Risk Pooling through Transfers in Rural Ethiopia

LEI PAN
VU University Amsterdam and Tinbergen Institute

I. Introduction

Risk is a major issue in developing countries. Many researchers have stressed the severity of risk in developing countries (e.g., Baulch and Hoddinott 2000; Fafchamps 2003; Dercon 2005a). Kinsey, Burger, and Gunning (1998) find that harvest failures were very frequent in the resettlement areas in rural Zimbabwe. Lybbert et al. (2004) claim that, among the pastoralists in the arid and semiarid lands of eastern and southern Africa, livestock losses during one cycle of drought and recovery can be up to 50%–80% for cattle and 30% for sheep and goats. In the Ethiopia Rural Household Survey (ERHS), farmers were asked to list the shocks they experienced in 1999–2004: 52% of the households reported drought, 38% reported pests or diseases affecting crops or livestock, and 35% reported the death of a household member (Dercon, Hoddinott, and Woldehanna 2005).

Households employ several methods to cope with these types of risk. Strategies include accumulating and decumulating assets (Deaton 1991), diversifying agricultural income by planting multiple crops (Dercon 1996), shifting labor to off-farm employment (Kochar 1999), and taking loans (Udry 1990, 1994;[1] Fafchamps and Lund 2003) or transfers (Dercon and Krishnan 2003).

There are many empirical studies on the issue of risk pooling. Most of them consider two questions. The first is whether risk is fully insured. The most famous example is Townsend (1994), which tests for full insurance by regressing individual consumption on individual income and aggregated village consumption or income. This idea that under full insurance idiosyncratic shocks should not have a significant impact on consumption has been adopted by many researchers (e.g., Grimard [1997]; Ravallion and Chaudhuri [1997];

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[1] The contingent repayment with the loans makes the loans very similar to transfers in the Udry studies.

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Jalan and Ravallion [1999]; and De Weerdt and Dercon [2006] all applied this idea in their papers).

The second question is how responsive the risk pooling strategies are to shocks. This is usually determined by regressing a variable that indicates a measure of risk coping strategy on shocks. For example, Jalan and Ravallion (2001) study the relation between unproductive liquid assets and risk. Fafchamps and Lund (2003) explore how gifts, informal loans, and sales of livestock and grain respond to shocks. Kochar (1999) investigates how households increase their labor supply to cope with risk.

Despite the rich literature in risk pooling, most of the papers can only provide an answer to *whether* there is full insurance but not *how large* the impact of different risk pooling strategies is on risk pooling. It is tempting to use the coefficient from the Townsend test to measure how far away the observed risk sharing is from full insurance. However, such an interpretation should be done with caution as households can rely on self-insurance instead of social insurance to stabilize their consumption. To take an extreme example, in a community where self-insurance through consumption smoothing is the only method for risk management, the Townsend test would suggest a high extent of risk pooling, when in fact there is none. This suggests that the Townsend coefficient cannot be used as a measure of the extent of risk sharing.

In the studies of specific strategies, usually only the significance of coefficients is meaningful. The value itself does not tell how much risk is insured by a certain strategy, since the variables of shocks are usually dummies or indices (examples using the ERHS data set are Dercon [2004] and Dercon et al. [2005]).

It is usually not sufficient to know if a certain strategy plays a role in risk pooling. Estimating to what extent shocks are pooled is essential for researchers to evaluate the importance of different strategies. For example, one worry about introducing formal insurance to farmers in developing countries is that it will crowd out informal insurance, which might make the resulting gain in welfare relatively small. If informal insurance does play a role in insuring risk, whether or not to implement formal insurance depends on how large the impact of informal insurance is on risk pooling. Therefore, going from a qualitative measure of the degree of risk sharing to a quantitative measure is a crucial step in understanding the risk pooling behavior of households.

In this article I focus on risk pooling through transfers using ERHS data. In order to help poor households in bad times, government and nongovernment organizations (NGOs) provide food aid and food-for-work programs. A large amount of food aid is distributed every year in Ethiopia. The annual volume of cereal food aid has ranged between 3.5% and 26% of the total domestic food grain production over the 1985–96 period (Clay, Molla, and Habtewold 1999). However, the targeting of food aid is poor: Dercon and Krishnan (2003) report that the characteristics of those who obtained aid and those who did not differ very little.

Aside from external aid from government and NGOs, mutual support is also very common in rural Ethiopia. Hoddinott, Dercon, and Krishnan (2005) study the networks in ERHS villages and find that many households have connections to different sorts of social networks and get support from them. In good years, households send transfers to households suffering negative shocks; in bad years, they receive support from other households. From this point of view, transfers work like insurance that collects premiums from those households that experience positive shocks and compensates those households that experience negative shocks.

The social networks in which such risk pooling occurs can be informal, based on kinship, friendship, or religion. These social networks may not be designed to pool risk (Fafchamps and Gubert [2005] provide an example for rural Philippines). There are also semiformal organizations in rural Ethiopia. These organizations require membership and fees. For example, the funeral association *iddir* is prevalent in Ethiopia. The institution collects contributions from its members and pays out to a household when a member or relative of a member dies (Hoddinott et al. 2005).

I explore two functions of transfers. It is well known that shocks can have persistent effects on growth (e.g., Dercon [2004] provides evidence of this for Ethiopia). Transfers may play a role in insuring shocks. The degree of risk pooling through transfers depends on the type of shocks. If the shocks are idiosyncratic, households may be able to rely on their social networks to insure the shocks. If the shocks are covariant, households will not be able to do so since the social networks are usually geographically concentrated. This is likely to be the case in the surveyed villages, where Hoddinott et al. (2005) find that 87% of the individuals in the households' social networks are in the same village. Therefore, it is unlikely that households are able to rely on their social networks to insure covariant income shocks, and government actions are necessary for households to avoid the welfare loss from covariant income shocks. Therefore, measures of both idiosyncratic and covariant shocks are constructed. By decomposing the shocks in this way, I study the roles that transfers from government or NGOs and friends or relatives play in insuring these two types of shocks separately.

However, households with negative shocks are not necessarily poor households. Transfers may try to target not only the unlucky households but also the poor households. Transfers are then used to reallocate income from richer households to poorer households. In this case, transfers depend not on shocks but on income differentials.

In summary, while many researchers have studied the effectiveness of various risk pooling strategies, most can answer only whether risk is fully insured. In this article I use continuous rather than discrete measures of shocks, which are constructed from a regression of income on income determinants. How much risk pooling households achieve through transfers can be studied based on the shocks I construct.

This article is organized as follows. Section II describes the data set. Section III gives the econometric specification. Section IV discusses the results. Section V concludes.

II. Data

The data used are from the ERHS. The survey data were collected by the Economics Department of Addis Ababa University in collaboration with the Centre for the Study of African Economies at Oxford University and the International Food Policy Research Institute. The EHRS is one of the few panel data sets available at the household level in Africa. In 1989, around 450 households in six sites were initially surveyed for a famine study. Three more sites were added in 1994–95 to include areas north of Debre Birhan, which could not be surveyed in 1989 due to military conflict. Six other sites were also added to cover the main agroclimatic zones and farming systems of the richer parts of the country.[2]

In total 1,477 households were surveyed in the beginning of 1994. In constructing the panel, the sample was stratified to ensure a sufficient coverage of the main farming systems and of female and landless households. These households have been reinterviewed several times subsequently. New survey rounds took place in the second half of 1994 and in 1995, 1997, 1999, and 2004. The data from the first five of the seven rounds are publicly available. Since the 1989 survey used a very different questionnaire from that of the later rounds and also covered different villages, I use the data from only the 1994 (two rounds), 1995, and 1997 surveys for the purposes of this article.

The data set provides detailed information on household income and assets as well as transfers. Means and standard deviations of household income and assets can be found in table 1. The income data are collected by asking about four sources of household income: farm income, labor income, livestock income, and transfer income.

[2] This section mainly draws on Dercon and Krishnan (1998).

TABLE 1

DEFINITIONS AND DESCRIPTIVE STATISTICS OF THE VARIABLES

Variables	Definition	Mean	SD
Yearly income (*y*)	Household income excluding transfers (in Br)	2,933.32	13,585.41
Male (*m*)	Male household members (age ≥ 16)	1.48	1.06
Female (*f*)	Female household members (age ≥ 16)	1.54	.94
Child (*ch*)	Household members ages 6–15	1.81	1.53
Livestock (*k*)	Value of the livestock owned by the household (in Br), divided by 1,000	2.06	3.16
Land (lan)	Land owned by the household (in hectares)	2.49	38.81
Other assets	Value of other productive assets (hoes, plows, etc.) owned by household (in Br)	52.65	148.73
Landless	Dummy: = 1 if the household has no land; 0 if not	.09	.29
Land quality	Share of land that is *lem* (good land)	.42	.43
Plant coffee	Dummy: = 1 if the household has (a) coffee plant(s); 0 if not	.27	.44
Plant *qat*	Dummy: = 1 if the household has (a) qat plant(s); 0 if not	.13	.34
Plant false banana	Dummy: = 1 if the household has (a) false banana plant(s); 0 if not	.29	.45
Plant eucalyptus	Dummy: = 1 if the household has (a) eucalyptus plant(s); 0 if not	.34	.47
Female head	Dummy: = 1 if the household head is female; 0 if not	.21	.41
Head age	Age of the household head	46.40	16.42
Head education	Years of education of the household head	1.52	2.74
Haresaw	Dummy: = 1 if the household in Haresaw site; 0 if not	.05	.22
Geblen	Dummy: = 1 if the household in Geblen site; 0 if not	.04	.20
Dinki	Dummy: = 1 if the household in Dinki site; 0 if not	.06	.23
Debre	Dummy: = 1 if the household in Debre Berhan site; 0 if not	.13	.33
Yetmen	Dummy: = 1 if the household in Yetmen site; 0 if not	.04	.20
Shumsha	Dummy: = 1 if the household in Shumsha site; 0 if not	.09	.29
Sirbana	Dummy: = 1 if the household in Sirbana Godeti site; 0 if not	.07	.25
Adele	Dummy: = 1 if the household in Adele Keke site; 0 if not	.07	.25
Korod	Dummy: = 1 if the household in Koro-degaga site; 0 if not	.08	.27
Turfe	Dummy: = 1 if the household in Turfe Kechemane site; 0 if not	.07	.26
Imdibir	Dummy: = 1 if the household in Imdibir site; 0 if not	.05	.21
Azedeboa	Dummy: = 1 if the household in Aze Deboa site; 0 if not	.05	.22
Addado	Dummy: = 1 if the household in Addado site; 0 if not	.09	.29
Garagodo	Dummy: = 1 if the household in Gara Godo site; 0 if not	.07	.25
Doma	Dummy: = 1 if the household in Doma site; 0 if not	.05	.21
Observations	4,164		

Source. Author's calculation using the ERHS data.
Note. 1 Ethiopian birr [Br] ≈ US$0.1. Observations with missing values are not included.

Land is allocated by peasant associations.[3] Selling land is illegal, though renting and sharecropping exist.[4] Livestock is the most important productive asset for the households in the surveyed villages. Other productive assets such as hoes and plows amount to only 7% of the value of livestock.[5]

As the survey was designed in 1989 for studying the drought in 1984–85, questions about shocks were asked in each round of the survey. For example, information about rainfall and shocks on crops is included in the data set. The data also contain information about changes in household composition and birth and death information for livestock. However, since the questions are mainly in the form of yes and no, the data do not contain much quantitative information of risk. Thus in this article I measure risk based on observed income.

The ERHS data provide information about households' transfer income from which the amount of transfers each household receives can be identified. The income data include not only food aid but also other income from transfers. The data indicate whether the transfer is from friends and relatives[6] or from government and NGOs and how much each household earns from food-for-work programs.

The transfers that households hand out are part of their expenditures. Taxes and contributions to peasant associations are treated as the transfers to government/NGOs. Transfers to friends and relatives include several types of transfers: food the household gives out, educational and medical expenses the household pays for members of other households, contributions to church and *iddir*, and contributions for livestock loss.

The first round (in 1994), third round (in 1995), and fourth round (in 1997) of the surveys were conducted in similar seasons. In the first round and fourth round surveys, information on transfers, including all those handed out and received in the four months before the surveys, was collected. For comparison purposes, the data of the third round survey are adjusted if the time between the second round survey and the third round survey is not 4 months.

The descriptive statistics for transfers are given in table 2. There are three

[3] In Ethiopia, a peasant association is not a farmers' self-help group as the name might suggest, but the lowest tier of civil administration. The peasant association can be considered as a local government institution covering one or more villages, and so transfers to and from peasant associations can be considered as a component of transfers to and from government/NGOs.

[4] During the initial land reform in 1975 and the subsequent redistributions, peasant associations were instructed to use household size as the criterion to allocate land. There were also other factors that determine land allocation. Examples include land quality, if the household was newly formed, if the household had cultivated a certain parcel of land, etc.

[5] Calculated using the ERHS data.

[6] Transfers from organizations like the *iddir* funeral association are also included in this category, since these transfers are from households' social networks and are part of the mutual support.

TABLE 2
DESCRIPTIVE STATISTICS OF THE TRANSFERS

Variables	Observations*	Mean	Median	SD	99th Percentile	Max
Total transfers in	1,062	136	57	500	1,300	14,319
Transfers in from government/NGOs	445	112	47	687	492	14,319
Food for work	242	120	76	128	603	955
Transfers in from friends/relatives	438	150	48	343	1,969	3,518
Total transfers out†	3,474	39	22	68	272	1,499
Transfers out to government/NGOs	2,075	28	19	59	187	1,396
Transfers out to friends/relatives	3,136	24	11	47	187	1,081
Food handed out	224	584	331	707	3,494	4,387

Note. All the statistics are based on the value of transfers for 4 months (the unit is birr).
* The number of the nonzero observations.
† Food handed out is excluded.

characteristics of the transfers that should be noted. First, we can see from the big differences between the 99th percentiles and the maxima that there are a few observations with very high levels of transfers. These observations are very likely to reflect measurement errors. For example, the units of the in-kind transfers may have been recorded incorrectly in the survey.

Second, the amount of "food handed out" is large compared with other transfers. Since only the amount of food handed out 1 week before each survey was asked, the data have to be multiplied by a large number (17.3) to make it a 4-month total. Thus I consider these data to be noisy and exclude them from the later analyses.

Third, transfer levels are generally low. Because of the outliers, the medians are probably better measures of the level than the means. Compared with the income level in table 1, transfers amount to less than 15% of income (obtained by multiplying transfers by three to adjust the 4-month total to a yearly total).

The extent to which transfers insure against income risk depends not only on average transfer levels but also on their distributions. In table 3, I list the median income, the value of transfers handed out and received, and the percentage of households that hand out or receive transfers in each village in each year. It is clear from the table that a high percentage of households hand out transfers, but transfers received are location dependent for both those from government and NGOs and from friends and relatives. Comparing the median income to the percentages of households that receive and hand out transfers in villages, I find some cases that may reflect income redistribution. For example, in the rich village Sirbana Godeti almost all the households transfer out, while in the relatively poor village Shumsha a high percentage of the

TABLE 3

VALUE OF TRANSFERS AND PERCENTAGE OF HOUSEHOLDS THAT RECEIVED AND HANDED OUT TRANSFERS

			Government/NGOs			Friends/Relatives	
Village	Year	Median Income	Transfers In	Food for Work	Transfers Out	Transfers In	Transfers Out
Haresaw	94	1,096	0	6,121	59	189	162
			(0)	(62)	(24)	(4)	(38)
	95	460	262	2,455	443	379	116
			(5)	(23)	(25)	(1)	(25)
	97	1,169	94	2,590	763	747	605
			(3)	(15)	(57)	(12)	(72)
Geblen	94	529	141	5,790	17	0	70
			(2)	(78)	(2)	(0)	(13)
	95	334	80	42	0	0	0
			(2)	(2)	(0)	(0)	(0)
	97	135	2,716	255	328	129	80
			(63)	(5)	(34)	(2)	(27)
Dinki	94	577	0	0	829	258	276
			(0)	(0)	(49)	(1)	(32)
	95	155	0	0	395	49	139
			(0)	(0)	(32)	(3)	(20)
	97	967	0	0	82	555	247
			(0)	(0)	(5)	(4)	(47)
Debre Berhan	94	3,054	258	0	2,392	1,067	1,527
			(1)	(0)	(69)	(7)	(78)
	95	1,597	361	0	1,775	5	1,263
			(2)	(0)	(88)	(1)	(88)
	97	2,878	0	0	838	755	2,495
			(0)	(0)	(19)	(6)	(94)
Yetmen	94	1,588	0	0	1,181	0	1,171
			(0)	(0)	(89)	(0)	(60)
	95	2,159	0	0	539	55	254
			(0)	(0)	(89)	(5)	(74)
	97	3,460	0	13	274	205	659
			(0)	(2)	(22)	(5)	(65)
Shumsha	94	689	30,626	0	2,433	795	3,512
			(96)	(0)	(81)	(3)	(87)
	95	784	4,175	955	999	414	1,286
			(60)	(1)	(72)	(8)	(86)
	97	1,049	2,820	0	185	296	4,169
			(55)	(0)	(8)	(3)	(90)
Sirbana Godeti	94	3,716	115	0	2,145	56	3,284
			(1)	(0)	(87)	(1)	(96)
	95	3,357	0	0	1,169	437	2,242
			(0)	(0)	(81)	(4)	(96)
	97	3,646	202	0	5,062	461	7,083
			(1)	(0)	(73)	(3)	(100)
Adele Keke	94	1,689	0	3,151	4,347	1,699	1,722
			(0)	(21)	(71)	(8)	(34)
	95	2,262	0	380	300	1,023	322
			(0)	(1)	(19)	(18)	(35)
	97	2,766	3,146	168	12,158	695	2,240
			(59)	(1)	(78)	(6)	(70)
Koro-degaga	94	1,053	69	0	2,213	3,979	1,408
			(1)	(0)	(94)	(28)	(89)
	95	1,970	516	0	1,344	6,427	1,583
			(17)	(0)	(82)	(28)	(92)
	97	2,626	506	0	2,323	9,540	1,789
			(3)	(0)	(40)	(20)	(89)

TABLE 3 (*Continued*)

Village	Year	Median Income	Government/NGOs Transfers In	Government/NGOs Food for Work	Government/NGOs Transfers Out	Friends/Relatives Transfers In	Friends/Relatives Transfers Out
Turfe Kechemane	94	2,508	587	0	138	7,842	1,837
			(3)	(0)	(16)	(19)	(93)
	95	3,787	1,413	642	1,224	3,931	2,476
			(1)	(12)	(90)	(19)	(91)
	97	3,862	0	0	8	2,964	2,891
			(0)	(0)	(1)	(10)	(96)
Imdibir	94	4,354	75	613	59	2,990	3,742
			(1)	(6)	(3)	(10)	(99)
	95	1,431	86	2,708	592	2,616	1,004
			(13)	(51)	(52)	(31)	(97)
	97	1,524	160	0	901	3,962	2,175
			(18)	(0)	(47)	(40)	(98)
Aze Deboa	94	1,287	0	0	183	1,081	6,481
			(0)	(0)	(5)	(14)	(90)
	95	1,751	68	0	2,218	363	1,527
			(3)	(0)	(69)	(13)	(100)
	97	2,155	414	0	139	3,065	1,177
			(1)	(0)	(4)	(19)	(97)
Addado	94	1,308	22	0	1,832	55	2,961
			(1)	(0)	(63)	(1)	(76)
	95	2,003	0	0	1,720	2,459	1,390
			(0)	(0)	(55)	(2)	(71)
	97	3,082	0	0	1,211	130	3,188
			(0)	(0)	(38)	(5)	(95)
Gara Godo	94	592	0	49	1,314	1,068	2,920
			(0)	(1)	(71)	(13)	(93)
	95	934	0	266	922	47	620
			(0)	(12)	(74)	(4)	(84)
	97	1,199	623	82	22	2,761	653
			(7)	(1)	(3)	(96)	(97)
Doraa	94	859	34	0	958	75	353
			(1)	(0)	(74)	(1)	(56)
	95	456	83	2,856	322	16	154
			(4)	(73)	(34)	(3)	(34)
	97	1,036	70	0	226	0	538
			(2)	(0)	(16)	(0)	(50)

Source. Author's calculation using the ERHS data.
Note. The value of transfers is given in Ethiopian birrs, with the percentage of households that receive and hand out transfers included in parentheses. Food handed out is excluded from transfers out to friends/relatives.

households receive transfers from government/NGOs.[7] Risk pooling is less clear from table 3. Some cases that may reflect insurance can be found. For example, the income in Geblen in 1997 is much lower because of a drought

[7] To provide more formal evidence of this, I regress the value and the percentage of transfers on the median income. The results are reported in table Bl in app. B. I find that the richer villages receive less from government/NGOs and that the richer villages pay out more to both government/NGOs and friends/relatives. These findings are all in line with income redistribution. The only exception is transfers in from friends/relatives, for which richer villages receive more. I am indebted to one of the referees for suggesting these regressions.

than that in the other two years, so 63% of the households in the village get transfers from government/NGOs. However, for villages like Adele Keke and Gara Godo, table 3 seems to show that there is no risk pooling, as they get transfers in the years with higher median income. Of course, comparing the village median income in one year to that of the other years is not a precise way of measuring risk. In addition it excludes all idiosyncratic shocks. Section III will provide a sophisticated way to measure shocks and further explore the issue of risk pooling and income distribution in the 15 Ethiopian villages.

III. The Effects of Transfers, Risk Pooling, and Redistribution

A. The Income Equation and Measures of Shocks

In this section, I construct two kinds of shocks: covariant income shocks and idiosyncratic income shocks. Several methods have been used in the literature to measure income shocks. Rosenzweig (1988) uses the difference between a household's income and its mean income over a 9-year panel. Jacoby and Skoufias (1997) define the idiosyncratic shock as the deviation of the change in log full income from the change in the village-season-year mean and the aggregate shock as the mean change itself. Kochar (1999) measures income shocks as the residual in a regression of crop profits on a household fixed effect, lagged income, and the amount of land owned. Similar to Kochar (1999), I define my income shocks as the difference between household income y_t (excluding transfers) at period t and the household's expected income $E_{t-1}y_t$ (excluding transfers) at period $t-1$ as determined from a regression of y_t on a set of income determinants. I assume that income depends on three components: capital, labor, and land. In the ERHS context, capital takes the form of livestock. Demographic variables and other household characteristics are used as additional predictors. As mentioned in Section II, the data contain some information about income related shocks so they are also included in the regressors. Using a constant elasticity of substitution as the functional form of the income function,[8] household income is modeled as

$$y_{vht} = (\alpha_1 k_{vht-1}^{-\rho} + \alpha_2 \text{lab}_{vht-1}^{-\rho} + \alpha_3 \text{lan}_{vht-1}^{-\rho})^{-\tau/\rho} \times \exp\Big(\sum_i \eta_i a_{i,vht-1} + \sum_j \phi_j c_{j,vh} + \sum_t \psi_t l_t + \sum_p \lambda_p w_{p,vht} + \sum_q \chi_q o_{q,vht} + \text{cons} + e_{vht}\Big), \quad (1)$$

$$\text{lab}_{vht-1} = m_{vht-1} + \beta_1 f_{vht-1} + \beta_2 ch_{vht-1}, \quad (2)$$

[8] This functional form and the choice of most of the variables are based on Cockburn (2002).

where v, h, and t are indexes of village, household, and time, respectively, and α_i, β_i, η_i, ϕ_j, ψ_t, λ_p, and χ_q are coefficients. The parameter τ is the scale return of production, and ρ is the substitution parameter. The variable y is household income excluding transfers, k is livestock, lab is the aggregate household labor as defined in equation (2), and lan is land. The variables m, f, and ch represent males, females, and children, respectively, present in the household.[9] The variables a_i and c_j denote time-variant and time-invariant predictors, respectively.[10] The definitions of these variables are listed in table 1. Village dummies are included in the variable c_j to capture the village fixed effect. The variable l_t denotes the year dummies. The variable w_p denotes observed weather-related shocks, and o_q denotes the other observed shocks. Table 4 lists the definitions of w_p and o_q. Weather-related shocks are the shocks caused by rain, temperature, storm, and flood. Other shocks are shocks on crops caused by diseases, livestock, and birds, as well as shocks on livestock and the composition of households. The variable cons is a constant and e is the error term.

It should be noted that in the income function defined in (1) and (2), the error term e_{vht} is correlated across households. Since village dummies and year dummies are included in c_j and l_t, e_{vht} can be written as

$$e_{vht} = g_{vt} + b_{vh} + n_{vht}, \tag{3}$$

where g_{vt}, b_{vh}, and n_{vht} denote the unobserved village specific shocks, the household effect,[11] and the unobserved idiosyncratic shocks, respectively, and $g_{vt} \sim N(0, \sigma_g^2)$, $b_{vh} \sim N(0, \sigma_b^2)$, $n_{vht} \sim N(0, \sigma_n^2)$.

I also allow for serial correlation in the shocks:

$$\mathrm{Cov}(e_{vh,94}, e_{vh,95}) = c_1^g \sigma_g^2 + \sigma_b^2 + c_1^n \sigma_n^2 = \sigma_1^2, \tag{4}$$

$$\mathrm{Cov}(e_{vh,95}, e_{vh,97}) = c_2^g \sigma_g^2 + \sigma_b^2 + c_2^n \sigma_n^2 = \sigma_2^2, \tag{5}$$

$$\mathrm{Cov}(e_{vh,94}, e_{vh,97}) = c_3^g \sigma_g^2 + \sigma_b^2 + c_3^n \sigma_n^2 = \sigma_3^2, \tag{6}$$

where c_1^g, c_2^g, and c_3^g are the correlations of the village-specific shocks and c_1^n, c_2^n, and c_3^n are the correlations of the unobserved idiosyncratic shocks.

[9] This measure of labor is not responsive to shocks. With the setting of this article, if labor is indeed responsive to shocks, it will be counted as a shock itself.

[10] Since stratification was used in choosing households to survey, I include indicator variables for landless and female households in a_i in order to pool all the data. The information for weighing the sample is limited, as stated in the data description by Dercon and Hoddinott (2004), so no sampling weights are used in the regressions.

[11] Since the panel is short and the income equation is highly nonlinear, estimating the income equation with a household fixed effect does not give sensible estimates of the coefficients.

TABLE 4
DEFINITIONS OF VARIABLES OF OBSERVED SHOCKS

Variables	Definition
w_1	Dummy: = 1 if the household reported that the rain came on time in the previous farming season; 0 if not
w_2	Dummy: = 1 if the household reported that there was enough rain in the previous farming season; 0 if not
w_3	Dummy: = 1 if the household reported that the rain stopped on time in the previous farming season; 0 if not
w_4	Dummy: = 1 if the household reported that there was enough rain in the harvest in the previous farming season; 0 if not
w_5	Dummy: = 1 if the household reported that crops suffered from low temperature in the previous farming season; 0 if not
w_6	Dummy: = 1 if the household reported that crops suffered from wind/storm in the previous farming season; 0 if not
w_7	Dummy: = 1 if the household reported that crops suffered from flooding/water logging in the previous farming season; 0 if not
o_1	Dummy: = 1 if the household reported that crops suffered from diseases in the previous farming season; 0 if not
o_2	Dummy: = 1 if the household reported that crops suffered from livestock eating/trampling in the previous farming season; 0 if not
o_3	Dummy: = 1 if the household reported that crops suffered from birds/other animals in the previous farming season; 0 if not
o_4	Dummy: = 1 if the household reported that crops suffered from weed damage in the previous farming season; 0 if not
o_5	The size of land that was allocated to the three crops that were reported by households to be most affected by weather, insects, diseases, etc., weighted by the severity of the affection
o_6	Livestock shock: $(b_{vht} - d_{vht})/k_{vh,t-1}$, where b_{vht} is the birth of livestock in value and d_{vht} is the death of livestock in value
o_7	$dh_{vht}/\text{hhsize}_{vh,t-1}$, where dh_{vht} is the number of household members who died and $\text{hhsize}_{vh,t-1}$ is the size of household in the beginning of the year
o_8	$\text{join}_{vht}/\text{hhsize}_{vh,t-1}$, where join_{vht} is the number of household members who joined the household and $\text{hhsize}_{vh,t-1}$ is the size of household in the beginning of the year

Income is often found to be measured with errors in household surveys. These errors can be caused by a tendency of the surveyed households to underreport their income, recall bias, and so on. In addition, as the income data in the ERHS were collected by asking about household income from all possible sources, such as from farm income and wage income, an incomplete list of income sources in the questionnaire can also cause errors in measuring income. As these causes apply to every round of the survey and are likely to affect income in each round in the same way, it may well be reasonable to assume that the errors in measuring income are constant over time.

Under the assumptions that the errors in measuring income are constant and that they are not correlated to the explanatory variables in the income equation (eq. [1]) and the components of the error term (g_{vt} and n_{vht}), the errors in measuring income are a component of h_{vh}. Since I have included as many variables that capture the household fixed effect as possible in the explanatory variables of the income equation (age, education of the household head, etc.), a big part of b_{vh} should be the errors in measuring income. Estimating b_{vh} should allow me to deal with the errors in measuring income to some extent.

Accordingly I can now write the expected income $E_{t-1}(y_{vht}\exp(-b_{vh}))$ as

$$\begin{aligned} E_{t-1}(y_{vht}\exp(-b_{vh})) = {} & (\alpha_1 k_{vht-1}^{-\rho} + \alpha_2 \mathrm{lab}_{vht-1}^{-\rho} + \alpha_3 \mathrm{lan}_{vht-1}^{-\rho})^{-\tau/\rho} \\ & \times \exp\Big(\sum_i \eta_i a_{i,vht-1} + \sum_j \phi_j c_{j,vh} + \mathrm{cons}\Big) \\ & \times E_{t-1}\exp\Big(\sum_p \lambda_p w_{p,vht} + \sum_q \chi_q o_{q,vht} \\ & + \sum_t \psi_t l_t + g_{vt} + n_{vht}\Big). \end{aligned} \tag{7}$$

Assuming $\sum_p \lambda_p w_{p,vht} + \sum_q \chi_q o_{q,vht} + \sum_t \psi_t l_t \sim N(0, \sigma_o^2)$, I can rewrite equation (7) as

$$\begin{aligned} E_{t-1}(y_{vht}\exp(-b_{vh})) = {} & (\alpha_1 k_{vht-1}^{-\rho} + \alpha_2 \mathrm{lab}_{vht-1}^{-\rho} \\ & + \alpha_3 \mathrm{lan}_{vht-1}^{-\rho})^{-\tau/\rho} \\ & \times \exp\Big(\sum_i \eta_i a_{i,vht-1} + \sum_j \phi_j c_{j,vh} \\ & + \mathrm{cons} + \frac{\sigma_o^2 + \sigma_g^2 + \sigma_n^2}{2}\Big), \end{aligned} \tag{8}$$

and the shock can be defined as

$$\begin{aligned} s_{vht}^y & = y_{vht}\exp(-b_{vh}) - E_{t-1}(y_{vht}\exp(-b_{vh})) \\ & = E_{t-1}(y_{vht}\exp(-b_{vh}))\Big(\exp\Big(\sum_p \lambda_p w_{p,vht} + \sum_q \chi_q o_{q,vht} \\ & \quad + \sum_t \psi_t l_t + g_{vt} + n_{vht} - \frac{\sigma_o^2 + \sigma_g^2 + \sigma_n^2}{2}\Big) - 1\Big) \\ & = E_{t-1}(y_{vht}\exp(-b_{vh}))(\exp(d_{vht}^y) - 1), \end{aligned} \tag{9}$$

where $d_{vht}^y = \sum_p \lambda_p w_{p,vht} + \sum_q \chi_q o_{q,vht} + \sum_t \psi_t l_t + g_{vt} + n_{vht} - (\sigma_o^2 + \sigma_g^2 + \sigma_n^2)/2$.

I use feasible generalized least squares to estimate this model. The details of the estimation procedure can be found in appendix A. Table 5 shows the estimation results of the income function.

From estimating the income function, I obtain the residual from the re-

TABLE 5
ESTIMATION RESULTS OF THE INCOME FUNCTION

Independent Variables	Dependent Variable: Income	
	Coefficient	t-Statistic
Scale returns (τ)	.642***	16.31
Substitution (ρ)	−.485***	−6.71
Livestock (α_1)	.269***	7.42
Labor (α_2)	.448***	9.87
Land (α_3)	.283***	6.86
Female (β_1)	.410***	3.91
Kid (β_2)	.281***	3.84
Landless	.263***	2.62
Land quality	.099**	2.45
Plant coffee	.406***	5.72
Plant qat	.338***	4.68
Plant false banana	−.050	−.66
Plant eucalyptus	.091**	2.31
Female head	−.130***	−2.69
Head age	−.005***	−4.16
Head education	.031***	4.61
Haresaw	−.484**	−2.10
Geblen	−1.267***	−5.39
Dinki	−1.002***	−4.35
Yetmen	−.009	−.04
Shumsha	−.502**	−2.23
Sirbana	.532**	2.35
Adele	.174	.74
Korod	−.091	−.40
Turfe	.468**	2.01
Imdibir	−.099	−.38
Azedeboa	−.385	−1.55
Addado	.328	1.31
Garagodo	−.726***	−2.99
Doma	−.667***	−2.86
Year95	−.059	−.58
Year97	.316***	3.09
Constant	6.902***	36.32
Observed shocks	Not reported	
Observations	4,164	
R^2	.45	

Note. The parameter α_3 is calculated using $\alpha_3 = 1 - \alpha_1 - \alpha_2$.
** Significant at the 5% level.
*** Significant at the 1% level.

gression, which is an estimate of e_{vht} (denoted by $\hat{e}_{vht}$). I regress $\hat{e}_{vht}$ on the village dummies to get an estimate of g_{vt} (denoted by $\hat{g}_{vt}$).

To obtain an estimate of b_{vh}, I regress $\hat{e}_{vht} - \hat{g}_{vt}$ on the household dummies. This allows me to obtain an estimate of $b_{vh} + \overline{n}_{vht}$ (denoted by $\hat{b}_{vh} + \hat{n}_{vht}$). Since the panel is short, it is not reasonable to assume that n_{vht} is equal to zero. Thus it is necessary to exclude it from $\hat{b}_{vh} + \hat{n}_{vht}$ in order to obtain an estimate of b_{vh}. I achieve this by regressing $\hat{b}_{vh} + \hat{n}_{vht}$ on the change of the crops households stored from the first round to the fourth round.

This is based on the understanding that households store crops when there is a good harvest and consume or sell them when there is a bad harvest. Therefore, if the average shock is positive (negative) in the period from year 94 to year 97, the crops households stored should increase (decrease) in this period. This relation can be written as:

$$\overline{\sum_p \lambda_p w_{p,vht} + \sum_q \chi_q o_{q,vht} + \sum_t \psi_t l_t + g_{vt} + n_{vht}} = f(cr_{vh97} - cr_{vh94}) + er_{vh}, \quad (10)$$

where cr_{vh94} and cr_{vh97} are the crops the household stored in the first and the fourth round, respectively, er is the error term, and $f(\cdot)$ is a functional form.[12]

Since the variable *crop storage* can be measured without many difficulties in household surveys, it is unlikely that it is correlated with the errors in measuring income. Therefore, if I regress

$$U_{vht} = \hat{b}_{vh} + \hat{\bar{n}}_{vht} + \overline{\sum_p \hat{\lambda}_p w_{p,vht} + \sum_q \hat{\chi}_q o_{q,vht} + \sum_t \hat{\psi}_t l_t + \hat{g}_{vt}} \quad (11)$$

on $f(cr_{vh97} - cr_{vh94})$, the fitted value from this regression subtracted by

$$\overline{\sum_p \hat{\lambda}_p w_{p,vht} + \sum_q \hat{\chi}_q o_{q,vht} + \sum_t \hat{\psi}_t l_t + \hat{g}_{vt}}$$

can be used as an estimate of $\hat{\bar{n}}_{vht}$. Subtracting $\hat{\bar{n}}_{vht}$ from $\hat{b}_{vh} + \hat{\bar{n}}_{vht}$, an estimate of b_{vh} can be obtained. The results of this regression are reported in table B2 in appendix B.

With the estimates of the coefficients in the income equation and the estimates of g_{vt}, b_{vh}, and n_{vht},[13] the expected value of income and the shock defined in equations (8) and (9) can be calculated. I then regress d^y_{vht} on village-year dummies to decompose it into the covariant part (denoted by d^{cov}_{vht}) and the idiosyncratic part (denoted by d^{ind}_{vht}). Then the total income shocks s^y_{vht} can

[12] The form of $f(\cdot)$ used is $\delta_1 + \delta_2(cr_{vh97} - cr_{vh94})/(0.5(cr_{vh97} + cr_{vh94}) + 1)$, where δ_1 and δ_2 are coefficients. Dividing by the mean of cr_{vh97} and cr_{vh94} makes the expression unit free, and adding 1 makes it possible to include the observations with no crop stored in both the first and the fourth round.

[13] The estimate of n_{vht} is the sum of the residual from regressing $\hat{e}_{vht} - \hat{g}_{vt}$ on the household dummies and the estimate $\hat{\bar{n}}_{vht}$.

be decomposed into two parts: the covariant income shock s_{vht}^{cov} and the idiosyncratic income shock s_{vht}^{idi}:[14]

$$s_{vht}^{\text{cov}} = \frac{d_{vht}^{\text{cov}}}{d_{vht}^{y}} s_{vht}^{y}, \tag{12}$$

$$s_{vht}^{\text{idi}} = \frac{d_{vht}^{\text{ind}}}{d_{vht}^{y}} s_{vht}^{y}. \tag{13}$$

B. Transfers, Risk Pooling, and Redistribution

To study the relation among transfers, risk, and income, I specify the following equation to model the functions of risk pooling and redistribution of transfers:

$$\begin{aligned} \text{tr}_{vht} = {} & \gamma_1 s_{vht}^{\text{cov}} + \gamma_2 s_{vht}^{\text{idi}} + \theta(E_{t-1} y_{vht} - \overline{E_{t-1} y_{vt}}) \\ & + \sum_i \kappa_i x_{i,vht-1} + \sum_i \xi_i z_{i,vh} + \text{cons} + r_{vht}, \end{aligned} \tag{14}$$

where tr is the net transfer the household gets. The control variables are denoted by x_i and z_i, in which village dummies are also included. The constant term is denoted by cons. The variable r is the error term. The parameters γ_i, θ, κ_i, ξ_i are coefficients.

To study the function of insurance, I put on the right-hand side the measures of covariant and idiosyncratic shocks,[15] s_{vht}^{cov} and s_{vht}^{idi}, which measure the values of gains (losses) from shocks. The parameters γ_1 and γ_2 measure the contribution of transfers to risk pooling directly.

To capture the role that transfers may play in transferring from richer households to poorer households, I put on the right-hand side the difference between the expected income of the household and the median of the expected income in the village. If transfers do play a pro-poor role, poorer households

[14] Decomposed in this way, the shock measures have the following characteristics: (1) $s_{vht}^{\text{cov}} + s_{vht}^{\text{idi}} = s_{vht}^{y}$; (2) s_{vht}^{cov} and d_{vht}^{cov} have the same sign and s_{vht}^{ind} and d_{vht}^{ind} have the same sign; (3) when s_{vht}^{y} goes to zero, d_{vht}^{y}, s_{vht}^{cov}, and s_{vht}^{idi} also go to zero.

[15] One may argue that the study can be done by putting the observed shocks directly into equation (14) and there is no need to construct s_{vht}^{cov} and s_{vht}^{idi}. There are two reasons that the method described in this article is preferred. First, only a subset of the shocks is observed. Second, most of the observed shocks are only qualitative measures of the shocks. The method used in this article provides a way to measure the shocks quantitatively and integrate all the shocks into two measures. If I do a regression of transfers on the observed shocks, because of the omitted variables in the regression and the collinearity between the variables of the observed shocks, some of the estimates of the coefficients do not seem to be sensible. Moreover, since the observed shocks are only a subset of the shocks, it is hard to evaluate the extent of risk pooling by investigating these coefficients.

TABLE 6
RESULTS ON NET TRANSFERS

Independent Variables	Net Total Transfers (1)	Net Transfers from Government/NGOs (2)	Net Transfers from Mutual Support (3)
	Dependent Variables		
$s^{cov}_{vht}(\gamma_1)$	−.0056***	−.0045***	−.0011
	(−3.14)	(−3.56)	(−.86)
$s^{idi}_{vht}(\gamma_2)$	.0002	.0005	−.0003
	(.30)	(1.06)	(−.66)
$E_{t-1}y_{vht} - \overline{E_{t-1}y_{vt}}(\theta)$	−.0070***	−.0030***	−.0040***
	(−5.41)	(−3.90)	(−4.18)
Landless	1.024	−1.296	2.320
	(.29)	(−.55)	(.94)
Land quality	.471	−1.955	2.426
	(.17)	(−.97)	(1.23)
Plant coffee	−3.755	−2.274	−1.481
	(−.86)	(−.98)	(−.41)
Plant qat	−5.076	−6.810**	1.734
	(−.92)	(−2.15)	(.39)
Plant false banana	−3.897	1.457	−5.354
	(−.80)	(.83)	(−1.23)
Plant eucalyptus	−4.890	−1.840	−3.050
	(−1.63)	(−.84)	(−1.60)
Female head	2.666	−2.584	5.250***
	(.91)	(−1.22)	(2.59)
Head age	.187***	.104**	.083
	(2.69)	(2.36)	(1.54)
Head education	.553	.489**	.063
	(1.28)	(2.16)	(.18)
Constant	−22.544***	−11.904***	−10.640***
	(−4.94)	(−4.16)	(−3.05)
Village dummies	Not reported		
Observations	4,080	4,080	4,080
R^2	.16	.20	.08

Note. *t*-statistics shown in parentheses are based on robust standard errors.
** Significant at the 5% level.
*** Significant at the 1% level.

should receive more transfers than the richer households. Choosing expected income instead of real income here is based on the asset-based view in measuring poverty, since expected income depends only on the household's assets and productivity. The parameter θ measures the effects of transfers on reallocating income.

IV. Results

A. Results on Net Transfers

Table 6 shows the estimation results of equation (14). The three columns show the results for net total transfers, net transfers from government/NGOs, and net transfers from mutual support, respectively. The coefficients γ_1 and γ_2

measure how much covariant shocks and idiosyncratic shocks are insured through transfers, respectively, and the coefficient θ measures the income redistribution role. Evidence on the two roles that transfers from government/ NGOs may play (the insurance role and the redistribution role) can be found in table 6. The coefficient γ_1 is significant but γ_2 is insignificant in column 2, which means that covariant shocks are insured by transfers from government/ NGOs but that idiosyncratic shocks are not insured.[16] There is statistically significant evidence that transfers from government/NGOs go from households with high expected income to the ones with low expected income, since θ is significant in column 2.[17]

Transfers from friends/relatives are found to insure neither covariant nor idiosyncratic shocks, since both γ_1 and γ_2 are insignificant in column 3. Like the results in column 2, there is evidence that transfers from friends/relatives play a role in redistribution, since θ is significant in column 3 in table 6.[18]

The findings on risk pooling through mutual support are consistent with what the literature has suggested. As stated in Dercon (2005b), the effectiveness of the informal arrangements varies according to the type of shocks. Additionally, informal risk-sharing networks can only insure idiosyncratic but not covariant shocks, since the networks are mainly restrained within a certain boundary (e.g., villages). Table 6 shows that households are indeed not able to insure covariant shocks through transfers, as γ_1 in column 3 is insignificant. Within the network, evidence on risk sharing (though not complete risk sharing) has been found for many countries (see, e.g., Jalan and Ravallion

[16] One may argue that transfers should have two components: the expected transfers (tr1) and the unexpected transfers (tr2); tr1 might respond to tr2. This makes it desirable to regress tr1 on the sum of tr2 and the shocks derived in this article. Unfortunately the data do not allow breaking the transfers into tr1 and tr2. However, suppose this were feasible, then the estimates I report in this article should be an overestimate of the true impact of transfer on risk pooling (attenuation bias). This reinforces my conclusion that the impact of transfers on risk pooling is very small.

[17] Regressing taxes and contributions to peasant associations on the independent variables in table 6 (results not shown), I find that these taxes and contributions contribute to income redistribution. This is the main reason that transfers from government/NGOs are found to play a role in redistribution.

[18] As mentioned in Section II, extreme values of transfers are observed for some of the households. These observations may change the results of the estimation. To detect outliers, I use two criteria: (1) studentized residuals, Cook's distance, leverage, DFITS or DFBETA of s^{cov}_{vht}, s^{idi}_{vht}, $E_{t-1}y_{vht} - \overline{E_{t-1}y_{vt}}$ exceed their cutoffs; (2) household income is in the highest or lowest percentiles, or livestock the household owns is in the highest percentile, or land the household owns is in the highest percentile, or total transfers of the household is in the highest or lowest percentiles. If both criteria are satisfied, the observation is considered to be an outlier and is deleted from the analysis. In total 91 out of 4,164 observations are dropped. Including the outliers in the sample, I found that all the estimates of γ_1, γ_2 and θ are not significant at the 10% level. Only γ_1 for transfers from government/NGOs is significant at the 15% level.

1999 for China; Ravallion and Chaudhuri 1997 for India; and De Weerdt and Dercon 2006 for Tanzania). However, in these studies, the contributions of transfers on risk sharing cannot be distinguished from the contributions of other risk-sharing institutions. Morduch (1999) suggests that transfers from mutual support only play a minor role in risk sharing, especially where migration is limited. The risk sharing of idiosyncratic shocks through mutual support is indeed found to be insignificant in the 15 Ethiopian villages in table 6.

The results show that transfers from government/NGOs insure covariant shocks (the coefficient γ_1 is significantly negative in col. 2), and idiosyncratic shocks are not significantly insured by transfers from government and NGOs (γ_2 in col. 2 is not significant at the 10% level in table 6). Different from transfers from mutual support, transfers from government/NGOs have the ability to help the households pool covariant shocks. As just mentioned, households are not able to pool covariant shocks by relying on their social networks. Thus it is even more necessary for the government and NGOs to insure common shocks like drought, flood, and so on. Transfers from government and NGOs that target the covariant shocks can always play a role as a useful safety net to guarantee the effectiveness of the risk-sharing arrangement, as the system of informal risk-sharing arrangement is more likely to be down when income is in general low (Coate and Ravallion 1993). There can be two reasons that idiosyncratic shocks are not insured by transfers from government/NGOs. First, insuring idiosyncratic shocks is difficult and costly, since idiosyncratic shocks are much more challenging to be detected by external agencies. Second, in the communities where well-functioning risk-sharing arrangements exist, households can fully insure their idiosyncratic income shocks by pooling risk with their friends and relatives. In such communities, it may not be necessary for the government and NGOs to target the idiosyncratic shocks. However, the second reason does not seem to reflect the situation in table 6, as transfers from friends/relatives are not found to be able to insure the idiosyncratic shocks.

B. Results on Transfers Received

The results shown in the previous section are for regressions on net transfers. However, some of the components of the outflows of transfers (e.g., the taxes and contributions to peasant associations) may not be intended for risk pooling. Additionally, the data only provide information on limited categories of outflows of transfers (e.g., taxes and contributions to peasant associations, educational and medical expenses households pay for members of other households, contributions to church and *iddir*, and contributions for livestock loss), and therefore the measures of the outflows of transfers may be incomplete. There-

TABLE 7
RESULTS ON TRANSFERS RECEIVED

Independent Variables	Transfers Received from Government/NGOs (1)	Income from Food-for-Work Programs (2)	Transfers Received from Mutual Support (3)
	Dependent Variables		
$s^{cov}_{vht}(\gamma_1)$	−.0015***	−.0031***	.0010
	(−3.16)	(−3.06)	(.93)
$s^{idi}_{vht}(\gamma_2)$	.0001	.0005*	−.000001
	(.48)	(1.76)	(.00)
$E_{t-1}y_{vht} - \overline{E_{t-1}y_{vt}}(\theta)$	−.0004	.0002	−.0003
	(−.89)	(.58)	(−.39)
Landless	−2.094	−2.689*	2.377
	(−1.52)	(−1.89)	(1.14)
Land quality	2.277*	−1.425	3.367**
	(1.64)	(−1.20)	(2.06)
Plant coffee	−2.879	−.662	−.328
	(−1.64)	(−.55)	(−.11)
Plant qat	−.513	−.638	1.246
	(−.41)	(−.24)	(.35)
Plant false banana	1.798	.075	−6.992*
	(1.32)	(.09)	(−1.76)
Plant eucalyptus	.611	−.232	−2.639*
	(.67)	(−.14)	(−1.73)
Female head	−1.816	−2.206	3.592*
	(−1.52)	(−1.33)	(1.95)
Head age	.069**	.036	.098**
	(2.54)	(1.17)	(2.14)
Head education	.332***	−.075	.203
	(2.63)	(−.54)	(.81)
Constant	−3.581**	−.767	−1.842
	(−1.98)	(−.43)	(−.67)
Village dummies	Not reported		
Observations	4,080	4,080	4,080
R^2	.24	.14	.05

Note. *t*-statistics shown in parentheses are based on robust standard errors.
* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.

fore, I further study the effect of the inflows of the transfers on risk pooling. I redo the regressions shown in table 6 but instead of net transfers I put the measures of transfers received on the left-hand side. Considering that there may be differences between income from food-for-work programs and other transfers received from government/NGOs, I do the regressions for them separately. The results are shown in table 7. The three columns show the results for transfers received from government/NGOs (excluding income from food-for-work programs), income from food-for-work programs, and transfers received from mutual support, respectively.

In terms of insurance, the transfers received from government/NGOs and income from food-for-work programs play a role in insuring covariant shocks (γ_1 is equal to −0.0015 with a *t*-value of −3.16 in col. 1 and equal to −0.0031 with a *t*-value of −3.06 in col. 2). Transfers received from mutual support do not contribute to insuring income shocks, as both γ_1 and γ_2 are highly insignificant in column 3. These findings are consistent with the results in table 6.

In column 2, γ_2 is significantly positive (the value is very close to zero though). This means that households with negative idiosyncratic income shocks receive less from food-for-work programs. One explanation is that, when there are food-for-work programs set up at a location suffering from covariant shocks, households suffering higher idiosyncratic shocks face more constraints to join the programs. For example, if one or more members of a household are having health problems, the household may find that it does not have extra labor to join the programs. There is no evidence in table 7 that transfers received contribute to income redistribution.

C. Results on Consumption

The measured shocks described in this article can be easily used to study how much risk is insured in total. Transfers play only a small role in risk pooling in these 15 Ethiopian villages. If getting transfers is the only strategy households use to stabilize their consumption, their consumption should move almost perfectly along with the shocks. However, this is not the case. I redo the regression shown in equation (14) but put household yearly consumption on the left-hand side instead. The results are shown in table 8. Consumption does move along with shocks since both γ_1 and γ_2 are positive. However, both coefficients significantly differ from 1. The coefficient of the covariant shock is equal to 0.500, which means that households can only insure about half of the covariant shocks. The idiosyncratic shocks are, however, well insured. Only 9% of the idiosyncratic shocks leads to variation in consumption.

V. Conclusion

This article studies the role of transfers in risk pooling and income redistribution in Ethiopia. It explores not just *whether* but *how much* risk pooling is achieved through transfers for households in ERHS villages using a regression based concept of income shocks. From a regression of net transfers on income shocks, the covariant shocks are found to be partially insured by transfers from government/NGOs. However, the impact is very limited. Transfers from mutual support do not play a role in risk pooling. There is also evidence that transfers play a role in redistributing income from richer to poorer households.

The results indicate that the aid provided through food aid and food-for-work programs does not generate much help to the ones who actually need

TABLE 8
RESULTS ON CONSUMPTION

Independent Variables	Dependent Variable: Consumption
$s_{vht}^{cov}(\gamma_1)$	.500***
	(4.71)
$s_{vht}^{idi}(\gamma_2)$	.090**
	(2.38)
$E_{t-1}y_{vht} - \overline{E_{t-1}y_{vt}}(\theta)$	1.270***
	(13.13)
Landless	−69.530
	(−.37)
Land quality	250.915
	(1.55)
Plant coffee	−412.424*
	(−1.70)
Plant qat	−583.790*
	(−1.84)
Plant false banana	−389.133
	(−1.47)
Plant eucalyptus	−73.405
	(−.46)
Female head	−481.474***
	(−3.36)
Head age	3.998
	(1.12)
Head education	31.300
	(1.05)
Constant	6,010.490***
	(19.48)
Village dummies	Not reported
Observations	4,038
R^2	.24

Note. *t*-statistics shown in parentheses are based on robust standard errors.
* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.

it. Only the covariant shocks faced by the households are found to be insured by these transfers at a very low level. Both transfers received from food-for-work programs and other transfers from government/NGOs do not seem to have a significant impact on income redistribution.

The results also provide insights in the scope for introducing formal insurance to insure shocks. Results here have shown that transfers from informal social networks do not play a role in risk pooling. Even if "crowding out" does happen when formal insurance is implemented, it will have only a very minor impact on risk pooling.

Since the results on consumption show that households insure part of the covariant shocks and most of the idiosyncratic shocks, though transfers play only a small role in insurance, savings may serve an important role in stabilizing consumption in these 15 Ethiopian villages. Therefore, the impact of savings on risk pooling is an essential question and needs further research.[19] Though most of the research on risk pooling strategies studies the impact of different strategies separately, one should notice that the impact of transfers on risk pooling is not isolated from the impact of other strategies (e.g., savings) in reality. However, evaluating the impact of the strategies jointly cannot be achieved by estimating reduced-form regressions. Further research of evaluating the impact of transfers and savings jointly by employing more sophisticated models will be very helpful in more deeply understanding the behavior of the households.

Appendix A

Estimation of the Income Function

I use feasible generalized least squares (FGLS) to estimate the income function defined in Section III.*A*.

$$y_{vht} = (\alpha_1 k_{vht-1}^{-\rho} + \alpha_2 \text{lab}_{vht-1}^{-\rho} + \alpha_3 \text{lan}_{vht-1}^{-\rho})^{-\tau/\rho} \times \exp\Big(\sum_i \eta_i a_{i,vht-1} + \sum_j \phi_j c_{j,vh} + \sum_t \psi_t l_t + \sum_p \lambda_p w_{p,vht} + \sum_q \chi_q o_{q,vht} + \text{cons} + e_{vht}\Big),$$

$$\text{lab}_{vht-1} = m_{vht-1} + \beta_1 f_{vht-1} + \beta_2 ch_{vht-1},$$

$$e_{vht} = g_{vt} + b_{vh} + n_{vht},$$

$$\text{Cov}(e_{vh,94}, e_{vh,95}) = c_1^g \sigma_g^2 + \sigma_b^2 + c_1^n \sigma_n^2 = \sigma_1^2,$$

$$\text{Cov}(e_{vh,95}, e_{vh,97}) = c_2^g \sigma_g^2 + \sigma_b^2 + c_2^n \sigma_n^2 = \sigma_2^2,$$

$$\text{Cov}(e_{vh,94}, e_{vh,97}) = c_3^g \sigma_g^2 + \sigma_b^2 + c_3^n \sigma_n^2 = \sigma_3^2,$$

[19] It should be noted from table 8 that consumption is sensitive to income shocks especially to covariant income shocks, so savings are not sufficient in stabilizing consumption in these 15 Ethiopian villages.

which can be written as:

$$\log(y_{vht}) = \left(-\frac{\tau}{\rho}\right)\log(\alpha_1 k_{vht-1}^{-\rho} + \alpha_2 \text{lab}_{vht-1}^{-\rho} + \alpha_3 \text{lan}_{vht-1}^{-\rho})$$
$$+ \sum_i \eta_i a_{i,vht-1} + \sum_j \phi_j c_{j,vh} + \sum_t \psi_t l_t + \sum_p \lambda_p w_{p,vht}$$
$$+ \sum_q \chi_q o_{q,vht} + \text{cons} + e_{vht},$$
$$\text{lab}_{vht-1} = m_{vht-1} + \beta_1 f_{vht-1} + \beta_2 ch_{vht-1}.$$

It is obvious that the parameters of this function will not be estimated efficiently and the estimators of the covariance matrix will not be valid if it is estimated by nonlinear least squares (NLS) because the error terms are correlated through g_{vt} and are also serially correlated. I use FGLS to estimate this function. The generalized least-squares estimator of this function is

$$(\log(y) - \widehat{\log}(y))^T \Omega^{-1} (\log(y) - \widehat{\log}(y)),$$

where $\widehat{\log}(y)$ is the fitted value of $\log(y)$ and Ω is the variance-covariance matrix of the error term.

The essential part of the estimation is to obtain an estimate of Ω. If two observations are from different villages their error terms are not correlated. If two observations are from the same year and village, the error terms are correlated through g_{vt}. The error terms are also serially correlated.

To get estimates of the covariance matrix, estimates of the variances of the three components of the shocks are needed. I do this by first estimating the function using NLS so I can get estimates of e_{vht} (denoted by $\hat{e}_{vht}$). After doing an NLS estimation, I perform the following steps:

1. Run a regression of $\hat{e}_{vht}$ on the village-year dummies. The fitted values from this regression are taken as the estimates of g_{vt} ($\hat{g}_{vt}$) and the residuals are taken as the estimates of $b_{vh} + n_{vht}$ ($\hat{b}_{vh} + \hat{n}_{vht}$).
2. Calculate the variances of $\hat{g}_{vt}$ and $\hat{b}_{vh} + \hat{n}_{vht}$ to get $\hat{\sigma}_g^2$ and $\hat{\sigma}_b^2 + \hat{\sigma}_n^2$ and plug these variances into the covariance matrix Ω.
3. Calculate the covariance of e_{94} and e_{95} as an estimate of $\hat{\sigma}_1^2$ and get $\hat{\sigma}_2^2$ and $\hat{\sigma}_3^2$ in the same way. Plug the variances into the covariance matrix Ω.
4. Do the FGLS estimation by using the estimate of Ω.

Appendix B

TABLE B1

RESULTS OF THE REGRESSIONS USING TABLE 3

Variables	Median Income	Constant	Observations	R^2
Government/NGOs:				
Transfers in, value	−.639	2,239.06*	45	.03
	(−1.06)	(1.76)		
Transfers in, percentage	−.00005	.175***	45	.06
	(-1.65)	(3.02)		
Food for work, value	−.338*	1,247.51***	45	.07
	(-1.83)	(3.20)		
Food for work, percentage	−.00005*	.165***	45	.08
	(-1.91)	(3.18)		
Transfers out, value	.420	555.53	45	.06
	(1.65)	(1.03)		
Transfers out, percentage	.00003	.421***	45	.01
	(.64)	(4.80)		
Friends/relatives:				
Transfers in, value	.552**	477.81	45	.09
	(2.03)	(.83)		
Transfers in, percentage	.000005	.099**	45	.01
	(.22)	(2.21)		
Transfers out, value	.656**	520.30	45	.22
	(3.51)	(1.32)		
Transfers out, percentage	.00014**	.467**	45	.32
	(4.48)	(7.13)		

Note. The *t*-statistics are in the parentheses.
* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.

TABLE B2

RESULTS OF THE REGRESSION ON CROP STORAGE

	Dependent Variable: U_{vht}	
Independent Variables	Coefficient	*t*-Statistic
$(\mathrm{cr}_{vh97} - \mathrm{cr}_{vh94})/0.5(\mathrm{cr}_{vh97} + \mathrm{cr}_{vh94}) + 1$[a]	.043***	3.28
Constant	.136***	6.69
Observations	1,461	
R^2	.007	

Note. The variable U_{vht} is defined in eq. (11).
[a] The variables cr_{vh94} and cr_{vh97} are the crops the household stored in the first and the fourth round, respectively. Dividing by the mean of cr_{vh94} and cr_{vh97} makes the expression unit free, and adding 1 makes it possible to include the observations with no crop stored in both the first and the fourth rounds.
*** Significant at the 1% level.

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