The role of extended families and kinship

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Introduction

Extended families are especially important in poor countries, where social security systems are incomplete or nonexistent and households must cope with severe poverty and large shocks to economic and physical well-being.

In the absence of formal credit and insurance markets, extended families and kinships provide credit and insurance services.
This is possible because, according to Stiglitz (1990), they have

1. an advantage in *monitoring*: by living very closely, there is full observability of effort, no moral hazard, opportunistic behaviors are easier to identify
2. an advantage in *enforcement*: who disregards an obligation can be punished even in the absence of a written contract (social control and social stigma);
    - kinships allows to create a context of "infinitely repeated game": the player is the family or the kin, trigger strategies are possible.

Introduction II

Family and kinship networks often fulfill roles normally attributed to markets or governments.

- They can provide insurance, facilitate transactions and support the exchange of goods and services (roles of markets). Unlike markets, however, they do not rely on legal contracts.
- Kinship networks can help organize the provision of public goods (e.g. cleaning of irrigation canals), (role of government). But they do so without the power to tax or mobilize resources.

Supplied services I

Insurance mechanisms:

1. gifts and transfers between households (Rosenzweig, 1988; Rosenzweig and Stark, 1989; Fafchamps and Lund, 2003)
2. labor pooling provides protection against health risk. If a farmer is ill and cannot complete a critical task on time, the work of a whole season may be lost. Labor pooling enables farmers to seek assistance from their neighbors (Krishnan and Sciubba, 2004).
3. fostering children from another family. It takes place in response to shocks, such as the death of one or both parents. Evans (2005) illustrates the role that child fostering plays in caring for AIDS orphans in Africa. Often used to enable children to attend a distant school (e.g. Akresh 2004, 2005). In all studies, child fostering takes place primarily between close relatives.
4. protection against external events. Those who flee drought and famines seek shelter among relatives and kin whenever possible. Migrants provide shelter and assistance to freshly arrived migrants, creating tightly knit migration networks linking village of origin and place of destination (e.g. Munshi, 2003; Granovetter, 1995a).
5. funeral societies, as a way of dealing with funeral costs (Dercon et al. 2004). Clearly defined regular contributions, but the enforcement rests on extended family and kinship ties.

Supplied Services II

Credit

Fafchamps and Lund (2003) demonstrate that risk is shared via gifts, transfers and informal loans primarily within relative and kin-based networks

1. close relatives provide gifts
2. more distant relatives make informal loans.

These loans are hybrid debt contracts, whereby money is lent at zero interest in exchange for the promise of future repayment.

As Udry (1994) and Fafchamps and Gubert (2007a) show, repayment of such loans is *contingent* on shocks affecting both parties. They further show that contingent repayment takes place by letting borrowers in difficulty delay repayment and pay off part of the debt in labor.

Supplied Services III

Other

1. Information provision and diffusion about job or business opportunities. Granovetter (1995b), for instance, documents the role that networks play in matching workers and employers. Munshi (2003) and Granovetter (1995a) provide evidence of how information about business opportunities circulates in family and ethnic networks.
2. Market transactions often take place between relatives and kin. Fisman (2001b), for instance, interprets evidence that supplier credit is preferentially given to members of the same ethnic group as evidence of family ties.

Reminder on Insurance Theory

- risk averse individuals prefer a certain income Y to an uncertain income $\tilde{Y}$ with mean $E(\tilde{Y}) = Y$
- in utility terms, $U(Y) > U(\tilde{Y})$ - where $U(\tilde{Y})$ is is to be intended as expected utility.
- therefore risk averse individuals are willing to pay a prime P to fully insure their income - i.e. to make their income constant in all possible contingencies.
- the maximum prime $P*$ they are willing to pay is such that $U\left(E(\tilde{Y}) - P\right) = U(\tilde{Y})$
- any prime $P < P^*$ makes individuals better off with insurance than without
- **Note:** insurance neutralizes risk - which remains in the background, it does not disappear - but it is costly.
- **Note:** if insurance is actuarially fair (i.e. prime = expected reimbursement) risk averse individuals will certainly buy full insurance - otherwise only partial insurance.

This paper explores the role of the *household composition* on ex post income (consumption) smoothing.

It finds that ex post income smoothing is far from perfect and that informal mechanisms of risk sharing are little effective, although they remain important.
Moreover their effectiveness depends on

1. the number of household members non residing with the family
2. the number of "insurance agreements" with other distant households.

Background

Agricultural activity is inherently very risky. Weather conditions are the same for all people living in the same village $\Rightarrow$ common risk.

A formal crop insurance provided by a profit seeking agency is impossible, because of

1. high spatial covariation
2. moral hazard.

Note: increasing spatial dispersion to pool uncorrelated risks is very costly in terms of acquiring the information needed to assess risk, to monitor borrower performance, and to enforce contractual obligations.

Background

Risk shapes the structure of rural households.
Rosenzweig and Wolpin (1985): over 70 % of rural farm households in India in 1971 were intergenerationally extended.

- two adult generations related by kinship were residing in the same household, chiefly father and adult (married) sons.
- adult siblings did not co-reside in the same household when their father was absent.
- almost no intergenerationally extended households contained married daughters of the head. Daughters of the head married and resided with their husbands outside their village of origin.

Background

The proposed explanation.

1. there is specific knowledge accumulated by means of experience, specific to each plot of land and useless for other plots, that allows households to get the most from their land. If sons abandoned the household, such knowledge would be wasted. In other words, sons would be the highest bidders for father's plots. Selling the land to external people would result in a capital loss. Proximity also reduces information and enforcement costs.
2. However spatial concentration of the family is negative: common risk $\Rightarrow$Need to find alternative sources of income generated far away: but then again information problems

Background

- If kinship and common (family) experiences induce trust, knowledge and altruism among family members, implicit insurance contracts may be feasible even if spread across wide areas.
- Caldwell et al. (1986) found that households are able to obtain resources from relatives located outside the village. The most important source of these compensatory transfers is the family of the head's wife.
- Bringing in a new family member from another environment via marriage adds to the family's ability to smooth consumption (daughter-in-laws)
- Lucas and Stark (1985) also showed that rural households in Botswana who were residing in areas subject to drought received more remittances from migrant family members, for a given wealth, compared to households in non drought areas

Data

- International Crops Research Institute for the Semi-Arid Tropics (ICRISAT): survey in six villages in three agroclimatic regions in the semiarid tropics of India.
- Data for nine consecutive cropping years (1975/6 to 1983/4) for 201 households.

Key Variables I

We have to distinguish the component of potential income from the component due to ex post responses to income shocks.
We construct a measure of full income for each household for each year.
Full income is defined here as

- profits from crop production (net of all costs)
- plus the number of adult males in the household multiplied by the income that would be earned if each adult male household member worked 312 days at the going daily wage rate in the village that year.

This is potential income because it reflects the vagaries of weather but is uninfluenced by ex post responses to exogenous income shocks (such as to sell off assets, to give up more (less) leisure for additional (less) consumption, and/or to borrow) or by ex post insurance payments.
The contribution of adult females to full income is excluded because the number of women in the household fluctuates

Key variables II

- Mean gross transfer income (defined net of dowry payments in or out or any gifts associated with marital events, whether contemporaneous to the marriage or not) over the nine years. They account for about 10% of mean agricultural profits and about 5 % of real full income,
- Mean net transfer income (gross transfer income less transfer expenditures excluding dowry receipts and payments). Almost nil - there is an overall balance of gross inflows and outflows over the period, to be expected in a stationary environment if transfers have a strong insurance component.

The model I

Suppose that household i living in village j at time t earns income Π_{ijt} and define it as

$$\Pi_{ijt} = \xi_{ijt} + \mu_{jt}$$

i.e. it is composed of a household specific component and a village specific component. This means that all household living in the same village earn the same component μ_{jt} plus a specific component. Therefore, households' incomes are correlated.
Suppose also that

$$E_j(\mu_{jt}) = \bar{\mu}_j \ , \ E_{ij}(\xi_{ijt}) = 0$$

i.e. the intertemporal average of individual income equals the intertemporal average of village income.

The model II

Suppose that each household contributes a share γ of its income to a village pool and that it receives in exchange the same proportion of the equally shared pool. Then the net transfer is

$$\tau_{ijt} = \gamma(\sigma_{jt} - \Pi_{ijt}) \tag{1}$$

where

$$\sigma_{jt} = E_{jt}(\Pi_{ijt}) = \mu_{jt} + E(\xi_{ijt}) = \mu_{jt} + \frac{\sum_i \xi_{ijt}}{n_{jt}}$$

is the average income at the village level at time t.

The model III

The intertemporal average of (1) yields

$$E_{ij}(\tau_{ijt}) = \gamma E_{ij}(\sigma_{jt} - \Pi_{ijt}) = \gamma(\bar{\mu}_j - \bar{\mu}_j) = 0 \tag{2}$$

and taking differences between (1) and (2) we get

$$\tau_{ijt} = \gamma((\sigma_{jt} - \bar{\mu}_j) - (\Pi_{ijt} - \bar{\mu}_j)) \tag{3}$$

Equation (3) indicates that net transfers respond only to shocks/deviations of village income and household income from their intertemporal mean.

The empirical model to be estimated is the following

$$\tau_{ijt} = \beta_0 + \gamma_1 \hat{\Pi}_{ijt} + \sum_{k=2}^{m} \gamma_k F_{ijtk} \hat{\Pi}_{ijt} + \beta_1 \hat{\sigma}_{jt} + \beta_2 F_{ijt} + e_{ij} + V_{ijt} \quad (4)$$

where $\hat{\bullet}$ are shocks, i.e. deviations from the intertemporal means (e.g. $\hat{\Pi}_{ijt} = \Pi_{ijt} - \bar{\Pi}_{ij}$), F_{ijt} is a vector of characteristics of household composition, $e_{ij}$is a household (unobservable) time-invariant heterogeneity and V_{ijt} is an error term.
We define also

$$R_{ij} = \left| \frac{\partial \tau_{ijt}}{\partial \hat{\Pi}_{ijt}} \right| = \left| \gamma_1 + \sum_{k=2}^{m} \gamma_k F_{ijk} + \beta_1 \frac{\partial \hat{\sigma}_{jt}}{\partial \hat{\Pi}_{ijt}} \right| \quad (5)$$

the rate at which transfer respond to household income shocks.

Household composition

Family members able to participate in a mutual insurance contract should be included among the F_{ijt}. These include

1. the number of siblings of the household head, who are **not** co-residing with the head,
2. the number of 'migrant' household members, defined in the survey as household members with no other established household,
3. the number of daughters-in-law of the head.

The 'migrants' are principally sons of the head serving in the military and attending school, but include as well daughters in 'domestic' service. The majority of migrants reside outside of the district in which their home village is located.
The number of daughters-in-law thus represent the number of potential arrangements with external "insurers", tied via matrimony

Household Wealth

In F_{ijt} also the household's wealth is included
The reason is that richer households may be less willing to invest in family-based transfer:

1. if greater resources enable the household to self-insure through the running down of assets (credit market)
2. if greater resources are associated with less aversion to risk.

However, the wealth position of a household at time t, is affected by the household's ability to smooth income via transfers. So it is endogenous.
We thus employ as a measure of wealth the 1983 value of the head's inheritance, that represents endowed wealth (predetermined).

Predictions of the model

Consider equation (4) or equation (5). If there is full income pooling (i.e. full insurance), a condition possible only under perfect information, it must be

$$\gamma_1 = -1$$

All idiosyncratic (i.e. household specific) shocks should be fully compensated by transfer

$$\beta_1 = 1$$

All common (i.e. at the village level) shocks should completely reflect in transfers (in case of harvest failure due to bad weather all households receive less)

$$\gamma_k = 0$$

No household characteristic should influence the transfer rate.

Estimation Strategy

Households can be very heterogeneous in terms of ability and risk preferences:

- unmeasured ability can simultaneously influence full income and transfers
- unobservable household's degree of risk aversion may simultaneously influence the extent of ex ante income smoothing (that reduces income shocks) and ex post consumption smoothing arrangements (such as investing in marriages or migration).

To avoid spurious correlations we need to take into account these unobservables. $\Rightarrow$ fixed effects technique: valid if unobservables are time invariant.

Results

Table 4

Fixed Effects Estimates: Determinants of Household Net Transfers (Rupees)

Variable	(1)	(2)	(3)
Household full income deviation (*hfid*)	−0·0209	0·00257	0·000136
	(3·63)*	(0·24)	(1·19)
Inheritance × *hfid* ($\times 10^{-7}$)	0·605	0·511	0·393
	(3·22)	(2·49)	(1·88)
Average village full income deviation	0·00518	0·00235	−0·00389
	(0·35)	(0·15)	(0·25)
Daughters-in-law × *hfid*	—	−0·00701	−0·00928
		(2·44)	(2·75)
Migrants × *hfid*	—	−0·00660	−0·00693
		(2·52)	(2·65)
Siblings × *hfid*	—	−0·00402	−0·00377
		(1·78)	(1·64)
Head's age	−34·4	−40·5	−39·9
	(2·31)	(2·55)	(2·52)
Head's age squared	0·154	0·243	0·235
	(1·07)	(1·56)	(1·50)
Adult males	—	—	−62·7
			(2·69)
Adult females	—	—	−26·3
			(1·17)
Daughters-in-law	—	—	58·3
			(1·38)
H_0: no correlation between regressors and transfers (F)	10·91	7·65	6·71
H_0: no error components (χ^2)	624·2	504·1	473·3
H_0: errors uncorrelated with regressors in random effects model (Hausman), χ^2	20·2	29·3	36·9
n	1674	1674	1674
Predicted mean transfer rate (%)	2·1	1·8	1·9

* t-values in parentheses

Credit markets are an alternative ex post mechanism for smoothing income fluctuations. How much important are them?

We expect net indebtedness, similar to transfers, to move inversely with transitory fluctuations in full income and to be less responsive to current income changes among households with greater (endowed) wealth.

Do inter household transfers **substitute** for credit?

Results

Table 5

Fixed Effects and Two-Stage Fixed Effects Estimates: Determinants of Net Indebtedness (Rupees) in Aurepalle, Shirapur and Kanzara

Variable	(1)	(2)	(3)
Household net transfers*	—	—	−5·39 (1·63)
Household full income deviation (*hfid*)	−0·192 (2·46)‡	−0·209 (2·36)	−0·487 (2·41)
Inheritance × *hfid* ($\times 10^{-5}$)	0·110 (2·86)	0·113 (2·92)	0·222 (2·70)
Average village full income deviation	0·371 (2·01)	0·383 (2·05)	0·549 (2·18)
Head's age	−249 (1·42)	−251 (1·43)	−361 (1·59)
Head's age squared	0·619 (0·37)	0·690 (0·41)	0·844 (0·41)
Adult males	—	247 (0·93)	279 (0·85)
Adult females	—	−207 (1·09)	−415 (1·55)
H_0: no correlation between regressors and net indebtedness	4·20	3·22	—
H_0: no error components (χ^2)	23·2	22·9	—
H_0: errors uncorrelated with regressors in random effects model (Hausman), χ^2	10·8	10·8	—
n	837	837	837
Predicted mean transfer rate (%)†	7·6	9·0	—

* Endogenous variable. Two-stage fixed effects used to estimate. First-stage equation specification corresponds to column (3) of Table 4.

† Assumes sample mean correlation between household and village income fluctuations.

‡ t-values in parentheses

Conclusions

- In a risky world, not only kinship tends to bond family members in a single location (by means of transfers of experience and knowledge) but
- Kinship ties can be sustained over space and over time in implicit insurance-based transfer schemes which contribute to consumption smoothing in the face of common income risks.
- While such familial transfer arrangements have limited effectiveness, nonetheless they appeared to be preferred by households to the use of credit markets

- This paper looks more closely at the rural India custom of sending household-head daughters to marry in villages far away.
- The authors make the hypothesis that is a strategy of risk pooling (informal insurance).
- The predictions of a model based on insurance concerns correctly predicts the relations observed in data. This interpretation differs from the previous/traditional interpretation that far-away marriages depend of search costs, differentials in expected income levels, or simply had the purpose of improving the genetic mix of the kins.
- Once again ICRISAT data are used, the background is close to that we have already analyzed in Rosenzweig 1988. Though the empirical model is different.

Background

Trade off:

1. risk covariance decrease with the distance : larger opportunities for risk pooling across distant villages
2. informational costs (monitoring) increase with the distance

Solution:

Using the bonds of kinship to mitigate enforcement costs, a household locates its members in areas characterized by low covariances in income. The transfer of a family member to another established household confers diversification benefits to both households.

The presence in household i of a member of household j not only supplies household j with an incentive to contribute to consumption smoothing in i (altruism) but also introduces a verification and monitoring capacity.

Implications

If this hypothesis is correct, then:

- individuals from the same origin household will tend not to have the same destinations;
- households with more wealth, and thus better able to self-insure, will invest less in marriage migration; the distance between households linked by marriage will be less for the wealthier, to the extent that distance confers a diversification benefit;
- households facing greater income risk, for given wealth levels, will be more willing to finance moves of longer distance

The model I

Household i consumption at time t, denoted c_{it}, is the sum of income from crop production (stochastic) and other sources of household net income (such as asset sales, or gifts, transfers, loans etc.)

$$c_{it} = \pi_{it} + \tau_{it} \tag{6}$$

It is natural to think that τ_{it} depends on

1. the realization of π_{it}: in good times there is rather investment than sales of assets and viceversa.
2. expectations about future realizations of π_{it}
3. household wealth: in the absence of credit markets only wealthy household can turn assets into income

Accordingly τ_{it} is defined as

$$\tau_{it} = \alpha(w_{it})(\pi_{it} - \mu_{it}) + \sum_k \gamma_k(\pi_{it} - \pi_{kt}) \tag{7}$$

where w_{it} is household wealth, $\mu_{it}$is household's expectation at time t of future crop profit and k indexes the potential transfer partners. In a stationary context, the current realization of π_{it} does not affect future expectations which can be considered as constant.
Therefore, combining (6) and (7) the effect of the current realization of crop profit on household consumption is

$$dc_{it} = (1 + \alpha(w_{it}))d\pi_{it} + \left[\sum_k \gamma_k(1 - \frac{\partial \pi_{kt}}{\partial \pi_{it}})\right] d\pi_{it} \tag{8}$$

Note: in case of full insurance, consumption should remain constant and should not respond to income variation. Therefore $\alpha(\cdot) = -1$ and $\gamma_k = 0$.
The case of complete autarky would instead be for $\alpha(\cdot) = 0$ and $\gamma_k = 0$: in this case any income fluctuation affects consumption on a one-to-one basis.

Note: the term $\frac{\partial \pi_{kt}}{\partial \pi_{it}}$ that captures the "covariance" between the crop profits of households i and k is difficult to measure. Thanks to the evidence that incomes are less correlated the larger the distance between two villages, we model

$$\frac{\partial \pi_{kt}}{\partial \pi_{it}} = \delta d_{ik} \tag{9}$$

where d_{ik} is the distance in km between households i and k.

The model IV

A variant of equation (8) is estimated on ICRISAT data

$$\sigma^2(c_i) = \beta_0 + \beta_1 \sigma^2(\pi_i) +$$

$$+\beta_2 I_i \sigma^2(\pi_i) + \beta_3 W_i \sigma^2(\pi_i) + \beta_4 M_i \sigma^2(\pi_i) + \beta_5 D_i \sigma^2(\pi_i) + \varepsilon_i \quad (10)$$

where

- $\sigma^2(c_i)$ is the variance over-time of consumption
- $\sigma^2(\pi_i)$ is the variance over-time of crop profit
- I_i is inherited wealth
- W_i is the number of resident married women, each woman comes from household k
- M_i is the number of household migrants
- D_i is the average of the distances between households i and k

Note that $\beta_5 = -\bar{\gamma}\delta$

The model V

- In this context full insurance is for $\beta_k = 0$.
- Absence of across-household income transfer implies $\beta_3 = \beta_4 = \beta_5 = 0$

Results

TABLE 4

DETERMINANTS OF VARIABILITY IN REAL FOOD EXPENDITURES IN FARM HOUSEHOLDS, 1975–84

Variable	(1)	(2)	(3)
Profit variance	.114	.229	.227
	(14.9)	(7.91)	(7.18)
Inherited wealth × profit variance (× 10^{-6})	−.147	−.107	−.197
	(4.08)	(4.97)	(4.53)
Number of married women × profit variance	...	−.0346	−.0340
		(2.82)	(1.97)
Marriage distance × profit variance	...	−.000228	−.000231
		(4.31)	(4.33)
Number of migrants × profit variance	...	−.00719	−.00695
		(1.32)	(1.03)
Number of adult male market workers × profit variance	...	...	−.0003
			(1.24)
Number of adult female market workers × profit variance	...	...	−.0708
			(1.34)
Shirapur village (× 10^5)	11.0	11.1	11.4
	(4.29)	(3.75)	(3.50)
Kanzara village (× 10^5)	3.37	6.18	6.89
	(1.39)	(2.10)	(2.14)
Constant (× 10^5)	1.10	−1.64	−1.20
	(.59)	(.64)	(.44)
R^2	.764	.846	.852
F	63.3	43.4	33.9

NOTE.—t-ratios are in parentheses beneath coefficients.

We now want to test whether households who suffer from higher income volatility engage in more intense strategy of risk pooling. The problem is that we would like to use “potential” income volatility, but instead we observe only ex-post income which is affected by the risk management strategies put in place.

Even fluctuations in farm profits, net of family labor costs and thus net of family labor supply decisions, can be modified by households, for example, via crop or plot diversification strategies or investments in water control mechanisms. Both farm profit variability and arrangements facilitating ex post income transfers may thus reflect a household's attitudes toward risk.

Fact

An instrument is needed (an exogenous source of variation): We constructed monthly rainfall variances for each of the critical agricultural months (July-October) for each of the villages. We used as instruments these weather variables interacted with each household's inherited dry and wet landholdings to predict each household's mean and variance in profits for the 10 years.

The model

Table 5 reports estimates of the effects of profit variability and endowed wealth on

1. the number of migrants,
2. the presence or absence in the household of a worker with a regular salaried job (assured yearly income),
3. the mean distance between the origin village of the resident daughters-in-law and the sample household,
4. the value of the landholdings of the father-in-law of the head

on the basis of two-stage tobit, two-stage probit, and two-stage least squares procedures, respectively.

Two specifications are reported for each dependent variable, one with and one without (predicted) mean profits for the household.

Results

TABLE 5

Effects of Agricultural Profit Levels and Profit Variability on Household Labor Force and Marital Arrangements

	Dependent Variable (Estimation Procedure)							
	Number of Migrants (Two-Stage Maximum Likelihood Tobit)		Attached Laborer/ Salaried Worker (Two-Stage Maximum Likelihood Probit)		Mean Marriage Distance (Two-Stage Least Squares)		Value of Landholdings of Head's Father-in-Law* (Two-Stage Maximum Likelihood Tobit)	
Profit variance†	1.32	4.67	−.0381	.137	.707	54.8	.00490	−.0580
	(5.26)	(2.60)	(1.85)	(2.05)	(2.98)	(.52)‡	(.51)	(1.37)
Profit mean† ($\times 10^{-5}$)	. . .	−.152	. . .	−7.40	. . .	2.98	. . .	.00126
		(.33)		(2.66)		(.15)‡		(1.58)
Value of inheritance ($\times 10^{-4}$)	−2.57	−.0356	.0286	−.134	−2.21	−2.03	7,261§	8,618
	(2.20)	(.21)	(.59)	(1.41)	(1.85)	(1.32)	(1.16)	(1.72)
Constant	−.280	−6.42	.287	5.94	−10.31	−7.71	88,964	129,574
	(1.51)	(3.23)	(.37)	(2.41)	(.47)	(.30)	(.95)	(1.25)
χ^2, F	37.8	32.9	10.2	21.0	4.45	3.87	8.75	11.2
Hausman-Wu	9.93	7.08	2.46	13.1	19.4	10.6	2.12	2.48

Note.—Asymptotic t-ratios are in parentheses beneath coefficients.

* In 1983 rupees.

† Endogenous variable. Instruments include village-level means and variances of rainfall in July–October 1975–84, and interactions between the rainfall statistics and head's dry and irrigated landholdings at inheritance.

‡ Jointly significant: $F(2, 59) = 5.78$.

§ Inheritance of head's father (in 1983 rupees).

Conclusions

Analysis of longitudinal data from villages in South India indicates that

- marriage cum migration contributes to a reduction in the variability in consumption, for given variability in income from crop production,
- households exposed to higher income risk are more likely to invest in longer distance migration-marriage arrangements.

However, our framework also implies that

- agricultural technical change may significantly alter spatial marriage patterns, if not the stability of the marriage institution, since such change not only alters the spatial covariances and levels of risk but renders more difficult the assessment of risk and, thus, the establishment of implicit risk arrangements.
- improvements in formal institutional arrangements (e.g., credit markets) that facilitate consumption smoothing may reduce the role played by risk considerations in marital arrangements and rural migration, perhaps resulting in diminished rural mobility.
- the value to parents of having a girl relative to having a boy in environments characterized by underdeveloped insurance markets and spatially covariant risks may be substantially understated by sex differentials in expected labor market returns.

Blumenstock, Eagle, Fafchamps (2011)

- Informal agreements of risk sharing fail in case of covariate risks.
- Increasing distance will reduce risk covariation but it will increase problems of monitoring and transaction costs.
- Large distances can be supported only within kin and extended family (moral constraints).
- However transaction costs remain: transferring money and resources could be extremely costly in developing countries
- New technologies can help families to spread at longer distances.

(cont.)

- In Rwanda mobiles phones have become extremely popular: about 30 percent of people owns a mobile phone (that costs $50) and only 0.25 percent owns a fixed line.
- This paper estimates the transfers of airtime in response to a circumscribed earthquake in Rwanda in 2008 and how transfers are influenced by the characteristics of the recipients.
- Results indicate that transfers follow the logic of reciprocity rather than that of charity/altruism.

Background

Table 1: Mobile phone penetration: Number of mobile phones per 100 inhabitants.

	2000	2001	2003	2005	2007	2009	Annual Growth
Rwanda	0.49	0.78	1.49	2.47	6.53	24.3	77.1%
South Africa	18.28	23.39	35.93	71.60	87.08	92.67	17.4%
United States	38.53	44.77	54.90	71.43	83.51	97.1	9.1%

Source: International Telecommunication Union

In Rwanda, all phone usage is prepaid. Individuals buy airtime vouchers from stores and street vendors, the credit is deposited on their prepaid account.

Background

- Usage of a rudimentary mobile banking service that allows for interpersonal transfers of mobile phone airtime.
- Use of the service is free and all users are automatically enrolled.
- The service was launched in October 2006, but usage was relatively modest until the middle of 2008 when promotional campaigns encouraged a large number of individuals to start using the system (relatively few people were using this system at the time of the earthquake).
- Boosted by the success of mobile banking in neighboring Kenya (M-Pesa of Safaricom), the capabilities of the Rwandan system have since been expanded, and there are currently close to a million users of the system.
- In early 2010 other forms of mobile banking were included, such as interest-bearing savings accounts. Further expansions are planned to allow the payment of over-the-counter transactions.

Data

1. The main dataset is a log of ALL mobile-based airtime transfers that occurred between October 2006 and December 2009.
2. For each transaction, the monetary value of the airtime sent, and the time and date at which the transfer occurred.
3. Also information about phone call activity.
    1. Every time a user makes or receives a phone call, the cell tower nearest to the user is logged and the approximate location of each mobile subscriber over time can be inferred.
    2. It is possible to compute the number of unique contacts with whom a user has communicated over a given interval of time, as well as the geographic distribution of these contacts.
4. For confidentiality reasons, basic demographic information such as the age, gender, or education level are not observed.
5. Income is imputed on the basis of mobile usage and external data, a survey on a random sample of 900 mobile phone users and DHS.

The model

Basic model: establishing the amount of transfers the day of the earthquake at regional, individual and dyadic level

$$\tau_{rt} = \alpha_1 + \gamma_1 S_{rt} + \beta_1 X_{rt} + \theta_t + \pi_r + \varepsilon_{rt}$$

$$\tau_{irt} = \alpha_2 + \gamma_2 S_{rt} + \beta_2 X_{irt} + \theta_t + \pi_i + \varepsilon_{irt}$$

$$\tau_{ijrt} = \alpha_2 + \gamma_2 S_{rt} + \beta_2 X_{ijrt} + \theta_t + \pi_{ij} + \varepsilon_{ijrt}$$

- τ amount of transfers received by the region / individual / individual i in the dyad ij
- S_{rt} is a dummy which takes 1 for the "treated" regions at the day of the shock (and zero before and after).
- X are time-varying controls
- θ_t are time fixed effects (time dummies one per day)
- π are regional / individual / dyadic fixed effects

To minimize the likelihood that our results are driven by differential growth in mobile usage across locations, we restrict the analysis to a specific time window around the time of the shock (30 days before, 30 days after).

Results

Table 3: Average Effect of the Earthquake on Mobile Transfers Received (Gross)

	(1) District	(2) Cell Tower	(3) User	(4) Dyad
Earthquake shock	14169***	2832***	9.48***	11.92***
	(1,951.30)	(177.02)	(0.74)	(0.59)
Day dummies	yes	yes	yes	yes
Fixed effects	district	tower	user	directed dyad
Number of observations	1800	16020	6619440	10566000

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors, clustered by district, reported in parentheses.

Results

1. We observe a strongly significant positive coefficient on the shock variable.
2. The earthquake caused an additional influx of 14,169 Rwanda Francs (RWF), or approximately $28 USD. Though modest in absolute terms, this represents a large increase compared to an unconditional mean of 8,480 RWF in the two affected districts.
3. It is also large relative to the average annual income of roughly $1,000 USD in Rwanda.
4. In the second column of Table 3, we repeat the analysis at the more disaggregated level of the cell tower. The number of cell towers (267) is larger than the number of districts (30). Each observation corresponds to a smaller geographical unit and thereby allows us to more precisely identify the regions affected by the quake. Again we find a statistically significant coefficient on the earthquake shock.
5. The earthquake produced an additional influx of approximately $84 USD to the 15 towers within 20km of the epicenter.

Results

- This amount is small in absolute terms, but at the time of the earthquake, the mobile airtime transfer service had only recently been launched and only 1,400 individuals living in the earthquake region had used the service prior to the earthquake.
- Since the earthquake, service utilization has increased over 400-fold. According to available information, there are currently 750,000 to 1,000,000 active users in Rwanda each day. This compares to 2,500 at the time of the earthquake.
- If we are willing to assume that airtime transfers following an earthquake increase proportionally to the number of active users, a similar earthquake today would cause an additional influx of US$22,000 to $30,000 to affected areas.

Who receives airtime transfers?

$$\tau_{rt} = \alpha_1 + \gamma_1 S_{rt} + \beta_1 X_{rt} + \phi_1 Z_r S_{rt} + \eta_1 Z_r D_t + \theta_t + \pi_r + \varepsilon_{rt}$$

$$\tau_{irt} = \alpha_2 + \gamma_2 S_{rt} + \beta_2 X_{irt} + \phi_2 Z_{ir} S_{rt} + \eta_2 Z_{ir} D_t + \theta_t + \pi_i + \varepsilon_{irt}$$

$$\tau_{ijrt} = \alpha_3 + \gamma_3 S_{rt} + \beta_3 X_{ijrt} +$$
$$+ \phi_3 Z_{ir} S_{rt} + \phi_4 Z_{jr} S_{rt} + \eta_3 Z_{ir} D_t + \eta_4 Z_{jr} D_t + \theta_t + \pi_{ij} + \varepsilon_{ijrt}$$

where

1. Z are characteristics associated with either reciprocity or charity (wealth, network dimension, past transfers)
2. $D_t = 1$ for ALL regions on the day of the shock, and 0 otherwise.

The model

1. Terms of the form $Z_r D_t$ are included to control for the possibility that, in the country as a whole, variation in Z_r affects transfers on the day of the shock differently from other days.
2. In the dyadic regression characteristics of each member of the pair i,j are included.

Predictions

1. if transfers are manifestation of charity, they are unlikely to flow from the poor to the rich; not necessarily so if they follow a reciprocal motive;
2. if transfers are embedded in reciprocal relationships, users with more such relationships should receive more after the shock;
3. if transfers are based on a reciprocal arrangement, they are expected to fall with the distance between giver and recipient because distance impinges observability and makes self-enforcing reciprocity arrangements harder to sustain.

Results

Table 5: Net transfers and wealth

	(1) District	(2) Cell Tower	(3) User	(4) Dyad
Earthquake shock	24,121***	4,906***	12.53***	14.25***
	(1,531.00)	(978.52)	(3.40)	(3.28)
Wealth proxy of recipient * Shock	1.936***	2.041**	17.57***	13.69***
	(0.15)	(0.96)	(5.14)	(2.13)
Wealth proxy of recipient * Day of quake	-0.315**	-0.079	-1.32***	-0.54
	(0.15)	(0.18)	(0.20)	(0.40)
Wealth proxy of recipient * In quake region			1.38*	0.17
			(0.73)	(0.38)
Wealth proxy of sender * Shock				6.00
				(6.00)
Wealth proxy of sender * Day of quake				0.63*
				(0.37)
Wealth proxy of sender * In quake region				0.03
				(0.42)
Day dummies	yes	yes	yes	yes
Fixed effects	district	tower	user	directed dyad
Number of observations	1800	16020	6619440	10566000

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors, clustered by district, reported in parentheses.

Results

Table 6: Net transfers and number of contacts

	(1) District	(2) Cell Tower	(3) User	(4) Dyad
Earthquake shock	24,381***	4,631***	12.24***	13.36***
	(721.13)	(415.26)	(3.56)	(2.58)
Degree of recipient * Shock	0.004***	0.004**	0.05	0.03
	(0.00)	(0.00)	(0.03)	(0.03)
Degree of recipient * Day of quake	0.000	-0.000	-0.00***	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Degree of recipient * In quake region			0.01*	0.00
			(0.01)	(0.00)
Degree of sender * Shock				0.01
				(0.01)
Degree of sender * Day of quake				0.00
				(0.00)
Degree of sender * In quake region				-0.00*
				(0.00)
Day dummies	yes	yes	yes	yes
Fixed effects	district	tower	user	directed dyad
Number of observations	1800	16020	6619440	10566000

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors, clustered by district, reported in parentheses.

Results

Table 7: Net transfers and past reciprocity

	Dyad	Dyad (with FE)
Earthquake shock	12.095***	11.898***
	(0.948)	(0.702)
Airtime sent in the past (from i to j) * Shock	0.462***	0.476***
	(0.124)	(0.119)
Airtime sent in the past (from i to j)	-0.172***	
	(0.009)	
Airtime sent in the past * Day of quake	0.056	0.057
	(0.041)	(0.042)
Airtime sent in the past * In quake region	0.139***	0.129*
	(0.050)	(0.073)
Airtime received in past (by i from j) * Shock	0.138	-0.167
	(0.251)	(0.278)
Airtime received in past (by i from j)	1.034***	
	(0.038)	
Airtime received in the past * Day of quake	-0.212***	-0.215***
	(0.037)	(0.054)
Airtime received in the past * In quake region	-0.328***	-0.277
	(0.121)	(0.195)
Day dummies	yes	yes
Fixed effects	no	directed dyad
Number of observations	10566000	10566000

Notes: Outcome is τ_{ijrt}, i.e. the airtime received by i from j on day t. *** p<0.01, ** p<0.05, * p<0.1. Standard errors, clustered by district, reported in parentheses.

Results

We investigate whether transfers come uniformly from other unaffected regions of Rwanda, or whether transfers come primarily from unaffected areas in the vicinity of the earthquake.

- if transfers follow primarily a charitable motive, we expect all unaffected areas to contribute;
- not so if transfers are motivated by reciprocity, and relationships are strongest with people nearby.

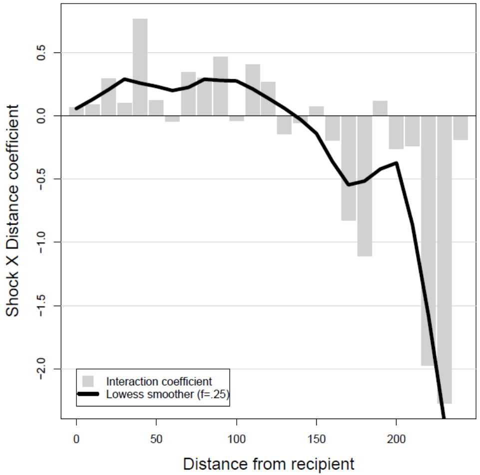
Results

Divide the number of contacts of each user i into different groups, with distance ranging from 0 Km to 250 Km.
Interact each of these variables with the earthquake shock.

- After the quake, people with many contacts near the epicenter do not receive more transfers, presumably because nearby friends are also affected by the earthquake.
- People with contacts more than 30 Km away from the epicenter are more likely to receive transfers in the aftermath of the earthquake,
- The effect dies down for contacts located more than 100 Km from the epicenter.

This pattern is consistent with the predictions of a model of reciprocation in which information and monitoring costs increase with distance and close range relationships therefore include a stronger mutual insurance element

Results



Shock X Distance coefficient
0.5
0.0
−0.5
−1.0
−1.5
−2.0
0
50
100
150
200
Distance from recipient
Interaction coefficient
Lowess smoother (f=.25)

- As a robustness check of the average treatment effect, we verify that the effects of the earthquake on transfers are unique to the day of the earthquake, and do not generally occur on days without significant economic shocks. We include lag and lead terms to test whether there was a significant effect of the earthquake on transfer patterns in the days immediately before and after the earthquake. This effect does not exist: before the earthquake and after the earthquake, there was no significant change in transfers to the affected regions.
- Table 15 presents results from testing the same specification as in column 1 of Table 3 but with a "placebo" shock at the same location on different dates. Thus, we test for a spurious effect 1 and 2 months before, as well as 1 month after, the actual earthquake. We observe no significant change in transfers on the day of the placebo earthquakes.

Robustness

Table 15: Placebo Tests - Region

	(1) 1 week early	(2) 1 month early	(3) 2 months early	(4) 1 month late	(5) 2 months late
placebo	-55.046	-883.510	476.872	422.916	-165.949
	(333.48)	(671.79)	(1098.90)	(424.18)	(356.80)
placebo_lag1	-381.418	-53.947	-618.709	2003.713	11.852
	(618.73)	(217.97)	(612.11)	(1128.16)	(247.78)
placebo_lag2	-984.936	-1168.092*	-26.755	50.986	1436.589***
	(541.80)	(510.72)	(458.54)	(925.05)	(302.94)
placebo_lag3	-961.343	130.801	-1566.041	-2797.677***	-254.537
	(603.55)	(484.92)	(1163.88)	(722.97)	(333.08)
placebo_lag4	-764.067	-828.406*	-535.389	-542.332	662.051
	(465.33)	(349.95)	(895.21)	(609.62)	(401.94)
placebo_lag5	818.791	-1152.675	-388.534	396.936	83.309
	(1436.49)	(747.69)	(1208.20)	(548.55)	(206.67)
placebo_lag6	1032.607	-671.954**	-789.253	-759.333	1191.760
	(880.44)	(182.22)	(529.11)	(1680.09)	(586.25)
placebo_lag7	252.983	88.647	268.176	225.380	835.777**
	(257.85)	(838.98)	(697.38)	(1449.35)	(250.26)
calls_gross	0.103***	0.103***	0.103***	0.103***	0.103***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
me2u_val_out	0.529***	0.529***	0.529***	0.529***	0.529***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
_cons	737.229	737.553	737.288	737.174	736.841
r2	0.754	0.754	0.754	0.754	0.754
rmse	4025.238	4025.264	4025.233	4025.195	4025.252
N	74300.000	74300.000	74300.000	74300.000	74300.000

Outcome: Value of incoming airtime sent to people in district (in RWF; US$1=550RWF). Heteroskedasticity-robust SE's in parentheses (clustered at district level).

Conclusions

- Evidence that people are using the mobile network to help each other cope with economic shocks.
- Ex ante it is ambiguous whether people give out of purely charitable motives, or whether they are giving out of an expectation of future reciprocity.
- Building a simple model of giving over the mobile network, we show that these two motives for giving produce conflicting empirical hypotheses, in particular with respect to the marginal effect of wealth, distance, and past reciprocity on the amount transferred following the earthquake.
- The giving observed after the earthquake is most consistent with a model based on expectations of reciprocity.
- In this paper, we argue that by allowing for inexpensive interpersonal transfers, mobile phones are providing a new method for risk sharing.

Conclusions

The presence of mobile-phone based risk sharing networks may have an adverse effect on people who are not a part of the network. If, for instance, wealthy individuals substitute out of informal risk sharing arrangements and into predominantly phone-based arrangements, it is possible that poorer people will be left with fewer opportunities for risk sharing. In this way, mobile phones could end up having a regressive effect.

Mobarak and Rosenzweig (2012)

- Motivation: there is ample evidence that in agricultural economies the need for insurance against erratic weather and rainfall is large.
- Though very few people are covered by a formal insurance, although nowadays there exist formal contracts which circumvent the moral hazard and adverse selection problems.
- One of these innovative contracts is index-insurance against the risk of low or delayed rains.
- It is based only on the measurement of rainfall

Example

Individuals can buy n units of insurance during the seeding season. The price of each unit is p. If rainfall is below a given level at a certain date of the growing season, then the insurance company will pay R and zero otherwise.

(cont.)

- pros:
  - rainfall is an exogenous index independent of individual's effort and type
  - no need of assessing and evaluating individual damage - low administrative costs
- cons:
  - rainfall stations need to be located near the client, otherwise measured rainfall could be little correlated with the actual rainfall experienced by the farmer.
    - the difference between measured rainfall and actual rainfall is called basis risk

(cont.)

This paper exploits a large field experiment in three Indian states to answer the following questions:

1. Why don't people buy index-insurance? is it because individuals already have informal insurance? Crowding-out effect of informal insurance
2. Once insured with index-insurance, are farmers changing their crop-portfolio, moving towards riskier and higher-yield crop variety?

Model

- Theoretical model:
  - groups of identical individuals engage in an informal insurance cooperative game against idiosyncratic shocks, with complete information. Aggregate shock are un-insurable.
  - In this setting individuals are able to cover idiosyncratic risks only partially (when all individuals are in the bad state insurance fails).
  - Next, an index-insurance is introduced, actuarially fair, which allows the group to insure against *common* risks.

Model

Predictions:

1. If there is no basis risk and index-insurance is actuarially fair, partners will choose full insurance regardless of group's ability to indemnify idiosyncratic losses.
2. If index-insurance is fair but there is basis risk, then groups with a higher ability to indemnify buy more insurance.
    1. Intuition: individuals compare expected utility with and without index-insurance
        1. with basis risk, individuals may simultaneously incur in a) the loss due to bad weather, b) the loss due to the idiosyncratic risk, c) they have to pay the index-insurance price without getting any reimbursement. Thus, the introduction of index-insurance could worsen the utility in the bad case (although only in the bad case).
        2. higher ability to indemnify idiosyncratic losses compensates for part of the losses in the bad state –> individuals buy more index-insurance, because the bad state utility goes up.
3. Subsidizing index-insurance with basis risk increases the coverage and can increase risk-taking

The reference group

- the community groups authors looked at are the Indian sub-caste (or *jati*) (there exists 350 sub-castes).
- the *jati* is a well-defined, and the most important risk-sharing group in rural India (Munshi, 2011).
- it is a centuries-old institution whose salience is maintained over generations through strict rules on marital endogamy.
- the *jati* network is spatially dispersed across villages and districts, and it therefore has the potential to indemnify aggregate rainfall risk as well as individual losses.

The reference group

baseline data indicates that

- 59% of all financial transfers and informal loans are received from other members of the same *jati*
- 90% of these transfers and the majority of informal loans originate outside the villages of the respondents.
- over 21% of households reported that they experienced a financial loss in the crop year 05/06. For 85% of households experiencing a loss, however, the amount of assistance was less than half of the loss. Informal insurance is thus far from complete.

To get a measure of each *jati* ability to indemnify idiosyncratic losses and losses from aggregate (rainfall) events, authors regress received transfers and informal loans on income losses due to individual shocks and rainfall deviations.

The experiment

- sampling frame: list of all households in 63 villages in three large states Uttar Pradesh (UP), Andhra Pradesh (AP) and Tamil Nadu (TN), included in a survey (REDS - Rural Economic and Development Survey) carried out in 2005/06 providing also baseline information.
- 19,685 households in 118 different sub-castes
- 42 of these villages randomly selected for the marketing experiment, the 21 other villages assigned to a control group.
- 12,201 households in the treatment villages.
- 5,100 of these households randomly selected to receive insurance marketing treatments, stratified by type of occupation: ~300 households in occupations entirely unrelated to agriculture, ~2400 cultivator households, and ~2400 agricultural laborer households.
- 4,667 rural households in TN, AP and UP were eventually offered insurance.

The experiment - description of the insurance product

- new insurance product designed in collaboration with the Agricultural Insurance Company of India Lombard (AICI).
- the rainfall insurance policy is a "Delayed Monsoon Onset" index-based insurance product.
- pricing and payout attributes determined by AICI based on their internal actuarial and managerial calculations.
- AICI local offices and marketing affiliates in each state marketed the product in the project villages.
- the price for a unit of insurance varied from Rs 80 to Rs 200 (USD 1.6 - 4), with an average price of Rs.145 in our sample villages, depending on the risk.
- three trigger dates: the first (Rs.300) payout came if the monsoon was between 15-20 days late; a larger (Rs.750) payout came if the monsoon was 20-30 days late; and the largest (Rs. 1200) came if the monsoon was between 25 and 40 days late.

Example

index-insurance was priced at Rs. 129 per unit in Dindigul in Tamil Nadu. If a farmer purchased 5 units of insurance, paying Rs. 645 in premiums, then he would receive Rs. 1500 if the monsoon (defined as an accumulation of 40mm of rainfall) was delayed by at least 20 days, Rs. 3750 if it was delayed by at least 25 days, and Rs. 6000 if it was delayed by at least 30 days.

The experiment - field operations

- the first insurance marketing were conducted in Tamil Nadu in October 2010 (prior to the November 2010 monsoon season); next in Andhra Pradesh and Uttar Pradesh in January- March 2011 (prior to the onset of monsoon in May).
- the 4,667 households were randomly assigned to different sales and marketing treatments. The main treatments randomly varied the price of the insurance (actuarially fair, unfair, subsidized)
- homogenous marketing/sales operations
- overall, roughly 40% of all households purchased some insurance. Of those, 38% purchased multiple units of insurance, with 17% purchasing 5 units or more.
- in several villages rainfall stations were built
- distance to the nearest rainfall station was recorded in Andhra Pradesh and Uttar Pradesh only.
    - The mean reported distance was 4 kilometers, with a standard deviation of 5.9 kilometers.

Results

- Variables:
  - η_j sub-caste ability to insure against idiosyncratic shocks (estimated by authors)
  - ι_j sub-caste ability to insure against common (village level) shocks (estimated by authors)
  - distance to AWS (automatic weather station) = proxy for basis risk
    - evidence that rainfall measured 14km away is uncorrelated with farm output.

Results

Table 6

Fixed-Effect Estimates: Determinants of Formal Insurance Take-up

Variable/Est. Method	Three States	Two States (AP and UP)			
	FE-State			FE-Caste	
η_j	0.125 [0.56]	0.151 [0.61]	0.0228 [0.07]	-	-
$\eta_j \times$ Distance to aws	-	-	0.151 [3.42]	0.139 [2.55]	0.157 [2.31]
ι_j	-198 [1.71]	-209.6 [1.28]	-209.7 [0.94]	-	-
$\iota_j \times$ Distance to aws	-	-	-	-	-18.6 [-0.528]
Distance to aws (km)	-	-	-0.0254 [3.50]	-0.0246 [2.63]	-0.019 [1.50]
Agricultural laborer	-0.0343 [2.19]	-0.0341 [2.13]	-0.028 [1.58]	-0.0238 [1.49]	-0.0379 [1.43]
Agricultural laborer × Distance to aws	-	-	-	-	0.00333 [0.797]
Actuarial price	-0.00143 [2.07]	-0.00159 [2.07]	-0.00167 [2.40]	- 0.00154 [2.14]	- 0.00157 [2.14]
Subsidy	0.389 [3.38]	0.355 [2.86]	0.35 [3.10]	0.376 [3.26]	0.372 [3.20]
Owned land holdings	0.000405 [0.14]	0.000445 [0.14]	0.000648 [0.20]	0.00353 [1.42]	0.0035 [1.42]
Village coefficient of variation, rainfall	0.523 [2.16]	0.751 [2.89]	0.747 [2.77]	0.874 [2.92]	0.908 [3.04]
N	4,260	3,338	3,338	3,338	3,338

Absolute values of t-ratios in brackets, clustered at the caste level. Standard errors are bootstrapped to account for the fact that η_j and ι_j are estimated regressors. Specifications also include scheduled tribe or caste indicator and whether non-Hindu

Results

Theoretical predictions are confirmed:

- at small distance from the AWS (i.e. no basis risk), there is no correlation between sub-cast ability to indemnify idiosyncratic shocks and willingness to buy formal insurance.
- instead, there is some evidence that ability of sub-caste to hedge against village level risks crowds out formal insurance
- basis risk is an important determinant of willingness to buy.
- when basis risk increases, individuals belonging to the sub-castes more able to indemnify idiosyncratic risks, purchase index-insurance more often
- laborers are partially insured by farmers. Nonetheless they buy a lot of insurance: in fact they buy more than farmers subject to high basis risk.

The experiment - follow up

- in June-July 2011 (after the harvest), one additional round of follow-up surveys was conducted in Tamil Nadu in order to track household behavior following insurance purchase.
- farmers were asked detailed questions about their seed choices for both the regular (Kharif) and the irregular cropping seasons following the insurance marketing offers.
- all farmers were asked to characterize the perceived average return and riskiness attributes (e.g. drought resistance, pest resistance) of each of the rice varieties.
- the Tamil Nadu sample is comprised of baseline households, plus an additional "control sample" of 648 households from villages where no insurance product was marketed.

Results

Table 10
Intent-to-Treat Caste Fixed-Effects Estimates of Index Insurance on Risk and Yield:
Proportion of Planted Crop Varieties Rated "Good" for Drought Tolerance and Yield,
Tamil Nadu *Kharif* Rice Farmers

Crop Characteristic:	Good Drought Tolerance	Good Yield
Variable	(1)	(1)
Offered insurance	-0.0593	0.0519
	[2.67]	[1.93]
Owned land holdings	0.0000934	0.00056
	[0.02]	[0.12]
Village coefficient of variation, rainfall	0.351	-0.516
	[0.88]	[0.81]
N	325	325

Absolute values of t-ratios in brackets, clustered by caste/village (because the randomized insurance treatment was stratified at the caste/village level).

- From the follow-up survey in TN, indices of drought tolerance and yield have been computed for all rice varieties.
- Farmers who were offered index-insurance (intention to treat) adopted riskier varieties with higher yield

Conclusions

- informal insurance is not always able to protect against village-level shocks
- in India, it depends on how widespread and dispersed are sub-castes and on their size
- thus, providing formal index-insurance against aggregate shocks could then be welfare improving
- though, when informal insurance is able to hedge aggregate risks, it interferes with individuals' willingness to buy formal insurance
    - informal insurance is preferred to index-insurance because the former is not subject to basis risk

Conclusions

- indeed, this paper shows that
  - if sub-castes are able to insure against village-level shocks, then farmers demand less of index-insurance (significant at 10%)
  - when index-insurance is imperfect, better (informally-) insured individuals acquire more formal insurance
  - better insurance favors the adoption of a crop-portfolio riskier but more profitable