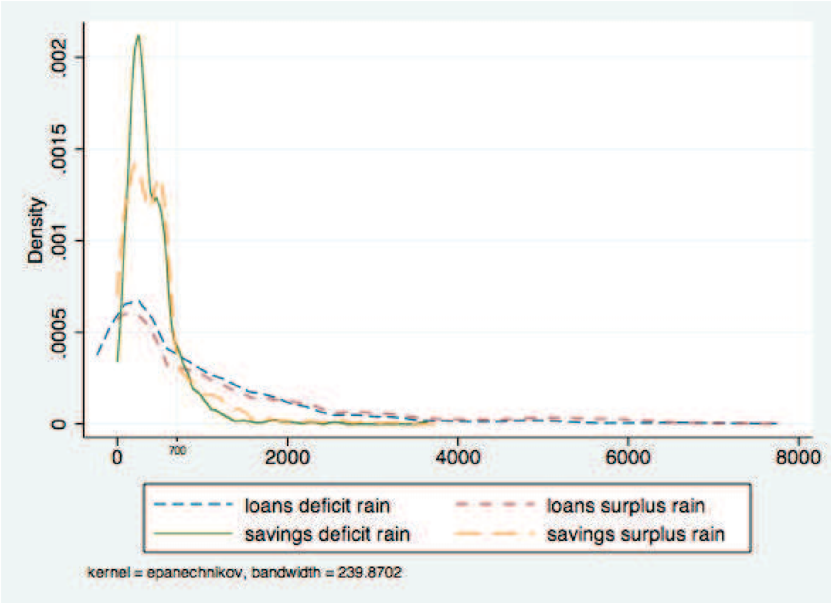
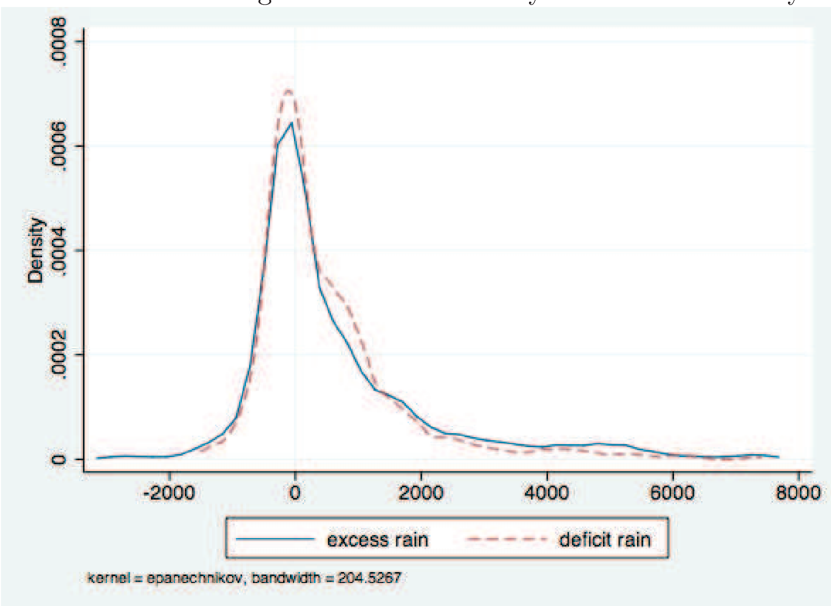



Figure 5: Net SHG borrowing and monsoon intensity in t-1: Kernel density estimate




sustainability.

A last way of checking the availability of funds to lend in SHGs is to look at the passbook balance of members in 2009, which states the accumulated savings since joining the group. Given that I asked in each survey about all loans taken in the last two years, I can reconstruct virtually

Table 15: Borrowing: repayment performance

| | Rain deficit in t-1 | | Rain surplus in t-1 | |
|---|---|---|---|---|
| | SHG loans | Other loans | SHG loans | Other loans |
| Default (%) | 0.99 | 0.61 | 1.06 | 0.76 |
| Late repayment[‡](%) | 46.64 | 40.08 | 30.69 | 24.17 |
| Repaid (%) | 52.01 | 42.01 | 56.99 | 46.96 |
| Actual duration[†](months) | 6.13 | 7.56 | 6.23 | 7.34 |
| Contractual duration (months) | 4.23 | 5.82 | 4.74 | 3.67 |
| Nb. of loans | 896 | 488 | 1130 | 658 |

[†] Actual duration is equal to the time to repay if the loan is repaid or to $max$(contractual duration, time elapsed from the date of borrowing) if the loan is not repaid. [†] Late repayment is equal to one in case (time to repay $>$ contractual duration) if the loan is repaid or (actual duration $>$ contractual duration) if the loan is not repaid (and is equal to zero otherwise).

the entire credit history of each member, from 2002 to 2009 (though with a gap in 2006). By comparing the total credit taken from SHG since 2002 to the passbook balance in 2009, I get an idea of the long-term net position of each member. The conclusion of such computation is clear: about 80% of the sample are long-term net debtors, confirming that SHGs are powerful credit instruments over the long run.

I conclude the discussion by pointing that, given the high frequency at which SHG net borrowing is zero at the individual level, it is not entirely clear how much benefit it can bring to members in terms of consumption smoothing. Indeed, if the general rule is to balance personal credit and savings, the only smoothing allowed is seasonal smoothing, which is clearly limited given that there is only one main harvest per year (though, of course, farming income can always be complemented by casual work off season). SHG members would probably benefit from more flexibility in the system of compulsory savings, at least once the groups have built up a reasonable pool of savings and become bank-linked. I will now check whether I can detect some benefits in terms of shock absorption given the current system.

# 8 Food security and risk mitigation

Consumption can be affected by rainfall because of different reasons. First, I have shown earlier that home production (of rice) is strongly affected by rainfall, which directly determines consumption from home production and the need to buy more or less on the market. The second factor that might affect consumption is income. I have seen in section 6 that a good monsoon significantly increases agricultural income, which might boost market purchases (though the effect of monsoon on agricultural income that I found was arguably limited). Finally, there might be an effect from the evolution of market food prices.

Unfortunately, given that the questionnaire collected food consumption information about the week preceding the survey, my data is not ideal to capture those effects, as the surveys were carried right after the harvest (between January and March) when rice stocks should still be plenty. My consumption data will thus not be able to tell about the potential use of credit for short-term consumption smoothing before the harvest, i.e. when households are most hit. Yet, the questionnaire did ask about food security throughout the year. In particular, for each month of the year before the survey, we asked if the household had enough to eat. The two first columns of table 16 regress the number of months with enough food over the monsoon deficit variable. I find that food security decreases rapidly when the monsoon is lower than average. Yet, SHG members are much less dependent on the quality of monsoon and enjoy a much more stable consumption profile over the year (see the graphical representation in panel A of table 17). Hence, it appears that the large credit effect detected in the year following a bad monsoon helps SHG households to smooth consumption when there is the highest need to do so.

The remaining columns of table 16 look at mitigation strategies. I find that SHG members tend to increase in a convex way the number of crops grown on their farm in response to a bad shock, while other households don't modify their crop mix. SHG members increase especially the cultivation of solanaceous crops (i.e. fruit plants such as tomatoes, eggplants, chillies), which present higher yield potential and a higher commercial value but require more nutrients and more labor than traditional grain crops such as rice. As shown in figure 2, vegetables are especially grown from January to April and their cultivation is thus facilitated by the SHG credit taken during what I refered to as the 'sales' period in tables 9 and 13. Finally, in the two last columns, I find that SHG members migrate more immediately after a bad monsoon, in order to look for alternative income-generating activities. This process is facilitated by SHG credit taken during the 'immediate' period. Because of this and because they can access credit easily, SHG members do not have to migrate any more one year after the shock, while control households have to send out many temporary migrants in order to cope with food and income scarcity at this critical season. This is also in line with them cultivating vegetables during the first half of the year.

# 9 Conclusion

Extreme weather events are projected to become more frequent in a warming climate. Policy needs a better understanding of the magnitude of the impacts on rural households, the distribution across income groups and the coping strategies adopted.

In developing countries, most poor households experience extremely variable income because of the combined effect of a large exposure to climatic, economic and policy shocks and a lack of appropriate insurance devices. Climatic shocks in particular are expected to increase in frequency and magnitude in the future, leaving rain fed agriculture and populations in developing countries at great risk. It is well established in the literature that recurring income shocks, as well as traditional risk-mitigating strategies and coping mechanisms, can be very costly for poor households. In this context, reliable access to finance and credit in particular can potentially bring welfare-improving consumption-smoothing opportunities.

The present paper studies the effect of monsoon intensity on the agricultural production and

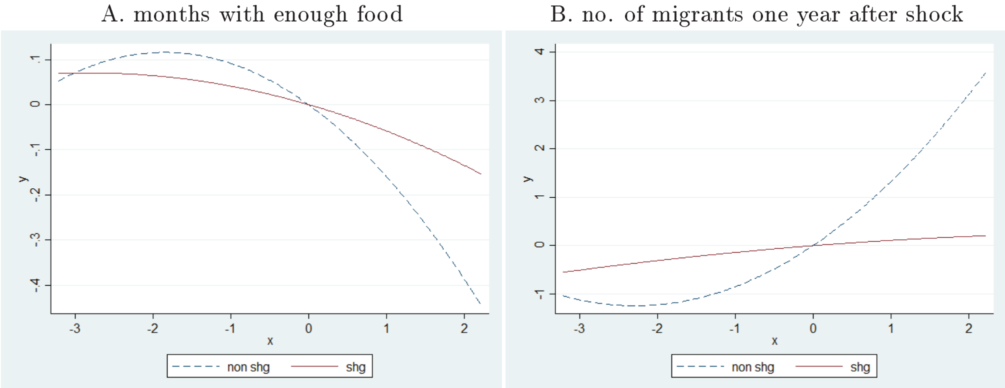
Table 16: Food security and diversification

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | months with enough food | | crop mix | | no. of seasonal migrants | |
| Rain deficit of last year (D) | | | -0.0135 | -0.0254 | -0.108 | -0.0854 |
| | | | (0.0325) | (0.0408) | (0.182) | (0.205) |
| D_squared | | | | -0.00471 | | 0.0798 |
| | | | | (0.0145) | | (0.0880) |
| D Xshg | | | 0.0284 | 0.0225 | 0.344*** | 0.174 |
| | | | (0.0189) | (0.0192) | (0.124) | (0.178) |
| D_sq. Xshg | | | | 0.0250 | | 0.0667 |
| | | | | (0.0160) | | (0.107) |
| Rain deficit of previous year (D_1) | -0.0221** | -0.126*** | | | 0.316* | 1.088*** |
| | (0.00943) | (0.0280) | | | (0.191) | (0.369) |
| D_1_squared | | -0.0338*** | | | | 0.238*** |
| | | (0.00793) | | | | (0.0758) |
| D_1 Xshg | 0.00178 | 0.0612* | | | -0.310** | -0.963** |
| | (0.00727) | (0.0352) | | | (0.145) | (0.457) |
| D_1_sq. Xshg | | 0.0208* | | | | -0.253** |
| | | (0.0113) | | | | (0.121) |
| Observations | 3005 | 3005 | 2384 | 2384 | 949 | 949 |
| Adjusted $R^2$ | | | | | | |
| F_D | | | | 0.600 | | 0.661 |
| F_D Xshg | | | | 0.0920 | | 0.0839 |
| F_D_1 | | 0.000 | | | | 0.00561 |
| F_D_1 Xshg | | 0.0820 | | | | 0.0999 |

Poisson estimations. Std errors clustered at the household level in parentheses (*p<0.10, **p<0.05, ***p<0.01). All equations include a constant, time and household fixed effects, and control for household size.

Table 17: Estimated relationship from table 16, over the relevant range of the deficit variable

A. months with enough food B. no. of migrants one year after shock




The graphs draw the functions $\hat{y} = \hat{\rho}_1 D + \hat{\rho}_2 D^2$ for non shg and $\hat{y} = (\hat{\rho}_1 + \hat{\beta}_1)D + (\hat{\rho}_2 + \hat{\beta}_2)D^2$ for shg.

income, access to credit and consumption of rural households in Jharkhand, India. Using first-hand panel data about members of Self-Help Groups (SHGs) and comparison households, I find a strong rain sensitivity of agricultural outcomes for all households. By contrast, while credit dries up dramatically for nonmembers after a bad monsoon, I find that SHG members enjoy a stable access to credit over time and can even increase their borrowing at the period of strongest food and income scarcity that occurs just before the new harvest. That is, local savings and credit associations such as SHGs keep playing their crucial buffer role even in case of (largely covariate) weather shocks, thanks to their collection of regular deposits, their strong repayment performance and their linkage with external commercial banks for additional funding.

Though the timing of the surveys does not allow to estimate the direct impact on short-term consumption smoothing, I do find evidence that SHG members enjoy a higher food security over the year. Moreover, I find that SHG members diversify their agricultural production over time and especially after a monsoon deficit. In particular, they increase the relative importance of vegetables in their crop mix, which are grown after the rice season and have a higher commercial value. Finally, I find that SHG members migrate more immediately after a bad monsoon, as they substitute low-yield rice cultivation for alternative temporary occupations. To the contrary, they migrate less than comparison households during the critical bridge period before the new harvest, as they have accumulated some buffer from those alternative occupations and can borrow to finance consumption at this period of scarcity.

I conclude that Indian SHGs are useful and effective credit instruments for rural households, which appear extremely resilient to covariate weather shocks. They offer significant seasonal smoothing possibilities to members, with potentially substantial benefits to members. However, I note that their policy of forced savings might be too rigid in order to play an effective insurance role over the medium run in case of important adverse shocks. Indeed, I observed that the most frequent behavior at the member level is to fully collateralize credit with one's own regular savings over the year, this even after bad rain shocks. As a consequence, either SHGs are able to relax the constraint for members to save regularly during periods of economic hardships, or they could be advantageously complemented by proper insurance devices. Given the widely-recognized difficulty of selling weather-based insurance products to poor farmers, the first way might be worth exploring.

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# A Sample and maps

Table 18: Sample villages and district

| Region | District | Village | Type |
|---|---|---|---|
| Northeast | Banka† | Fattapathar | Member |
| Northeast | Banka† | Kanibel | Member |
| Northeast | Banka† | Devhar | Control |
| Northeast | Dumka | Gwalshimla | Member |
| Northeast | Dumka | Sitasal | Member |
| Northeast | Dumka | Tetriya | Member |
| Northeast | Dumka | Barhet | Control |
| Northeast | Dumka | Ranga | Control |
| Northeast | Godda | Bagmunda | Member |
| Central | Hazaribagh | Bigha | Member |
| Central | Hazaribagh | Debo | Member |
| Central | Hazaribagh | Ranik | Member |
| Central | Hazaribagh | Rupin | Control |
| Central | Koderma | Garhai | Member |
| Central | Koderma | Irgobad | Member |
| Central | Koderma | Saanth | Member |
| Central | Koderma | Lariyadih | Control |
| Southeast | E. Singhbhum | Haldipokhar | Member |
| Southeast | E. Singhbhum | Murasai | Member |
| Southeast | E. Singhbhum | Pukhuria | Member |
| Southeast | E. Singhbhum | Pathar Banga | Control |
| Southeast | W. Singhbhum | Baihatu | Member |
| Southeast | W. Singhbhum | Chandra Jarki‡ | Member |
| Southeast | W. Singhbhum | Kera | Member |
| Southeast | W. Singhbhum | Mermera | Member |
| Southeast | W. Singhbhum | Unchibita | Member |
| Southeast | W. Singhbhum | Jarki | Control |
| Southeast | W. Singhbhum | Nakti | Control |
| Southwest | Gumla | Jaldega | Member |
| Southwest | Gumla | Semra | Member |
| Southwest | Gumla | Umra | Member |
| Southwest | Gumla | Kurum | Control |
| Southwest | Khunti | Banabira | Member |
| Southwest | Khunti | Bhandara | Member |
| Southwest | Khunti | Udikel | Member |
| Southwest | Khunti | Irud | Control |
| Southwest | Khunti | Kamra | Control |

*Notes:* † Bihar. ‡ Chandra Jarki replaced Kera in round 4 due to insecurity reasons.

Table 19: District poverty (2001 Census data)

| District | Population (thousands) | BPL households[1] | SC (%) | ST (%) | Female literacy (%) | Infant mortality (‰) | Households electrified (%)[2] |
|---|---|---|---|---|---|---|---|
| Banka | 1,608.8 | 215,784 | 12.4 | 4.7 | 28.7 | 56 | 4.7 |
| Dumka | 1,759.6 | 125,701 | 7.3 | 39.9 | 32.3 | 47 | 7.7 (20.4) |
| Godda | 1,047.9 | 117,719 | 8.6 | 23.6 | 27.4 | 54 | 8.5 (16.1) |
| Hazaribagh | 2,277.5 | 222,810 | 15.0 | 11.8 | 42.8 | 46 | 34.7 (57.2) |
| Koderma | 499.4 | 51,282 | 14.4 | 0.8 | 33.6 | 46 | 21.7 (31.2) |
| E. Singhbhum | 1,983.0 | 117,918 | 4.7 | 27.8 | 57.3 | 36 | 47.4 (67.1) |
| W. Singhbhum | 2,082.8 | 152,560 | 4.9 | 53.4 | 34.4 | 54 | 16.5 (22.5) |
| Gumla | 1,346.8 | 87,546 | 5.0 | 68.4 | 39.9 | 60 | 5.1 (6.8) |
| Khunti | 2,785.1 | 207,187 | 5.2 | 41.8 | 51.7 | 45 | 29.9 (48.1) |

*Notes:* [1] 2002-07, official BPL list from the Government of Jharkhand (Bihar for Banka).
[2] Figures between brackets are from a household survey by the Ministry of Health and Family Welfare in 2002-04.

Figure 6: Southwest monsoon in India

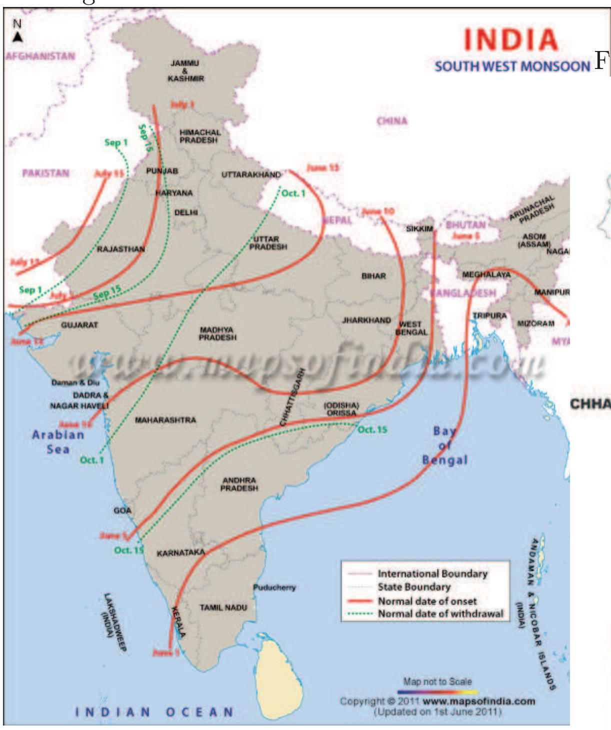


Figure 7: Agro-climatic zones in Jharkhand