CONSUMPTION SMOOTHING AND VULNERABILITY IN FOUR RURAL VILLAGES OF ETHIOPIA[1]

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Abstract

Using year long intensive monitoring rural household survey, the study has shown that while covariant shocks lead to change in consumption patterns, idiosyncratic shocks appear to be fully insured using various copying strategies. However, households were less likely sell livestock to smooth income shock during survey periods. They seek for wage employments but are compelled to sell livestock in absence of such opportunities. Impact of changes in total household income on consumption with control for idiosyncratic shocks were also investigated and found that households are smoothing their consumption evenly across time. Further test of consumption smoothing indicated that there is a limit to insure against shocks through better-off households within communities. Disaggregating into asset poor and nonpoor, the study has also shown that asset poor households are more diversifying income sources than asset nonpoor. However, most of them have low returns; and hence they are more vulnerable than asset nonpoor households.

Keywords: *Consumption smoothing; Vulnerability; Assets poor and non-poor; Rural Ethiopia*

[1] The author thanks two anonymous referees of Ethiopian Economic association (EEA) for their very useful comments; Tadele Fereda for valuable suggestions and proof reading of this version; Dr. Mulat Demeke for his motivation and providing the data; and Liyusew G/Medhin for proof reading of previous version. All errors are my own.

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1. Introduction

Developing economies are widely characterized by low and volatile incomes and incomplete markets for most goods and services (Townsend, 1995). The former together with poor development of financial or risk-sharing institutions make consumption smoothing an important issue in low-income countries like Ethiopia. According to World Bank's (2000) report, these countries are vulnerable to shocks that lead to reduction in welfare of the poor. The Millennium Development Goals (MDGs) is intended to reduce the incidence of poverty by halve between 1990 and 2015.

The shocks may be idiosyncratic (household specific i.e., affecting individual household) and/or covariate (affecting groups of households, communities, regions, or nations). While idiosyncratic risks include shocks associated with income failure, illness, shortage of agricultural inputs, etc., covariate risks include uncertainties associated with nature, markets (both input and output), social unrest, and policy and institutional failures (Weinberger and Jütting, 2000).

The types of shocks experienced affect the extent to which consumption can be smoothed. If the risks experienced are idiosyncratic, it can be smoothen through mechanisms that allow households to rely on others to share the repercussions of such shocks. However, if the shocks are common across group members, then it is covariate and cannot be insured or smoothed out by those within group, because no household experienced gains that could be shared (see Townsend, 1995; Morduch, 1999 and Skoufias and Quisumbing, 2003). Understanding the natures of these vulnerabilities and informal as well as formal coping mechanisms that may mitigate shocks are a first step in establishing effective social protection programs or safety net systems (Skoufias and Quisumbing, 2003; Harrower and Hoddinott, 2004).

Households in low-income economies use various coping strategies to reduce or mitigate both income and consumption risks (Morduch, 1999) though incomplete markets or poor development of risk-sharing institutions make a distinction of their economies (Townsend, 1995). Households in a community, for instance, may informally agree to insure each other or provide state contingent transfers and remittances to friends and neighbors (Rosenzweig, 1988; Besley, 1995 and Morduch, 1999), use their savings (Paxson, 1992), take loans from the formal financial sectors during difficult times (Udry, 1994), sell assets (Deaton, 1992), send their children to work instead of school to supplement income (Jacoby and Skoufias, 1998), enter into new-income generating activities (Harrower and Hoddinot, 2004) or undertake ex-

ante income smoothing strategies and adopt low-return, low-risky crop and asset portfolios (Rosenzweig and Binswanger, 1993).

While, on aggregate, a community may have developed sufficient mechanisms, and effectively smoothing consumption, there may be segments of the community excluded from participating, and they may, therefore, be vulnerable. Thus, exploring differences in household characteristics and characteristics of particular coping mechanisms employed helps to reveal the nature and extent of consumption smoothing of villages (Harrower and Hoddinot, 2004). Discovering who is the most vulnerable within a community by examining the abilities of groups to smoothen their consumption relative to each other could help governments and donors to ensure that adequate coverage within the community occurs.

This study explores strategies used by rural households in Ethiopia to mitigate consumption shortfalls caused by shocks. This is not the first lesson on this topic. For instance, using panel data of three/four rounds[3] and relying on recall of household total consumption and income for "*last four months*" before survey, Dercon and Krishnan (2000) and Skoufias and Quisumbing (2003) have conducted a similar analysis on Ethiopian rural households. However, to my knowledge, a year long intensive monitoring panel data nature has never been conducted so far. This study tries to bridge research gaps by investigating character of such types of data collected at fortnight day's interval for at least one year during the course of entire survey period. In section 2, the theoretical framework is briefly described. Section 3 describes the source of data and basic descriptive statistics. While section 4 discusses basic findings, section 5 summarizes and concludes.

2. Theoretical framework

The model for consumption smoothing is developed based on the theory of full insurance initiated by Arrow (1964) and others (see Townsend, 1995). The theory of full insurance states that if households are risk averse, markets are complete, or if there are second best institutions that pool risks to achieve Pareto-optimal allocation, marginal utility of consumption across households will be equalized. This implies that the growth in household consumption will respond to the growth in village level (aggregate) consumption but not to idiosyncratic shocks or variation in income. Technically, this means that the functioning of risk sharing institutions will mitigate idiosyncratic shocks and equalize the marginal utility of consumption across

[3] This included two survey rounds in 1994 (1994a and 1994b) and; a round of data collection in 1995 and 1997.

households within a village (see Deaton, 1992; Morduch, 1995 and Gertler and Gruber, 1997).

Imagine that a central planner of a village with N number of households tries to maximize the sum of life time utilities of members subject to the village level resource constraints, uncertainty, and predetermined social weight. Let via central planner, each household j get Pareto-share ω_j of aggregate income, with $\omega_j > 0$, $\forall j$ and $\sum \omega_j = 1$. And also let C_{jt} be consumption of household *j* at time *t* and λ_t the Lagrange multiplier associated with aggregate resource constraint at time *t*. If we assume twice continuously differentiable utility functions with U'>0 and U"<0, then, following Mace (1991), Cochrane (1991), Altonji et al. (1992), Townsend (1994) and Dercon and De Weerdt (2002), we can write the first order condition of this problem as

$$U'(C_{jt}) = \frac{\lambda_t}{\omega_j} \qquad \textbf{(1)}$$

The differenced logarithmic equivalent is given by:

$$\Delta \ln(C_{jt}) = \Delta \ln \lambda_t \qquad \textbf{(2)}$$

Equation (2) states that if optimal insurance is attained, then the growth of marginal utility of consumption in a given period should be equal for all households. For any two households i and j in a village, we can substitute away λ_t in (1) and write the first order condition as:

$$\frac{U'(C_{jt})}{U'(C_{it})} = \frac{\omega_i}{\omega_j} \qquad \textbf{(3)}$$

Equation (3) shows that the marginal utility of each household's consumption reflects its Pareto weight in the village. Following Deaton (1997) and Gertler and Gruber (2002), assume that within-period preferences are of the constant relative risk aversion type and can be represent by

$$U(C_{jt}) = (1-\rho)^{-1} \pi_{jt} n_{jt} \left(\frac{C_{jt}}{n_{jt}} \right)^{1-\rho} \qquad \textbf{(4)}$$

π_{jt} accounts of inter-temporal needs of households which are not already captured by household size, n_{jt}. Plugging (4) into (3), taking logarithms and rearranging terms give

$$\ln\left(\frac{C_{jt}}{n_{jt}}\right) = \ln\left(\frac{C_{it}}{n_{it}}\right) - \rho^{-1}\left(\ln \pi_{it} - \ln \pi_{jt}\right) - \rho^{-1}\left(\ln \omega_i - \ln \omega_j\right) \quad \textbf{(5)}$$

Equation (5) holds across all the N-1 community that household j belongs. Adding up these N-1 equations yields the following (Bardhan and Udry, 1999):

$$\ln\left(\frac{C_{jt}}{n_{jt}}\right) = \overline{C}_{Nwt} - \rho^{-1}\left(\frac{1}{N-1}\sum_{i=1}^{N-1}\ln \pi_{it} - \ln \pi_{jt}\right) - \rho^{-1}\left(\frac{1}{N-1}\sum_{i=1}^{N-1}\ln \omega_i - \ln \omega_j\right) \quad \textbf{(6)}$$

where $\overline{C}_{Nwt} = \frac{1}{N-1}\sum_{i=1}^{N-1}\ln\frac{C_{it}}{n_{it}}$ or average (logarithm of) village consumption at time *t*. Note that the final term in equation (6) is a time invariant fixed effects that can be purged out by taking first difference.

$$\Delta \ln\left(\frac{C_{jt}}{n_{jt}}\right) = \Delta\overline{C}_{Nwt} - \rho^{-1}\Delta\left(\frac{1}{N-1}\sum_{i=1}^{N-1}\ln \pi_{it} - \ln \pi_{jt}\right) \quad \textbf{(7)}$$

Equation (7) implies that under full insurance risk sharing hypothesis, household resources are uncorrelated with shifts in preferences, and this does not affect consumption growth once aggregate resources are controlled for. Numerous studies have made use of equation (7) to test the full insurance hypothesis at village level.

The version of equation (7) that is more commonly encountered in the empirical literature (e.g., see Ravallion and Chaudhuri, 1997 and Jacoby and Skoufias, 1998) is of the form:

$$\Delta \ln C_{jtv} = \sum_{tv}\theta_{tv}(VD_{tv}) + \beta\Delta \ln Y_{jtv} + \varphi\Delta X_{jtv} + \Delta\varepsilon_{jtv} \quad \textbf{(8)}$$

where $\Delta \ln C_{jtv}$ and $\Delta \ln Y_{jtv}$ denote changes in log per capita consumption and change in log per capita income of household *j* at time *t* in community *v,* respectively; VD_{tv} is a vector of village dummies interacted by survey period to capture all common shocks at village level; X_{jtv} is a vector of time varying household characteristics; θ_{tv}, β

and φ are parameters to be estimated; and $\Delta\varepsilon_{jtv}$ is household specific error terms capturing changes in unobservable components of household preferences. This specification is used to test the extent of consumption smoothing achieved within a community by regressing changes in individual household income against changes in individual consumption, while controlling for the effects of covariate shocks.

Following the same general approaches, Dercon and Krishnan (2000), Skoufias and Quisumbing (2003) and Harrower and Hoddinott (2004) used shocks instead of income. Their measure of vulnerability is basically determined by the coefficient of shock variables estimated from a regression equation such as:

$$\Delta \ln C_{jtv} = \sum_{tv} \theta_{tv}(VD_{tv}) + \phi \Delta S_{jtv} + \varphi \Delta X_{jtv} + \Delta \varepsilon_{jtv} \qquad \textbf{(9)}$$

where S is a set of dummy variables indicating the occurrence of idiosyncratic household shocks; ϕ is parameter to be estimated, and all other variables and parameters retain definitions given in equation (8). In equation (9), parameter ϕ provides an estimate of the extent to which idiosyncratic income shocks plays a role in explaining household specific consumption smoothing[4]. The expected value of ϕ is zero when the shock has no explanatory power in explaining household consumption.

Moreover, the effect of changes in household and village average income against household consumption is estimated by:

$$\Delta \ln C_{jtv} = \beta \Delta \ln Y_{jtv} + \gamma \Delta \left(\overline{\ln Y_{tv}} \right) + \varphi \Delta X_{jtv} + \Delta \varepsilon_{jtv} \qquad \textbf{(10)}$$

where $\Delta\left(\overline{\ln Y_{tv}}\right)$ denotes change or growth rate in average village income at period t of village v, γ *is a parameter to be estimated* and all other variables are as previously defined. This specification allows the growth rate in household consumption to be determined by the growth rate in household income as well as the growth rate in average income, denoted by $\Delta\left(\overline{\ln Y_{tv}}\right)$.

[4] This is equivalent to imposing the restriction that θ_{tv} and φ equal zero

If specific idiosyncratic income shocks appear to have little effect on consumption, the way in which households react to such shocks can be explored by using a similar specification as indicated in equation (9). In such cases, the effect that income shock has on the probability that a household will engage in particular coping strategy is tested. A series of binary variables can be used to signifying whether household reported, or has been undertaken a particular coping strategy during a given period. Whether experiencing an income shock increased the likelihood that households pursued specified strategies is estimated using a fixed effects logit model of the form:

$$prob\left(CS_{jtv}=1\right)=\frac{\exp\left(\mu_j+\phi S_{jtv}+\varphi x_{jtv}\right)}{1-\left(\mu_j+\phi S_{jtv}+\varphi x_{jtv}\right)} \qquad \textbf{(11)}$$

The equation in (11) takes into account the role of household-specific, time invariant observed and unobserved factors (μ_j). Here, CS_{jtv} denotes the use of any variety of coping strategies related to activities such as livestock sales, food/crop received through food for work, credit, remittance, food/crop received from friends or relatives within communities. Using equation (11), separate fixed-effects regressions can be employed for each of the dependent variables. Households whose value of CS_{jtv} does not vary across rounds (visits) are dropped from the estimation. And where the shock has no explanatory power for households that adopted the coping strategy, the expected value of ϕ is zero.

Finally, whether certain groups of communities within villages are better able to smooth consumption relative to their reference groups in the face of idiosyncratic income shocks are estimated by:

$$\Delta \ln C_{jtv}=\sum_{tv}\theta_{tv}(D_{tv})+\beta\Delta\ln y_{jtv}+\psi Z+\delta\left(Z*\Delta\ln y_{jtv}\right)+\varphi\Delta x_{jtv}+\Delta\varepsilon_{jtv} \qquad \textbf{(12)}$$

where Z is a binary variable to identify those households possessing the characteristics of examination. The magnitude and sign of the ð coefficients indicate whether there is higher or lower covariation between income and consumption changes in the group of examination relative to its reference group.

3. Data source and basic descriptive statistics

The database for this study has come from Year-Long Intensive Monitoring survey (second part of 5th round Ethiopian Rural Household Panel data Survey) conducted in

1999/00-2000/01 by Economics Department of Addis Ababa University (AAU) in collaboration with USAID/Ethiopia. While the first part of 5th round covers a one-shot household surveys in 18 villages and covered 1,685 households, the second part was designed to record transactions and activities as they occur instead of recall as in the first part. In that regard 4 villages namely, D/Brehan, Yetmen, Eteya and Azedebo out of 18 were purposely selected to be representative of teff (Yetmen), wheat (Eteya), and perennials (Azedebo) crops production and animal husbandry as major integral to their farming systems (D/Brehan). From each village 62 households were considered (as they were in the original panel data survey) that yields a total sample size of 247 households[5]. The first visit (survey) was conducted in April, just at the beginning of first plough. So as to make the data more reliable, each household was re-visited 25 times during the course of the entire survey periods, or once every two weeks for a period of one year (see Annex I).

The survey provides information on consumption income, land and labor use, asset ownership and numerous demographic characteristics. Furthermore, information on shocks[6] (exogenous) events such as rainfall shock[7] and crop shock[8], loss of productive time related to religions, funeral and feasts ceremonies, and illness is included. Table 1 shows, along with some basic descriptive data for the sample, that such shock are common. Approximately, more than 40 percent of sample households, except Azedebo, faced rainfall shock and loss of productive time due to religions, funerals, feast, etc., ceremonies. Reported crop shock ranges between 11 percent in D/Brehan to 64 percent in Yetmen. For almost more than a quarter of sample households at least one economically active member loss productive time due to illness for more than 7 working days. Lack access to extra employment opportunities[9]were reported by 70 percent of the sample households and it became remarkable in Yetmen and Azedebo where more than 80 percent of sample households have no such opportunities (Table 1).

[5] One household is dropped due to incomplete information.

[6] All data on shocks are self-reported.

[7] It is a shock for either too much, quite a lot, not enough, far too little etc., rain for crop involved or no rain when it should have to rain.

[8] It is a shock when crops were affected either by frost/low temperature, wind/storm, water logging/flooding, parasites/plant diseases, insects, livestock trampling/eating and birds/other animals/or weeds problems and resulted in either noticeable damage to crops, significant loss to crops, major loss of crops and/or causes total crop failure.

[9] Interested in working extra, but no casual wage employment or food-for-work program, credit needed but not acquired from relatives or government and/or fertilizer, chemicals and improved seed needed but not available to buy on time etc. However, only interested in working extra but no wage employment or food-for-work program shocks are used in the regression analysis.

On average, household heads aged over mid-forty with regular family sizes ranges between 5 and 8 (Table 1). Household members are less practicing migrating-out/in for possible jobs opportunities during surveys period as changes in family size between surveys (visits) indicate only very slight change. Females are heads for 17 percent of sample households, which account for 16 percent in D/Brehan, Yetmen and Eteya and 23 percent in Azedebo. Majority of sample households (about 60 percent) are asset poor[10], as measured by livestock holding[11]. The figures account for more than 90 percent in Azedebo and 70 percent in Yetmen in contrast to only 20 percent in D/Brehan (Table 1).

As a means of income diversification, households usually diversify to non-crop incomes. These income generating schemes were mostly concentrated (45 to 65 percent) to food gifts from families and/or friends; and livestock/livestock product sales (see annex II). Petty trade, agricultural and nonagricultural wage labor and services accounted for less than 20 percent of non-crop income. The returns from noncrop income are very low, however. For instance, the net income from sale of livestock was only averaged 1000 Birr per year in D/Brehan, where it was the second important line of activity. It was less than 800 Birr in other villages; and even gets worse in Yetmen. Other non-crop income such as loan, remittances/transfers received are limited to less than, on average, 300 Birr per a year (Table 1).

Food and nonfood consumption in the villages were also very small, with biweekly total real per capita consumption[12] floating between 20 and 35 Birr (i.e., 1.50 to 2.50 Birr per capita per day). The largest share was per capita food consumption, over 70 percent, followed by nonfood consumption and others (gifts, remittances and transfers) (see annex IV). Furthermore, food consumption across visits varies by less than 10 percent while nonfood consumption is considerably more volatile (see Fig. 1). Thus, this seems to suggest that households try to smooth food consumption across time.

[10] Asset nonpoor households have livestock holdings in the top two quintiles and asset poor households have livestock holding in the bottom three quintiles (see Annex III).

[11] Equivalently measuring land holding can also be used.

[12] All consumption and income data are deflated using fixed basket indices approach at May 2000 D/Brehan market prices

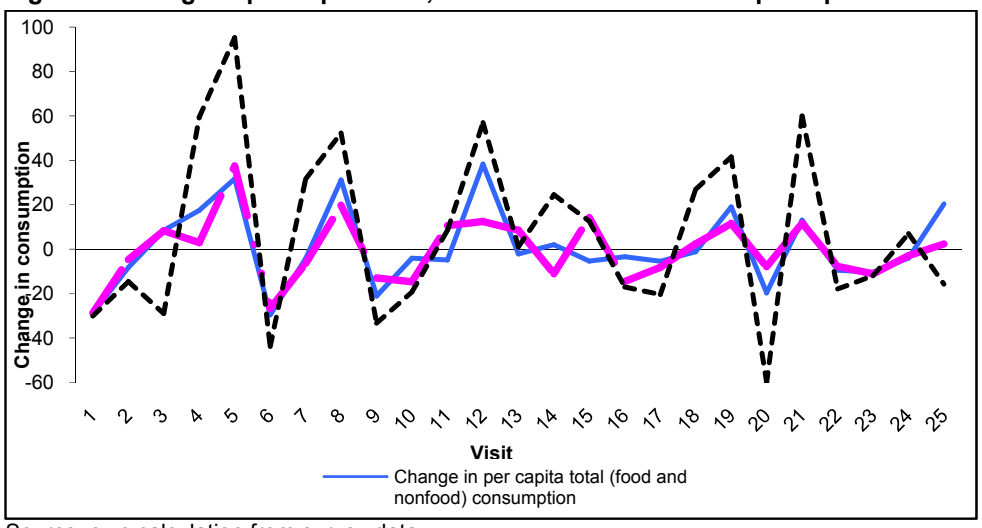
Table 1: Means and standard deviations of household characteristics

	Whole sample	Villages			
		Deberebrehan	Yetmen	Eteya	Azedebo
Household characteristics					
Age of household head (in years)	47.53	52.21	47.02	45.69	45.21
	(14.45)	(15.24)	(16.00)	(13.12)	(12.41)
Household size, Visit (1- 5)	6.79	6.08	5.28	8.18	7.61
	(2.79)	(1.57)	(2.34)	(3.33)	(2.63)
Change in household size between visits	-0.19	-0.16	-0.07	-0.60	0.05
	(0.97)	(0.75)	(0.54)	(1.26)	(1.06)
Household head dummy: 1 if female household head; 0 otherwise	0.17	0.16	0.16	0.15	0.23
	(0.38)	(0.37)	(0.37)	(0.36)	(0.42)
Education of head	0.38	0.18	0.25	0.53	0.58
	(0.49)	(0.39)	(0.43)	(0.50)	(0.50)
Asset nonpoor dummy: 1 if households have livestock holding in the top two quintiles; 0 otherwise	0.40	0.80	0.25	0.48	0.05
	(0.49)	(0.41)	(0.44)	(0.50)	(0.21)
Asset poor dummy: 1 if household have livestock holding in bottom three quintiles; 0 otherwise	0.60	0.20	0.75	0.52	0.95
	(0.49)	(0.41)	(0.44)	(0.50)	(0.21)
Income shock to household					
Rainfall shock dummy: 1 if unbalanced rainfall on plots; 0 otherwise	0.38	0.49	0.41	0.42	0.20
	(0.24)	(0.16)	(0.24)	(0.30)	(0.12)
Crop shock index dummy:1 if shock index is>=25%; 0 otherwise	0.34	0.11	0.64	0.40	0.21
	(0.34)	(0.16)	(0.30)	(0.39)	(0.20)
Loss of productive time due to religions, funerals etc., ceremonies dummy: 1 if loss; 0 otherwise	0.41	0.69	0.42	0.47	0.07
	(0.24)	(0.08)	(0.10)	(0.10)	(0.05)
At least one active member of household loss productive time due to illness dummy: 1 if loss; 0 otherwise	0.32	0.33	0.24	0.31	0.40
	(0.28)	(0.25)	(0.34)	(0.28)	(0.26)
Lack of market opportunities dummy: 1 if Interested in working but no wage employment opportunities etc; 0 otherwise	0.70	0.47	0.92	0.54	0.85
	(0.46)	(0.50)	(0.27)	(0.50)	(0.35)
Income from sales, loan, remittances, transfer payments, gift etc					
Net income from sales of livestock/livestock products (in Birr)	757.21	1038.06	493.02	788.70	618.99
	(1017.14)	(1001.83)	(518.49)	1492.1	(698.41)
Loan (in Birr)	153.36	192.42	72.46	126.64	220.63
	(404.87)	(664.12	(196.62)	248.96	(326.44)
Remittances, transfer or gift received (in Birr)	257.93	309.61	138.76	381.31	200.14
	(243.07)	(192.99)	(103.85)	(309.65	(242.37)

Source: Own calculation from survey data

Note: Values in the parentheses are standard deviations

Figure 1: Change in per capita food, nonfood and total consumption per visit



Source: own calculation from survey data

4. Consumption smoothing and vulnerability: discussion of basic findings

In this section, we first examine whether the incidence of self-reported idiosyncratic shocks have a significant impact on household consumption. It is followed by investigating how households protect consumption against idiosyncratic shocks through examining the coping strategies they employ and then explore whether all idiosyncratic shocks as represented by changes in total income affect consumption. Finally, it examines which groups are relatively more vulnerable as a result of changes in income.

Empirical results of estimating equation (9) are presented in Table 2[1]. Five proxy variables are used for income shock[2]: rainfall and crop shocks, extra wage employment opportunities including food-for-work at least one members of household loss productive time due to illness and own labor use for productive activities (in person days).

[1] Outline of Huber (1967) and White (1980) methods are used to correct standard error for heterosckedesticity

[2] There is statistically significant difference between mean of real log total expenditure for all shocks reported (see Annex III).

When only these idiosyncratic income shocks regressed against change in real total consumption (see column 1 of Table 2), only changes in log of own labor use for productive activities (in person days) appears to have a positive effect on consumption. It indicates that an increase in own labor use increases total real household expenditure by 13 percent. However, when progressively controlling for the representation of village common shocks (covariate shocks), the significance of the coefficient (including the coefficient of other idiosyncratic shocks) is not everlasting (see columns 2 and 3).

The coefficients of covariate shocks are statistically significant (as shown by F-statistic) implying that covariate shocks explain variations in consumption over time (see columns 2 and 3). The key finding of this paper is that the specified idiosyncratic shocks have little significant impact on consumption in the study settings. By contrast, covariate shocks appear to be very important in explaining fluctuations in consumption (see column2). For instance, loss of productive time due to religions, feast, funerals etc., and other ceremonies affect total consumption at 10% of level of significance[3]. Similar results are obtained by including other socioeconomic characteristics (see Table 2 column 3).

When household fixed-effect regression is employed, lack of market opportunities for wage employment decreases real per capita total consumption by 10 percent, but change in log of own labor input for productive activities (in person days) has the effect of increasing real consumption per capita by about 3 percent (see Table 2 column 4). In addition, the regression is controlled for age-sex compositions (only significant one are reported). For instance, family size of households, female headed household, male and female household members aged 11- 15 and male household members aged 16-64 are among controlled variables influencing consumption expenditure significantly (see Table 2 column 3).

[3] Households' labor endowment is controlled by including own labor used (in person days) in the regression.

Table 2: Least squares determinants of change in real total per capita consumption

	(1) Income shocks	(2) Idiosyncratic and village common shocks	(3) Idiosyncratic, common shocks and socioeconomic characteristics	(4) Household fixed effects regression
Income shocks				
Rainfall shock dummy: 1 if rainfall shock (unbalanced rainfall per plot) is reported; 0 otherwise	0.074	0.150	-0.195	0.014
	(0.49)	(1.01)	(1.49)	(0.46)
Crop shock dummy: 1 if severity of crop affected shock index per plot is >=25%; 0 otherwise	0.130	-0.085	0.018	0.047
	(0.53)	(0.35)	(0.08)	(0.81)
Illness shock dummy: 1 if at least one active member of household loss productive time due to illness; 0 otherwise	-0.128	-0.117	0.024	0.028
	(1.16)	(1.10)	(0.25)	(1.13)
Lack of market dummy: 1 if interested in working but no wage employment opportunities; 0 otherwise	-0.045	-0.147	-0.050	-0.110
	(0.42)	(1.37)	(0.48)	(3.36)***
Change in log of own labor input in person days	0.131	0.003	0.047	0.034
	(2.37)**	(0.05)	(0.83)	(2.90)***
Villages dummies interacted with round (F-test)				
Change in log share of number of days not worked due to religious etc ceremonies		1.68*	1.89*	
Autumn (Fall) season (Sep. - Nov.)		0.99	4.08***	
Winter season (Dec. - Feb.)		2.99***	1.42	
Spring (Vernal) (March- May)		3.33***	2.90**	
Socioeconomic characteristics				
Age of household head (in years)			-0.000	-
			(0.12)	
Education level of household head			0.001	-
			(0.38)	
Family size of households			0.003	0.021
			(2.26)**	(1.27)
Household head sex dummy: 1 if female headed			0.027	-
			(3.77)***	
Total number of male hh member aged between 11 and 15 years			-0.005	0.006
			(2.73)***	(0.48)
Total number of female hh member aged between 11 and 15 years			-0.004	-0.008
			(1.93)*	(0.51)
Total number of male hh member aged between 16 and 64 years			-0.001	-0.001
			(1.62)	(0.21)
Constant	0.009	0.192	0.135	-0.130
	(3.21)***	(3.61)***	(2.70)***	(1.15)
Number of observations	6175	6175	6175	6175
Number of groups (sample size)	247	247	247	247
F-statistic	1.88	4.00***	3.41***	2.28**

Note: Dependent variable is change in log real per capita consumption (food, nonfood and value of gifts received) between rounds (visits). Absolute value of t-statistics is in parentheses. *= significant at 10%; **= significant at 5% and ***= significant at 1%. Standard errors are corrected for heteroscedasticity using Huber-While methods.

4.1 Income risk and household coping mechanisms

As specific idiosyncratic shocks have little impact on consumption, exploring the coping strategies used by households are essential. There is no single coping strategy used by households in response to idiosyncratic income shocks; rather a portfolio of strategies is employed. Table 3 reports the effect of a shock on the likelihood of a household adopting a response to an idiosyncratic shock for the full sample and for a disaggregated sample of asset-poor and asset non-poor households using equation (11). The result reported has shown that rainfall and illness shocks increase the probability that the household reports food/crop received through food-for-work and credit as survival strategy. When examining these shocks across wealth classification, while both groups were significantly more likely used these strategies for rainfall shock, only asset poor household use such coping strategies for illness shock.

Likewise, while crop shock increases the likelihood that households engaged in food/crop received through food-for-work, lack of market for wage employment increases the opportunities that households use credit as endurance strategies. Further examination of these shocks across asset non-poor and asset poor households shows that while both groups are more likely to have food/crop received through food-for-work for a crop shock, only asset poor households are more likely to have credit for lack of wage market shock. On the other hand, households that experience idiosyncratic income shocks related to crop failures are less likely to use credit for whole sample, asset poor and asset non-poor households.

Table 3 has also shown that households are less likely to sell livestock/livestock products to smooth rainfall and crop shocks for sample as whole, asset poor and non-poor households during the surveys period. However, they sell livestock/livestock products if the shock is due to lack of wage employment opportunities. This implies that at incidence of such shocks, households tend to seek for wage employment opportunities but are compelled to sell livestock/livestock product only in the absence of such opportunities. More likely smoothing of rainfall and crop shocks through food-for-work program further strengthened the evidence. Moreover, since food-for-work program is also part of wage employment, its absence is less likely used to smooth income shock of wage employment for the sample as a whole and for asset poor households.

Remittance and food aids from relatives or friends within community are other coping strategies. Asset poor households are more likely to receive remittance for rainfall shock and food aids for crop shock. In contrast, asset poor and non-poor households are less likely to receive food aids and remittance as a result of lack of market opportunities,

respectively. In general, asset poor households are looking for different coping strategies to income shocks observed as compared to asset non-poor households. Thus, asset poor households are more vulnerable to consumption expenditure.

Table 3: Household fixed effects Logit estimates of household coping responses to idiosyncratic shocks.

	Income shocks				
	Rainfall shock on plots	Crop shock index dummy (1 if >25%)[1]	Interested in working, but no wage employment etc	At least one member of the household lost productive time due to	Number of groups
Sales of Livestock					
Household had livestock sales dummy: 1 if yes; 0 otherwise	-0.961** (10.87)	-0.797** (7.69)	1.041** (9.16)	0.025 (0.26)	221
Asset poor	-0.760** (6.01)	-0.753** (5.41)	0.781** (5.15)	0.021 (0.17)	131
Asset nonpoor	-1.137** (9.31)	-0.852** (5.49)	1.353** (7.88)	0.032 (0.21)	90
Food/crop received through food for work					
Household had food/crop through food for work programs: 1 if yes:	1.026** (5.86)	0.595** (2.70)	-0.403* (1.63)	0.402** (1.95)	80
Asset poor	1.254** (5.52)	0.527** (1.89)	-0.556* (1.80)	0.404** (1.99)	63
Asset nonpoor	0.706** (2.60)	0.711** (1.97)	-0.143 (0.37)	0.204 (0.54)	27
Credit					
Household had credit received for consumption: 1if yes	0.506** (4.92)	-0.634** (4.92)	0.539** (3.90)	0.434** (3.97)	112
Asset poor	0.507** (4.14)	-0.690** (4.57)	0.687** (4.19)	0.549** (4.46)	83
Asset nonpoor	0.503** (2.66)	-0.473** (1.94)	0.131 (0.48)	-0.006 (0.03)	29
Remittance					
Household had remittance since last visit: 1 if yes	-0.083 (1.10)	-0.099 (1.15)	-0.103 (1.03)	-0.082 (0.93)	247
Asset poor	0.348** (3.23)	-0.151 (1.34)	0.064 (0.50)	-0.031 (0.29)	151
Asset nonpoor	-0.198* (1.85)	-0.024 (0.18)	-0.349** (2.18)	-0.172 (1.15)	96
Food/crop gift received within community					
Household had food/crop received as gifts from relatives/friends within community: 1 if yes	-0.384 (1.39)	0.427 (1.55)	-0.688* (1.81)	0.316 (1.18)	66
Asset poor	-0.445 (1.16)	0.948** (2.84)	-1.625** (3.23)	0.483 (1.50)	40
Asset nonpoor	-0.313 (0.78)	-0.787 (1.25)	0.477 (0.99)	-0.049 (0.10)	26

[1] Statistical significant test for cut points and all self reporting shocks are reported (see Annex III).

Notes: Household size, age-sex compositions are included in the regression but insignificant. Z-values reported in brackets. *= Significant at 10%; **= Significant at 5%. I estimated 60 separate logit equations i.e., three separate logit equations for each shock versus coping mechanisms by whole sample, asset poor and asset nonpoor.

4.2 Household non-crop income diversification

This section is intended to explore whether shocks induced households enter into non-crop activities and this is done by disaggregating the sample into poor and non-poor households. Although virtually all households are farmers and have access to land, they do also participate in other non-crop income diversification activities in responses to shocks (this does not, of course, necessary mean that the decision of households to diversify income is after the occurrence of crop failure). These include agricultural and non-agricultural wage employment, livestock and petty trade, crafting, etc., (see Table 4).

Table 4 has shown that crop failure shock increases the likelihood that poor households reported income from agricultural and non-agricultural wage laborer. Moreover, asset poor households were more likely to undertake petty trade activity as a result of rainfall and illness shocks. Meanwhile, the likelihood of earning through livestock trade increased for wage employment shock, but decreased for rainfall and crop shocks at all levels.

Lack of wage employment opportunities increases the likelihood of households to undertake crafting, making and selling of charcoal activities. These activities are less likely undertaken for rainfall shock (see Table 4). This implies that when there is rainfall shock, households first seek for wage employment and if it is unavailable they would look for crafting activities. This is probably due to culturally abused prerogatives given to craftsmen, and it is also less profitable.

Generally, asset poor households are more likely to enter into different activities as responses to income shocks. However, most of them have low returns and are remedies for only short period. This consecutively implies that asset poor households are more vulnerable than asset non-poor households.

Table 4: Household fixed effects logit estimates of household income diversification

	Income shocks				
	Rainfall shock on plots	Crop shock index dummy (1 if >= 25%)	Interested in working, but no wage employment etc	At least one member of the household lost productive time due to illness	Number of groups
Agricultural wage laborer	-0.100	0.189	-0.269	-0.367	
	(0.23)	(0.46)	(0.48)	(0.70)	18
Asset poor	-1.094	1.527**	0.683	-0.592	
	(1.56)	(1.91)	(0.90)	(0.90)	13
Asset nonpoor	0.937	-0.366	-0.125	0.055	
	(1.45)	(0.69)	(0.20)	(0.07)	5
Non-agricultural wage laborer	0.244	0.591**	0.319	-0.008	
	(1.46)	(3.32)	(1.53)	(0.04)	71
Asset poor	0.226	0.618**	0.300	0.014	
	(1.11)	(2.95)	(1.26)	(0.07)	48
Asset nonpoor	0.282	0.518	0.381	-0.070	
	(0.96)	(1.54)	(0.88)	(0.19)	23
Livestock trade	-0.961**	-0.797**	1.041**	0.022	
	(10.88)	(7.69)	(9.16)	(0.23)	221
Asset poor	-0.762**	-0.753**	0.781**	0.012	
	(6.02)	(5.42)	(5.15)	(0.12)	131
Asset nonpoor	-1.137**	-0.852**	1.353**	0.033	
	(9.31)	(5.49)	(7.88)	(0.21)	90
Petty trade (e.g. grain etc)	0.237	-0.115	-0.316	0.256*	
	(1.54)	(0.69)	(0.15)	(1.69)	84
Asset poor	0.294*	-0.205	-0.383	0.393**	
	(1.69)	(1.08)	(0.17)	(2.32)	65
Asset nonpoor	0.033	0.198	0.013	-0.312	
	(0.10)	(0.57)	(0.02)	(0.86)	19
Crafting, making and selling of charcoal	-0.209	0.207	1.124**	-0.195	
	(1.19)	(1.08)	(5.56)	(1.03)	92
Asset poor	-0.428*	0.299	2.449**	-0.773	
	(1.85)	(1.32)	(7.18)	(0.35)	46
Asset nonpoor	0.101	-0.328	-0.428	-0.531	
	(0.38)	(0.09)	(1.16)	(1.34)	46
Food gift from families, friends etc	-0.012	-0.217	-0.171*	0.023	
	(0.16)	(0.26)	(1.79)	(0.30)	247
Asset poor	-0.161	-0.573	-0.078	0.083	
	(1.60)	(0.53)	(0.63)	(0.78)	151
Asset nonpoor	0.145	0.022	-0.296**	-0.115	
	(1.41)	(0.18)	(1.97)	(0.83)	96

Notes: Household size, sex-age compositions are included in the regression but insignificant. Z-values reported in brackets. *= Significant at 10%. **=Significant at 5%. I estimated 72 separate logit equations i.e., three logit equations are estimated for each shock versus income diversification by whole sample, asset poor and asset non-poor).

4.3 Further tests of consumption smoothing

In the regression analysis, we have shown that households whose consumption experienced idiosyncratic shocks are insured against through different coping strategies. This section investigates how income changes are transmitted to consumption changes. It complements the previous section by investigating further the nature of consumption smoothing by examining household attributes associated with such vulnerability.

Equation (8) treats the stronger version of consumption smoothing and the impact of changes in total household income on changes in consumption with controls for covariant shocks term. Specification (1) reported in Table 5 shows that the coefficient of changes in income given income shocks is statistically not significant for all sample, asset poor and non-poor households. Thus, households attempt to spread resources to smooth consumption evenly across time through the use of mechanisms that reduce or mitigate income shocks, or those that help them cope with the effects of such shocks. In other words, a household allocates proportionally equal budget every period as insurance, through different coping strategies.

Table 5: The impact of changes in log household per capita income on log household per capita consumption
(Dependent variable: change in log per capita household consumption)

	Parameters estimate			
	(1)	**(2)**		**Sample size**
Sample	$\Delta \ln y_{jtv}$	Positive $\Delta \ln y_{jtv}$	Negative $\Delta \ln y_{jtv}$	
Full sample	0.020	0.059*	0.118**	247
	(0.43)	(1.62)	(3.54)	
Asset poor household	0.031	0.014	0.136**	151
	(0.50)	(0.30)	(3.08)	
Asset nonpoor household	0.022	0.104*	0.076	96
	(0.31)	(1.83)	(1.42)	
F-test				
Test 1: full sample			0.67 (p=0.41)	
Test 2: Asset poor			0.17 (p=0.67)	
Test 3: Asset nonpoor			1.36 (p=0.28)	

Notes: * = significant at 10%. ** = Significant at 5%. Absolute value of t-statistics is in the parentheses. Standard errors are corrected for heteroscedasticity using Huber-white methods.

Treating positive and negative shocks symmetrically further strengthens the finding by assuming that positive and negative shocks have the same impacts. Specification

(2) takes this into account, including positive and negative shocks as separate regressions. While the coefficients on negative shocks are large in magnitude for full sample and asset poor households, the hypothesis that positive and negative income shocks have statistically different impacts on changes in consumption is rejected, indicating positive and negative shocks have equal effects in all cases[1].

4.4 Partial consumption insurance

Partial consumption insurance tests the effects of growth rate in average income on household expenditure. Using equation (10), the top panel of Table 6 provides regression estimates of average income against household consumption for all households and disaggregation based on wealth. Neither for the sample as a whole nor based on wealth disagregation is the coefficients of average incomes significantly different from zero in explaining consumption expenditure. The findings, therefore, signify that although rural households of Ethiopia have traditions of informal mutual insurance scheme with better-off neighboring households within communities, the shock is not completely insured through such mechanisms i.e., there is a limit to which households can insure against consumption through better-off neighboring households.

Table 6 also examines whether positive and negative representation of covariate shocks has different impacts. These are reported in the lower panel of Table 6. As in the case of Table 5, while the coefficients on negative income shocks of all households and asset poor households are larger in magnitude and seem significant, the F-test that positive and negative income shocks have statistically different impacts on changes in consumption do not reject the null hypothesis. Thus, it reveals that positive and negative covariate shocks have equal effects[2].

[1] The regression is controlled for other variables such as female household head, age-sex categories, household head age and age squared etc. In most of the cases, some specific variable like age and age-squared are statistically significant at 5% levels of significance. Also change in log per capita of household consumption was regressed against only change in log per capita household incomes but there are no significant changes on the parameters estimated.

[2] Additional regressors included but not reported are female household head, age and age square of household head, and a full set of round (visit) dummy variables.

Table 6: Impact of change in log income on change in log consumption, controlling for change in mean log village income

	Specification (1)		
	γ estimates ($\Delta\left(\overline{\ln y_{tv}}\right)$)	β estimates ($\Delta \ln y_{jtv}$)	Sample size
All households	-0.146	0.041	
	(1.15)	(0.83)	247
Asset poor households	-0.184	0.052	
	(0.99)	(0.81)	151
Asset nonpoor households	0.004	0.021	
	(0.03)	(0.27)	96

	Specification (2)				
	γ estimates		β estimates		
	Positive $\Delta\left(\overline{\ln y_{tv}}\right)$	Negative $\Delta\left(\overline{\ln y_{tv}}\right)$	Positive $\Delta \ln y_{jtv}$	Negative $\Delta \ln y_{jtv}$	Sample size
All households	0.272	1.027**	0.058	0.110**	
	(1.57)	(4.82)	(1.55)	(3.28)	247
Asset poor households	0.323	1.828**	0.017	0.130**	
	(1.38)	(5.48)	(0.36)	(2.95)	151
Asset nonpoor households	0.147	0.335	0.08	0.0522	
	(0.57)	(1.25)	(1.38)	(0.92)	96
F-test					
Test 1: full sample	1.19 (p= 0.27)				
Test 2:Asset poor	0.11 (p= 0.73)				
Test 3:Asset nonpoor	2.47 (p= 0.12)				

Note: ** = significant at the 5 percent level of significance. Absolute value of t-statistics is in the parentheses. Standard deviation errors are corrected for heteroscedaticity using Huber-White methods.

4.5 Household vulnerability by socioeconomic characteristic

Table 7 reports the estimation results whether certain groups of communities within villages are better able to smooth consumption relative to their reference groups in the face of idiosyncratic income shocks. It has shown that neither asset poor households, female-headed households, households with young and old household heads nor households with young children experienced greater variation in consumption, given income changes, than their respective reference groups (only households with four or fewer members have greater variation in consumption with respect to its reference group). However, when separate regression was run for each village, asset poor households, female-headed households and households with

young heads experience greater variation in consumption with respect to reference groups in Yetmen. While asset poor household and household with four or fewer members have experienced variation in consumption with respect to reference groups in Azedebo, only households with four or fewer members (in Eteya) and none of the household (in Debrebrehan) experienced variation in consumption with respect to reference groups.

Table 7: The effect of idiosyncratic income shocks on consumption, by household characteristics

(Dependent variable: change in log consumption)

	Full sample	Debre-Brehan	Yetmen	Eteya	Azedebo
Asset non-poor households (reference group)	-0.007 (0.67)	0.007 (0.54)	0.003 (0.18)	0.000 (0.03)	-0.014 (0.29)
Asset poor household	0.138 (1.38)	0.272 (1.58)	-0.859** (2.23)	0.085 (0.29)	0.339** (1.99)
Male-headed households (reference group)	-0.005 (0.43)	0.016 (1.14)	-0.091** (3.19)	0.033 (1.58)	-0.013 (0.41)
Female-headed household	-0.114 (0.87)	0.156 (0.93)	0.882** (2.33)	-0.121 (0.32)	0.177 (0.64)
Households with no members ages 0-6 (reference group)	-0.012 (1.04)	0.006 (0.08)	0.002 (0.09)	-0.013 (0.73)	0.000 (0.03)
Household with members ages 0-6	-0.087 (0.94)	0.104 (1.17)	0.454 (1.23)	0.256 (1.09)	-0.155 (0.75)
Households whose head is over age 40 (reference group)	-0.006 (0.52)	0.002 (0.22)	-0.001 (0.08)	0.002 (0.15)	-0.022 (0.84)
Households whose head is age 40 or less	-0.017 (0.17)	0.045 (0.35)	0.747** (2.47)	-0.058 (0.24)	-0.133 (0.72)
Households whose head is under age 60 (reference group)	0.004 (0.37)	-0.006 (0.66)	0.040 (1.43)	0.024 (1.13)	-0.039 (1.07)
Households whose head is 60 or older	0.098 (0.83)	-0.019 (0.15)	-0.365 (0.76)	-0.349 (1.25)	-0.035 (0.17)
Households with more than four members (reference group)	-0.001 (0.11)	0.000 (0.02)	0.000 (0.03)	-0.020 (1.08)	0.099 (1.35)
Households with four or fewer members	-0.275** (2.31)	-0.033 (0.25)	-0.157 (0.36)	0.323* (1.66)	-1.205** (2.92)

Notes: * = Significant at the 10 percent level, **= significant at the 5 percent level. Absolute value of t-statistics is in parentheses. Standard errors are corrected for heteroscedasticity using Huber-White methods. A value for F test is 2.25 (prob value =0.0057). Variables included in the regression but not

reported are log share of productive time lost due to religions, feasts etc; loss of productive time due to health problems and change in family size.

5. Conclusion and recommendation

Using a unique panel data of a year long intensive monitoring survey of rural households in Ethiopia, the paper explores vulnerability issues through the lens of consumption smoothing. It asks which groups or individuals are unable to fully insure or smooth their consumption in the face of shocks to their income. Drawing on data from four villages of Ethiopia, the study has shown that in all cases, while covariant shocks lead to changes in consumption, specific idiosyncratic shocks appear to be fully insured. To fully insure idiosyncratic shocks, households have used different coping strategies. However, during the survey periods, households were less likely to sell livestock/livestock products to smooth shocks caused by rainfall and crop shocks. For these shocks they are seeking for wage employments first but are compelled to sell livestock in absence of wage employments opportunities

The impact of changes in total household income on consumption with controls for idiosyncratic shocks were also investigated and found that households are smoothing their consumption evenly across time through different coping mechanisms. Further test of consumption smoothing using average village income with control for idiosyncratic shocks indicated that there is a limit to which households insure against shocks through better-off households within the communities, i.e., the hypothesis of complete insurance is rejected.

As covariate shocks are stronger in explaining consumption smoothing, community or group based intervention is crucial. In doing so, governmental organizations or NGOs' have to engage in stipulation of modern farming systems and intend to produce more than once through irrigation, water harvesting, etc., schemes. The organizations need to engage in commencement of environmentally sound, economically viable and socially acceptable activities such as protection of acute and distress land through terracing and afforestation. Strengthening of such scheme can help, particularly the poor farming society to both provide job opportunities (in the form of food-for-work or conditional cash transfers systems) and improve fertility of cultivable land. Improving fertility of cultivable land brings sustainable development by improving agricultural productivity and profitability. This further would improve the extent of consumption smoothing.

Provision of community/group based opportunities alone may not guarantee consumption smoothing as agricultural activities are vulnerable to different shocks that might affect the community. Thus, community/group based insurance scheme is important. A provision of

insurance will guarantee household in cases of bad shocks and will also motivate the poor to participate in risky but profitable income generating ventures.

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Annex I: Duration of visits*

Visit 1 24 April 1992 - 08 May 1992 E.C
Visit 2 09 May 1992 - 23 May 1992 E.C
Visit 3 24 May 1992 - 08 June 1992 E.C
Visit 4 09 June 1992 - 23 June 1992 E.C
Visit 5 24 June 1992 - 15 July 1992 E.C
Visit 6 16 July 1992 - 15 August 1992 E.C
Visit 7 11 August 1992 - 01 September 1993 E.C
Visit 8 26 August 1992 - 12 September 1993 E.C
Visit 9 16 September 1993 - 27 September 1993 E.C
Visit 10 21 September 1993 - 12 October 1993 E.C
Visit 11 16 October 1993 - 27 October 1993 E.C
Visit 12 21 October 1993 - 12 November 1993 E.C
Visit 13 13 November 1993 - 01 December 1993 E.C
Visit 14 28 November 1993 - 05 December1993 E.C, for few it extends to 09, Jan. 1993.
Visit 15 13 December 1993 - 30 December 1993 E.C, for few it extends up to 24, Jan 1993
Visit 16 28 December 1993 - 15 January 1993 E.C, for few it extends up to 21 Feb, 1993
Visit 17 13 January 1993 - 30 January 1993 E.C
Visit 18 28 January 1993 - 15 February 1993 E.C
Visit 19 13 February 1993 - 17 March 1993 E.C
Visit 20 28 February 1993 - 08 April 1993 E.C
Visit 21 13 March 1993 - 24 April 1993 E.C
Visit 22 28 March 1993 - 04 May 1993 E.C
Visit 23 11 April 1993 - 23 April 1993 E.C
Visit 24 23 April 1993 - 03 May1993 E.C
Visit 25 05 May 1993 - 17 May 1993 E.C
Visit 26 17 May 1993 - 30 May 1993 E.C, for few it extends to 09 July 1993 E.C.

* Some up to 3% of the households were not interviewed within time ranges justified. Moreover, when it extends to some 6% to 7%, it was indicated by an extension just in front of the specified period.

Annex II: Household income diversification: Percentage of households reporting non-crop incomes

	Visit 1	Visit 2	Visit 3	Visit 4	Visit 5	Visit 6	Visit 7	Visit 8	Visit 9	Visit 10	Visit 11	Visit 12	Visit 13
Agricultural wage labor	0.00	0.00	0.40	0.40	0.40	0.81	2.02	1.21	1.21	0.81	0.81	0.81	1.21
Livestock/livestock product trade	7.69	19.03	13.36	12.96	16.60	4.45	16.19	19.03	19.03	6.07	13.36	12.55	42.11
Petty trade (e.g. grain trade etc,)	12.96	10.53	10.53	10.53	11.34	10.93	6.88	8.50	6.07	8.10	7.69	6.07	9.72
Nonagricultural wage labor	8.10	6.88	8.10	6.07	6.88	6.88	4.05	5.26	5.67	8.10	4.45	4.45	4.86
Services	3.64	4.05	4.05	4.05	5.26	6.07	6.07	6.88	6.48	4.86	5.26	4.86	5.26
Food gifts from family, friends etc	15.79	10.53	11.74	29.55	65.59	27.13	22.27	21.86	23.48	22.67	49.39	22.67	69.23
Crafting, making and selling charcoal etc	5.67	9.31	7.69	5.26	4.86	5.67	5.67	5.67	5.26	5.67	4.45	3.64	6.48

	Visit 14	Visit 15	Visit 16	Visit 17	Visit 18	Visit 19	Visit 20	Visit 21	Visit 22	Visit 23	Visit 24	Visit 25	Visit 26
Agricultural wage labor	1.21	1.21	0.40	1.21	0.81	1.21	1.62	0.40	1.21	0.81	1.21	1.21	1.62
Livestock/livestock product trade	43.72	40.89	42.91	45.75	43.72	42.11	48.99	48.18	47.77	46.96	44.53	45.34	42.51
Petty trade (e.g. grain trade etc,)	11.74	13.36	13.36	11.74	11.34	9.31	10.93	10.93	9.31	10.12	8.50	10.12	8.10
Nonagricultural wage labor	5.26	5.26	7.29	6.07	4.45	4.86	8.10	5.67	9.72	5.26	7.29	6.88	7.29
Services	3.64	5.26	4.45	3.24	2.83	4.05	4.05	4.05	3.64	3.24	3.64	2.83	2.43
Food gifts from family, friends etc	19.03	25.51	22.27	19.03	34.41	34.82	61.54	28.74	35.63	24.70	26.32	22.67	73.68
Crafting, making and selling charcoal etc	6.48	6.48	6.07	6.07	8.10	5.67	7.69	8.10	7.69	5.67	7.69	5.26	6.07

Source: own calculation from survey data.

Annex III: Mean difference test for real log of total expenditure per capita

Income shock variables	Groups	N	Mean (Sd)	t-value	p-value
Rainfall shock dummy: 1 if rainfall shock (unbalanced rainfall) reported per plot; 0 otherwise	0	5626	3.21(0.93)	2.514	0.006
	1	796	3.12(0.84)		
Crop shock index dummy: 1 if crop damage shock index is >=25%; 0 otherwise	0	6269	3.20(0.92)	2.476	0.006
	1	153	3.01(0.92)		
Illness shock dummy: 1 if at least one active member of household loss productive time due to illness, 0 otherwise	0	5474	3.21(0.91)	3.409	0.0003
	1	948	3.10(0.94)		
Market unavailability dummy: 1 if interested in working but no wage employment opportunities etc; 0 otherwise	0	1951	3.29(0.94)	5.32	0.000
	1	4471	3.16(0.90)		
Asset poor households dummy: 1 if households have livestock holding in the bottom three quintiles; 0 otherwise	0	2496	3.54(0.64)	25.07	0.000
	1	3926	2.97 (0.99)		

Annex IV: Mean and median per capita consumption, by survey visits

	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
	Visit 1		Visit 2		Visit 3		Visit 4		Visit 5		Visit 6		Visit7	
Per capita total consumption	49.48	32.31	75.25	23.01	31.03	21.12	58.38	22.90	33.83	26.89	47.12	35.41	35.39	24.92
Per capita food consumption	35.01	27.13	45.00	19.34	22.11	18.43	26.91	19.96	27.28	20.55	37.06	28.26	29.74	20.75
	(69.87)		(59.55)		(71.27)		(45.71)		(80.62)		(78.65)		(83.70)	
Per capita nonfood consumption	14.03	2.53	31.88	1.77	9.06	1.51	30.11	1.07	3.82	1.71	6.63	3.34	5.14	1.88
	(26.33)		(38.81)		(27.23)		(49.85)		(10.92)		(13.89)		(14.28)	
Per capita gift, transfer etc received	16.00	4.78	15.41	9.36	6.92	4.74	9.39	4.62	4.25	3.66	15.97	5.49	3.84	1.05
	(3.80)		(1.63)		(1.51)		(4.44)		(8.46)		(7.45)		(2.02)	

	Visit 10		Visit 11		Visit 12		Visit 13		Visit 14		Visit 15		Visit16	
Per capita total consumption	43.08	24.68	29.09	23.66	35.05	22.51	38.72	31.12	43.34	30.46	39.86	31.06	49.21	29.38
Per capita food consumption	35.52	20.23	23.19	17.26	29.90	19.09	28.91	21.47	31.52	23.29	25.64	20.72	37.33	23.68
	(82.47)		(79.07)		(85.29)		(73.74)		(71.82)		(64.07)		(75.55)	
Per capita nonfood consumption	5.93	2.51	3.57	2.02	3.21	2.20	6.82	3.45	11.90	3.48	12.77	4.34	11.33	4.88
	(13.55)		(11.91)		(8.96)		(17.02)		(26.33)		(31.10)		(22.17)	
Per capita gift, transfer etc received	8.80	7.88	5.54	3.86	9.35	5.01	5.11	3.77	11.44	7.16	16.11	13.67	9.39	6.61
	(3.99)		(9.02)		(5.75)		(9.24)		(1.85)		(4.82)		(2.28)	

	Visit 19		Visit 20		Visit 21		Visit 22		Visit 23		Visit 24		
Per capita total consumption	34.55	26.51	45.62	31.54	36.49	25.34	39.04	28.65	34.95	25.94	31.13	23.24	30
Per capita food consumption	23.12	19.02	28.55	21.22	26.51	19.54	27.64	21.83	25.70	20.13	22.66	17.88	20
	(66.66)		(62.31)		(72.35)		(70.51)		(73.23)		(72.48)		(65
Per capita nonfood consumption	9.35	4.09	13.58	5.79	8.02	2.31	9.45	3.70	7.12	3.04	6.62	2.68	8
	(26.27		(29.39)		(21.62)		(23.79)		(20.03)		(20.93)		(26
Per capita gift, transfer etc received	7.29	4.12	6.44	3.82	9.61	3.68	7.32	3.22	11.53	5.22	8.35	5.56	13
	(7.07)		(8.30)		(6.04)		(5.70)		(6.74)		(6.59)		(8

Source: own calculation from survey data.

Note: All figures are biweekly per capital consumption in Birr. Percentages of total consumptions are denoted by parentheses.