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Vulnerability of Household Consumption to Village-level Aggregate Shocks in a Developing Country*

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Abstract

Village-level aggregate shocks such as droughts and floods cannot be perfectly insured by risk sharing within a village. Then, what type of households are more vulnerable in terms of a decline in consumption when a village is hit by such natural disasters? This question is investigated in this study by using two-period panel data for the years 2001 and 2004 from rural Pakistan. We propose a methodology to infer the theoretical mechanisms underlying the heterogeneity of households in terms of their vulnerability, and focus on the difference between the across-household-type difference in marginal response to aggregate shocks and that in marginal response to idiosyncratic shocks. The empirical results obtained indicate that the sensitivity of consumption changes to shocks differs across household types, depending on the type of natural disasters. Moreover, land and credit access are effective in mitigating the ill-effects of various types of shocks. Household heads who are educated or elderly and households with a greater number of working members bear a larger burden of the village-level shocks; however, they are not vulnerable to idiosyncratic health shocks. It is revealed that these patterns may be explained by the coexistence of unequal access to credit markets and risk sharing among heterogeneous households in terms of risk tolerance.

JEL classification codes: O12, D12, D91.

Keywords: natural disaster, consumption smoothing, risk sharing, self-insurance, Pakistan.

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1 Introduction

In addressing the issue of poverty in developing countries, due consideration must be given to the vulnerability of households to natural disasters. Poor households are likely to suffer in terms of not only low levels of income and consumption on average but also from fluctuations in their income and consumption in the face of natural disasters. Such households are vulnerable to a decline in their welfare level because they are subject to substantial shocks, such as weather variability, and have limited ability to cope with such shocks (Dercon, 2005; Fafchamps, 2003). These conditions of poor households have led to an emerging literature on vulnerability measures in development economics (Ligon and Schechter, 2003; 2004; Kamanou and Morduch, 2005; Calvo and Dercon, 2005; Kurosaki, 2006a). According to these studies, poor people are considered to be vulnerable to shocks when (i) they cannot mitigate income volatility and (ii) their consumption expenditure is volatile over time (they lack reliable coping mechanisms).

Economic development in South Asia has been characterized by moderate success in economic growth and substantial failure in human development in relation to aspects such as basic health, education, and gender equality (Drèze and Sen, 1995). This characteristic is most apparent in Pakistan (World Bank, 2002). In July-August 2010, Pakistan experienced "the worst floods in its history... The floods have affected 84 districts out of a total 121 districts in Pakistan, and more than 20 million people — one-tenth of Pakistan's population... More than 1,700 men, women and children have lost their lives, and at least 1.8 million homes have been damaged or destroyed" (UN 2010, p.1). In this paper, the case of Pakistan is examined as an example of low-income countries subject to such natural disasters. Although the overall economic growth rates had improved during the 2000s in Pakistan, poverty reduction was slower than expected. Using a two-period panel dataset spanning three years from the North-West Frontier Province (NWFP),[1] one of the four provinces that comprise Pakistan, Kurosaki (2006a) and Kurosaki (2006b) indicated that rural households were indeed vulnerable to substantial welfare fluctuations. In addition, using a three-year panel dataset from Pakistan's Punjab, Kurosaki (1998) showed that farmers' consumption was excessively sensitive to idiosyncratic shocks that hit their non-farm income. Similar findings have been reported for other South Asian countries under agronomic conditions that are comparable to those of Pakistan, such as villages in the Deccan Plateau in India (Townsend, 1994; Kurosaki, 2001).

One shortcoming of existing literature is its focus on the welfare impacts of *idiosyncratic*

[1] In April 2010, the constitution of Pakistan was amended and the former NWFP was renamed "Khyber Pakhtunkhwa." In this paper, since all data correspond to a period before this constitutional amendment, the expression "NWFP" is used to refer to the current province of "Khyber Pakhtunkhwa."

shocks, such as loss due to theft or accidental injury. Such shocks imply that the experience of a particular household is different from and independent of other households. This focus has led to econometric specifications in which all village-level shocks are often controlled through fixed-effects, without fully analyzing information on the village-level co-movement of income and consumption. This is unsatisfactory, particularly when considering the growing influence of aggregate shocks on the welfare of villagers in the process of globalization and global warming. According to Sawada (2007), the impact of idiosyncratic risks and nondiversifiable aggregate risks that characterize a disaster are distinctively different, and the role of self-insurance becomes more important against large-scale disasters because formal or informal mutual insurance mechanisms are largely ineffective. However, research on the heterogeneity of the impact of natural disasters on household welfare and the economic mechanism underlying the heterogeneity is lacking.

This paper attempts to fill this gap in the literature by investigating the following question: Which type of households in rural Pakistan are more vulnerable to natural disasters such as floods and droughts in terms of a decline in their consumption during such disasters? In order to infer the microeconomic mechanisms underlying the heterogeneity of this vulnerability, this paper proposes a methodology that focuses on the difference between the across-household-type difference in the marginal response to aggregate shocks and that in the marginal response to idiosyncratic shocks. Since the marginal response to exogenous shocks is identified by the double difference in household consumption between two time periods as well as across villages, our approach may be considered to be a sort of quadruple differencing. The employment of this methodology is motivated by the possibility of a coexistence of risk sharing among villagers and intertemporal resource allocation using credit markets outside the village. Among existing studies, Asdrubali and Kim (2008) and Morten (2010) also proposed methodologies to analyze consumption smoothing with a focus on the difference between the marginal response to aggregate shocks and that to idiosyncratic shocks. However, we attempt to be explicit in specifying partial risk sharing while Asdrubali and Kim (2008) did not explicitly consider this aspect. Moreover, our approach directly focuses on consumption smoothing while Morten (2010) analyzed remittance transfer.

The remainder of the paper is organized as follows. The data used in this study is described in Section 2. The empirical model and empirical strategy employed for inferring the theoretical mechanism underlying the heterogeneous response of consumption to village-level shocks is presented in Section 3. The econometric results are presented in Section 4 and the conclusion is presented in Section 5.

2 Data

2.1 Characteristics of Pakistan's economy

Pakistan is a federal state comprising the four provinces of Punjab, Sindh, NWFP, and Balochistan. In general, Punjab and Sindh are regarded as economically advanced provinces, while NWFP and Balochistan are regarded as backward provinces. One difficulty in comparing the four provinces is the difference in their sizes. In terms of population as well as production, Punjab is the largest and accounts for over half of the national population. Sindh is the second largest and accounts for 23% of the national population, followed by NWFP, which accounts for 14%. Further, Balochistan is the largest in terms of area (approximately 45% of Pakistan's territory) but the smallest in terms of population (only 4% of the national population). The isolation and remoteness of Balochistan makes it difficult to obtain reliable data for this province.

Another dimension of spatial disparity in Pakistan is the difference in living standards between urban and rural areas. Even after adjusting for differences in prices, income and expenditure levels in urban areas are much higher than in rural areas. The urban-rural disparity is the greatest in Sindh, where the rural regions are lagging behind in terms of income, education, health facilities, and so on, and are characterized by a few big landlords and numerous landless sharecroppers (Naqvi et al., 1989; Perera, 2003).

Although declining, the share of agriculture in Pakistan's GDP continues to be high at over 20% (Government of Pakistan, various issues). There are two main crop seasons: *Kharif* and *Rabi*.[2] Since most land in Pakistan is semi-arid and arid, crop production in both seasons is highly dependent on irrigation. Despite the fact that Pakistan has the largest irrigated agricultural area among developing countries, agricultural output fluctuates substantially (Kurosaki, 1998). This is because the availability of canal water depends on rainfall in the Himalaya, which fluctuates every year; moreover, the availability of irrigation water at the farm level is disrupted frequently due to administration problems in the irrigation system. The majority of agricultural households combine crop farming and livestock raising as their main livelihood. Bullock cattle and she-buffaloes for milk are the most important large livestock animals, while small livestock animals including sheep and goats are important means of saving. In addition to the agricultural sector, the non-agricultural sector includes agro-industries (such as cotton-based textiles) and agro-services (such as trade of agricultural produce). Thus, due to the substantial dependence on the agricultural sector, the performance of Pakistan's macroeconomy as a whole fluctuates substantially, depending

[2] The *Kharif* crop is the monsoon or autumn crop for which harvests come in September-November; rice, cotton, and maize are major *Kharif* crops. The *Rabi* crop is the spring crop of the dry season for which harvests come in March-June; wheat and gram pulse are major *Rabi* crops.

on the weather.

Recent changes in Pakistanis' average consumption, inequality among them, and their poverty levels can be analyzed using repeated cross-section household datasets. For instance, Kurosaki (2009) characterized these changes using four rounds of nationally-representative, repeated cross-section data (PIHS/PSLM data) surveyed by the Federal Bureau of Statistics of the Government of Pakistan for 1998/99,[3] 2001/02, 2004/05, and 2005/06. His results revealed that the average consumption declined initially and increased in the two subsequent periods; the Foster-Greer-Thorbecke (FGT) poverty measures moved in the opposite direction; inequality decreased from 1998/99 to 2001/02, then it increased rapidly from 2001/02 to 2004/05. Nevertheless, since these are based on repeated cross-section data of households, we cannot have an idea of how many households actually experienced improvement in their welfare. For such analysis, we need panel data of households.

2.2 PRHS panel data

In this paper, we employ micro data from the Pakistan Rural Household Survey (PRHS), which is a unique panel dataset from Pakistan with a relatively large sample size. The survey was conducted jointly by the Pakistan Institute of Development Economics and the World Bank. The first survey (PRHS-I) was conducted in the period from September 2001 to January 2002; information was collected on agriculture-related activities for the crop seasons of *Kharif* 2000 and *Rabi* 2000/01 and that on consumption corresponding to the month preceding the survey. Approximately 2,700 rural households in all four provinces of Pakistan were included in the survey.

The second survey (PRHS-II) was conducted three years later in the period from August to October 2004; information was collected on the crop seasons of *Kharif* 2003 and *Rabi* 2003/04, and on consumption in the month preceding the survey. It must be noted that because of security problems and other reasons, sample households in NWFP and Balochistan were not re-surveyed.[4]

From the PRHS panel data, nominal consumption expenditure[5] per capita[6] in Pakistan rupees was calculated and then converted into real terms by dividing this value by the

[3]Pakistan's fiscal year as well as agricultural year begins on July 1 and ending on June 30 of the next year.

[4]In PRHS-I, approximately 450 sample households were surveyed in NWFP and approximately 400 sample households were surveyed in Balochistan.

[5]Since numerous farm households in Pakistan are subsistence-oriented and numerous rural laborer households are occasionally paid in kind, the value of these non-cash transactions were carefully imputed using village-level prices for calculating the consumption expenditure.

[6]To be precise, "per capita" implies "per adult equivalence unit," which is the unit adopted by the Government of Pakistan to establish the official poverty line. Individuals who are 18 years old or above are assigned the weight of 1.0 and others are assigned 0.8.

official poverty line.[7] This is known as the "welfare ratio" and is denoted as c_{it} below, where subscript i refers to individual i and t refers to the survey year. Individuals with $c_{it} \geq 1$ are classified as non-poor and those with $c_{it} < 1$ are classified as poor.

In this paper, a balanced panel of 1,609 households (929 in Punjab and 680 in Sindh) is employed, for which complete consumption information was available in both surveys. In PRHS-I, the number of sample households in Punjab and Sindh with complete consumption information was 1,874, thereby implying an attrition rate of 14%.

In PRHS-I, the sample households were randomly drawn from sample villages and the sample villages were selected as broadly representative of each province. Therefore, if the attrition was purely random, the PRHS panel data are broadly representative of rural Punjab and Sindh. Comparing the panel households with those that were excluded from PRHS-II, we found that the average c_{it} in PRHS-I among the excluded households was 12% lower than that among the households in the panel sample, and the difference was statistically significant (p value = 0.029). On the other hand, household size and composition were similar between the two groups (the difference was statistically insignificant). This suggests a possibility of weak attrition bias in that initially poor households were more likely to be excluded from the sample. Furthermore, those households that were affected so severely by exogenous shocks that they physically disappeared or became unable to be re-surveyed have not been included in the panel data. This implies that the portion of vulnerable households that is worst hit by natural calamities are not included in our dataset.

Table 1 presents three welfare measures based on the PRHS panel data: average of c_{it}, poverty measures, and Atkinson's (1970) inequality measures. Since there is a socioeconomic gap between the northern and southern parts of Punjab, we divide Punjab into two portions.[8] The changes between PRHS-I (2001) and PRHS-II (2004) are similar to the changes between PIHS 2001/02 and PSLM 2004/05, which are nationally representative. The poverty level gauged by three FGT measures decreased substantially from 2001 to 2004. The decrease was slightly larger in Sindh than in northern and southern Punjab, thereby reducing the

[7] The official poverty line of Pakistan is close to the level of 1 PPP\$/day (1.25 PPP\$/day in 2005 price), which is adopted widely in the international comparisons. The official poverty line was converted into the poverty line for each PRHS round in four steps: First, the poverty headcount rate for rural Punjab and Sindh was estimated at 38.5% using PIHS 2001/02 data and the official poverty line. Second, the poverty line for PRHS-I was fixed in order to generate the same poverty headcount rate using PRHS-I data for rural Punjab and Sindh, including the households that were excluded from PRHS-II. Third, an intertemporal inflation rate of 15.2% between PRHS-I and PRHS-II was estimated by weighting monthly CPIs by the number of observations for each corresponding month for PRHS-I and PRHS-II data. Fourth, the poverty line for PRHS-II was fixed by multiplying the PRHS-I poverty line by the inflation rate.

[8] There is no official division of Punjab into North Punjab and South Punjab. From among 35 districts in Punjab, 6 districts were surveyed in PRHS, and from among these six, 3 districts of Attock, Faisalabad, and Hafizabad are classified as "northern Punjab" and 3 districts of Bahawalpur, Muzaffargarh, and Vehari are classified as "southern Punjab" in this paper. Moreover, from among 22 districts in Sindh, the PRHS data include 4 districts of Badin, Larkana, Mirpur Khas, and Nawabshah.

gap between the two provinces. In both Punjab and Sindh, inequality increased during this period. This is similar to the change observed in nationally representative household surveys between 2001/02 and 2004/05. Thus, it is evident from Table 1 that there is a clear ranking of average economic well-being among the three regions: northern Punjab at the top, Sindh at the bottom, and southern Punjab in between.

2.3 Poverty transition at the household level

In order to utilize the advantage of panel data, Table 2 classifies sample households by their status of poverty *transition*. From among 1,609 sample households, 182 were below the poverty line in both periods ("chronically poor"), 342 were below the poverty line in PRHS-I but above it in PRHS-II ("getting out of poverty"), 176 were above the poverty line in PRHS-I but below it in PRHS-II ("falling into poverty"), and 909 were on or above the poverty line in both periods ("never poor"). In terms of individual population, 13.4% of the PRHS-I individuals belonged to the "chronically poor" households, 23.7% to the "getting out of poverty" households, 11.6% to the "falling into poverty" households, and 51.2% to the "never poor" households.

In terms of transition probability, 65.3% of households who were poor in PRHS-I became non-poor in PRHS-II, while 16.2% of households who were non-poor in PRHS-I became poor three years later in PRHS-II. Therefore, we observe a high level of poverty mobility during the survey periods. The vulnerability measured by the incidence of falls into poverty is thus rather high in rural Pakistan. Further, the transition probability from non-poor to poor was higher in Sindh (23.5%) than in southern Punjab (16.3%) and northern Punjab (9.9%). It must be noted that these falls into poverty occurred when the average poverty headcount ratio decreased. Thus, the aggregate figure conceals, from a micro viewpoint, the fact that certain households suffered from a severe decline in their overall welfare during the survey period.

A comparison of the three regions reveals that dwellers in rural Sindh were more vulnerable than those in rural Punjab. This regional contrast in vulnerability is robust to the application of other methodologies to the same panel data (see, e.g., Arif and Bilquees, 2008; Kurosaki, 2009).

Idiosyncratic and village-level negative shocks may possibly be responsible for the consumption decline of certain households when the nation experienced a consumption increase on average. As an indicator of idiosyncratic shocks, we constructed a dummy variable from the PRHS panel data for households whose members experienced a severe health shock due to injury or sickness that resulted in treatment in medical institutions during the two survey periods. Approximately 7% of the sample households experienced such shocks.

Further, with regard to village-level shocks, 24 variables were available in PRHS-II, all of which assessed the negative impact due to natural disasters on a five-point scale: 0 ("No effect": no report for crop damage), 1 ("Little effect": yield loss up to 10%), 2 ("Moderate": 10-25% loss), 3 ("Severe": 25-50% loss), and 4 ("Disaster": over 50% loss). Three types of disasters were investigated: drought, flood, and pest attack. Eight cropping seasons up to the survey reference period (i.e., from *Kharif* 2000 to *Rabi* 2003/04) were covered. Since we found that drought damage variables in a year are highly correlated with pest attack variables in the same year,[9] we exclude pest attack variables in the analysis below and focus only on droughts and floods.

Table 3 presents the incidence of these disasters from 2000 to 2004. It is evident that droughts are more common than floods — they occurred in all three regions with similar frequency. On the other hand, flood damage was not reported from northern Punjab, and only infrequently from southern Punjab. In other words, floods occurred most frequently in Sindh in the period. It may appear that the variation in drought and flood damage reported at the village level are in effect more aggregate, with little effective variation across villages within a region. In order to investigate whether or not this applies to our data, we examined the spatial correlations of drought and flood variables. For example, only 17.3% (21.3%) of the variation of the drought (flood) damage variable was explained by variation across the three regions. The rest were within-region and between-village variations.[10] Such variation will be utilized in identifying the effects of village-level shocks on overall household welfare.

3 Analytical Framework

3.1 Empirical model

One shortcoming of the transient poverty analysis in Table 2 is that it does not take into account changes in household consumption that may have occurred without crossing the poverty line. The consumption levels of some of the "chronically poor" may have been stable and slightly below the poverty line, while those of others of the "chronically poor" may have been fluctuating annually. In such a case, it may be preferable to regard the latter type as more vulnerable than the former type. Another issue is that it is possible that some of the observed changes in consumption levels were anticipated by the household. If this is the case, the observed changes in consumption must be decomposed into anticipated and unanticipated components. Thus, we regress consumption changes on the initial characteristics

[9]The correlation coefficients between drought damage and pest attacks were in the range from 0.363 to 0.741, all of which were statistically significant at the 1% level, while those between drought and flood damage were in the range from -0.199 to -0.015, all of which were not statistically significant at the 5% level.

[10]The number of sample villages in each region is 23 in northern Punjab, 25 in southern Punjab, and 46 in Sindh.

and variables that capture idiosyncratic and village-level shocks that were unexpected by the household. Since there are only two periods in our panel dataset, the empirical model is given by a cross-sectional regression model for household i:

$$\Delta \ln c_i = X_{1i}b_0 + Z_v X_{2i}b_1 + Z_i X_{2i}b_2 + \epsilon_i, \quad (1)$$

where $\Delta \ln c_i = \ln c_{it} - \ln c_{i,t-1}$; X_{1i} is a vector of household characteristics in period $t-1$ such as physical assets owned by the household, income sources, credit access, education level of the household head, and demographic composition; Z_v is a vector of village-level production shock variables (floods and droughts) for household i living in village v; X_{2i} is a subset of X_{1i} used as a shifter for the household's ability to cope with village-level shocks; Z_i is the idiosyncratic health shock; b_0, b_1, and b_2 are vectors of the parameters to be estimated; and ϵ_i is a zero mean error term. X_{1i} includes the intercept term and region dummies.

When the economy was hit by nation-wide negative shocks, parameter b_0 may be interpreted as a measure of vulnerability since it indicates the household attributes in X_{1i} that are associated with a larger decline in consumption in the face of nation-wide shocks (Ravallion, 1995; Jalan and Ravallion, 1999; Glewwe and Hall, 1998). However, since there was an overall growth in the economy in our dataset, it is preferable to interpret parameter b_0 as an indicator of which households were not able to keep up with the national growth trend.

Further, when only the intercept term is included in X_{2i}, parameter b_1 indicates the double-difference estimator[11] for the impact of drought (flood) on consumption; vector b_1 is expected to be negative. When region dummies are included in X_{2i}, the difference in vulnerability across regions can be examined. Moreover, when households' initial attributes are included in X_{2i}, vector b_1 indicates which household attributes are associated with a larger decline in consumption if the village is hit by a production shock Z_v. Thus, parameter b_1 is of main interest of this paper.

The model presented in equation (1) is an extension of the excess sensitivity of household-level consumption to idiosyncratic shocks after controlling for village-level aggregate shocks (Townsend, 1994; Kurosaki, 2006a). The extent to which household consumption responds to idiosyncratic shocks (parameter b_2) may be interpreted as one measure of vulnerability (Amin et al., 2003; Skoufias and Quisumbing, 2005). However, since our main motivation is to identify the impacts of village-level aggregate shocks, parameter b_2 itself is not of main interest in this paper. Further, since Z_i is orthogonal to Z_v by definition, the entire expression $Z_i X_{2i} b_2$ can be excluded and merged into ϵ_i without affecting our ability to obtain unbiased

[11] The first difference is across time (the dependent variable is the change in consumption) and the second difference is with respect to villages distinguished by drought and flood shocks.

estimates for b_0 and b_1.[12] Nevertheless, we include the term $Z_i X_{2i} b_2$ because it enables us to infer the theoretical mechanisms underlying the heterogeneity of household responses to village-level shocks. The main idea is to examine the difference between the across-household-type difference in marginal response to aggregate shocks (b_1 with respect to some household attribute) and the difference in marginal response to idiosyncratic shocks (b_2 with respect to the same household attribute). This approach may be termed a sort of "quadruple" differencing,[13] which is explained in greater detail below using a simple household model.

3.2 Inference of the theoretical mechanisms underlying the heterogeneous response to village-level shocks

Let W_{it} be the forward-looking welfare of household i in period t based on a standard model defined as

$$W_{it} = U_i(c_{it}) + E_t\left[\sum_{\tau=1}^{\infty}\left(\frac{1}{1+\delta}\right)^{\tau} U_i(c_{i,t+\tau})\right], \tag{2}$$

where $U(.)$ is an instantaneous utility function that satisfies $U'(.) > 0, U''(.) < 0$, δ is the subjective discount rate, and $E[.]$ is an expectation operator. We assume the following simple budget constraint that comprises

$$y_{it} + (1 + r_{it})s_{i,t-1} + x_{it} - c_{it} - s_{it} = 0, \tag{3}$$

$$y_{it} = y_i^P + y_t^T(Z_{vt}) + y_{it}^T(Z_{it}), \tag{4}$$

$$x_{it} = g_{it}(\theta_t, H_t), \tag{5}$$

where y_{it} (exogenous income flow to household i) is the sum of non-stochastic income (y_i^P), village-level aggregate transient income (y_t^T) a function of the village-level shock Z_{vt}, and idiosyncratic transient income (y_{it}^T) a function of the idiosyncratic shock Z_{it}; $s_{i,t-1}$ is net saving (credit if negative) from $t-1$ to t; r_{it} is the market interest rate on $s_{i,t-1}$; x_{it} is a net transfer receipt (payment if negative) of household i in period t from other members in the risk-sharing network; and $g(..)$ is a function for determining the net transfer receipt, which has as arguments vector θ_t (rules and institutions that determine the risk-sharing rule) and vector H_t, which includes the history of exogenous shocks in income until period t and the endogenous decisions of consumptions, savings, and transfers until period $t-1$ by all members in the risk-sharing network.[14]

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[12] Our regression results indicate that this is true, as shown below.

[13] The third difference is with respect to household types and the fourth difference is between village-level aggregate shocks and idiosyncratic shocks.

[14] See Ligon et al. (2000, 2002) for an example of function $g(..)$ under partial risk sharing due to limited commitment problems. In their cases, the function has a different form in both dimensions of i and t, and H_t includes all the history. In the classic full risk-sharing case analyzed by Townsend (1994), the functional form differs only in the i dimension, and H_t includes only the t period exogenous shocks.

In period t, household i chooses c_{it}, x_{it}, and s_{it} in order to maximize W_{it} subject to budget constraints. The optimal solution (the policy function) for the household regarding consumption may be expressed in the following reduced-form:

$$c^*_{it} = f_{it}(y^P_i, y^T_t, y^T_{it}, r_{it}, \theta_t, H_t). \tag{6}$$

Using the reduced-form expression, we investigate the marginal response of optimal consumption to transient income, $\beta_1 \equiv \partial c^*_{it}/\partial y^T_t$ and $\beta_2 \equiv \partial c^*_{it}/\partial y^T_{it}$, from which we derive empirical predictions regarding b_1 and b_2 in equation (1). Due to risk aversion, households would choose a completely smoothed consumption path even if their income is fluctuating, if such a path is feasible. However, intertemporal transactions are likely to suffer from credit (or liquidity) constraints, which are likely to be binding when the households' cash in hand is low, thereby resulting in non-smooth consumption (Deaton, 1991; 1992). Similarly, risk sharing among villagers in a village may suffer from information asymmetry (Ligon, 1998) and limited commitment (Ligon et al., 2000; 2002), thereby resulting in only partial insurance to idiosyncratic shocks to income because villagers cannot completely pool their income under such conditions.

(i) Hand-to-mouth economy

In an extreme case, when households have no means to smooth consumption (i.e., households do not belong to a risk-sharing network and cannot access any intertemporal resource allocation technology), their optimal consumption c^*_{it} simply equals y_{it} due to the assumption of $U'(.) > 0$. Therefore,

$$\beta_1 = \beta_2 = 1 \tag{7}$$

should hold for all households. Applying this to our empirical model (equation (1)), assuming that the income shock affects the transient income linearly at the same rate among all households, we obtain the empirical relation $b^A_1 = b^B_1 < 0$ and $b^A_2 = b^B_2 < 0$; the absolute values obtained for the four parameters are all very large. This implies that due to the absence of consumption-smoothing opportunities, household consumption declines significantly when a household is hit by idiosyncratic or village-level shocks.

(ii) Full risk sharing with no intertemporal technology

We assume the constant relative risk aversion (CRRA) preference, i.e., $U_i(c_i) = \frac{1}{1-R_i} c_i^{1-R_i}$, where R_i is an Arrow-Pratt coefficient of relative risk aversion (heterogeneous risk preference).[15] Under this assumption, the optimal solution under full risk sharing can be charac-

[15]Since Kurosaki (2001) found no evidence for heterogeneous time preference among South Asian households, this paper assumes a homogenous time preference.

terized by

$$\ln c_{it} = -\frac{1}{R_i}\ln\mu_t + \frac{1}{R_i}\ln\lambda_i + \frac{1}{R_i}t\ln\frac{1}{1+\delta} = \alpha_i'\bar{\ln c_t} + \beta_i', \tag{8}$$

where μ_t is the Lagrange multiplier associated with the resource constraint in the risk-sharing group in period t, λ_i is a Pareto-Negishi weight for household i, $\bar{\ln c_t}$ is the group mean of log consumption, and α_i' and β_i' are defined as

$$\alpha_i' \equiv \frac{1}{R_i}\left[\frac{1}{N}\sum_j \frac{1}{R_j}\right]^{-1}, \tag{9}$$

$$\beta_i' \equiv \frac{1}{R_i}\left[\ln\lambda_i - \frac{1}{N}\sum_j \alpha_j \ln\lambda_j\right], \tag{10}$$

where N is the number of households in the risk-sharing group. Equation (8) intuitively indicates that optimal consumption comprises a variable portion that is proportional to the group mean consumption at the rate of α_i' and a fixed portion β_i'. Equation (9) implies that when household i is more risk-averse than the group average in the sense that $\frac{1}{R_i} < \frac{1}{N}\sum_j \frac{1}{R_j}$, α_i' becomes smaller than unity; in other words, the household's share in variable consumption is smaller than the group average. Equation (10) implies that the risk-sharing group allocates consumption to households according to the size of λ_i. Although the weights can assume any positive values under the social planner's optimization framework, there exists a mapping from the consumption allocation under a full-information competitive equilibrium to the consumption allocation under the social planner's problem with a specific vector of λ. Under such competitive equilibrium, wealthier households who can contribute more to the group income pool on average are assigned higher λ_i and hence have higher consumption.

Therefore, if all households in the risk-sharing network have a homogeneous risk preference,

$$\beta_1 = 1, \qquad \beta_2 = 0 \tag{11}$$

should hold for all households. The empirical implication of this is that $b_1^A = b_1^B < 0$ and $b_2^A = b_2^B = 0$.

On the other hand, if the households have a heterogeneous risk preference,

$$\beta_1^A > 1 > \beta_1^B, \qquad \beta_2^A = \beta_2^B = 0 \tag{12}$$

should hold, where household A is relatively risk-loving and B is relatively risk-averse. In our empirical model, $b_1^A < b_1^B < 0$ and $b_2^A = b_2^B = 0$ should hold.

(iii) Access to an external credit market with no risk sharing

Under the permanent income hypothesis with infinite time horizon and a quadratic utility function, the optimal marginal response of consumption to completely transient income (y_t^T

and y^T_{it}) is equal to $r/(1+r)$ (Deaton, 1992). With no risk sharing, the distinction between village-level and idiosyncratic shocks is not significant for the household. Therefore, if all households have homogeneous access to the external credit market,

$$1 > \beta_1 = \beta_2 = r/(1+r) > 0 \tag{13}$$

should hold for all households. Thus, the empirical implication is that $b^A_1 = b^B_1 < 0$ and $b^A_2 = b^B_2 < 0$. This is qualitatively similar to case (i); however, the absolute values of the four parameters are all small due to intertemporal smoothing. Therefore, in empirical exercise, this case could be easily distinguished from case (i).

On the other hand, if households have heterogeneous access to the credit market and are faced with different interest rates, effectively,

$$1 > \beta^A_1 = \beta^A_2 = r^A/(1+r^A) > r^B/(1+r^B) = \beta^B_1 = \beta^B_2 > 0 \tag{14}$$

should hold, where the interest rate for household A is higher than that for household B. In terms of the empirical model of this paper, $b^A_1 < b^B_1 < 0$ and $b^A_2 < b^B_2 < 0$.

Although the above relations are derived under the restrictive assumption of a quadratic utility function and perfect access to an external credit market, their key characteristics — those with better access to credit are better able to mitigate the ill-effects of shocks and this ability should not differ between the ability to deal with village-level aggregate shocks and against idiosyncratic shocks — are likely to hold under less restrictive assumptions as well.[16]

(iv) Combining credit market with risk sharing

It is not an easy task to model situations where risk sharing and intertemporal resource allocation coexists for a household. The simplest case is when households form a full risk-sharing network and have access to the external credit market. In this case, insurable shocks of y^T_{it} are completely smoothed through village-level risk sharing while uninsurable shocks of y^T_t are partially smoothed through intertemporal resource allocation at the lowest interest rate among the villagers (r^*). Thus, the optimal solution should satisfy

$$1 > \beta_1 = r^*/(1+r^*) > \beta_2 = 0 \tag{15}$$

for all households. This is the Pareto optimal allocation with the highest level of consumption smoothing among all the cases considered in this subsection. Qualitatively, its implication is that $b^A_1 = b^B_1 < 0$ and $b^A_2 = b^B_2 = 0$, which is the same for the case of full risk sharing among homogeneous households with no access to credit markets; however, the slope of $b^A_1 = b^B_1 < 0$ is less steeper than the case of risk sharing, thereby distinguishing this case from other cases.

[16]Numerical results showing this are available on request, using the CRRA utility case.

As analyzed by Ligon et al. (2002), access to the external credit market may cause the full risk sharing more difficult to sustain under limited commitment. This is because a household that happens to have a high transient income has an incentive to renege the risk-sharing contract and save the transient income, thereby leaving the risk-sharing network for self-insurance. The case described above is sustainable only in a community with a highly strong ability to avoid such reneges. Without such an ability, the limited commitment is likely to result in partial risk sharing. Under partial risk-sharing regimes with limited commitment, access to the external credit market may worsen the condition of households due to more partial risk sharing (Ligon et al., 2000), while transfers under such partial risk sharing appear as debt contracts (Ligon et al., 2002). In these cases, the relationship among β_1^A, β_1^B, β_2^A, and β_2^B depends on how we model $g(..)$ and the household's credit access.

3.3 Short summary of the empirical strategy

Let us summarize our empirical strategy. First, a simplified version of our empirical model with no cross term identifies the causal effect of natural disasters and health shocks on consumption through double differencing. Then by considering the third differencing with respect to household types and compare the third difference between village-level shocks and idiosyncratic shocks (the fourth difference), we can infer the economic mechanisms underlying incomplete consumption smoothing.

However, the theoretical inference in this paper is incomplete in two senses. First, the restrictions on b_1^A, b_1^B, b_2^A, and b_2^B are necessary conditions, not sufficient conditions. Second, the restrictions are only a partial characterization of possible patterns of coefficients. Thus, it is necessary that the theoretical inference be made more complete. The limitation that restrictions are only necessary conditions implies that the same relationship among b_1^A, b_1^B, b_2^A, and b_2^B could occur under a different mechanism as well. For example, if exogenous income shocks (aggregate or idiosyncratic) affect the household transient income disproportionally, depending on the household type, we may have estimation results that indicate a difference between b_1^A and b_1^B, and between b_2^A and b_2^B. This possibility will also be considered in interpreting the regression results in the next section.

4 Sensitivity of Consumption Changes to Village-level Shocks

4.1 Empirical variables

Since the main objective of this paper is to analyze the vulnerability of households in a low-income country like Pakistan to a decline in consumption due to a natural disaster, we exclude relatively rich households ($c_{i,t-1} > 4$ or $c_{it} > 4$) in the regression analysis. In addition, we also exclude households that experienced a drastic change in their demographic structure (households in which the change in the number of household members was equal to or over 4). This reduced the sample size from 1,609 (Tables 1 and 2) to 1,293. Thereafter, the consumption was re-calculated after excluding the medical expenditure since it is highly correlated with Z_i (idiosyncratic health shock) and the increase in consumption due to $Z_i = 1$ does not imply an increase in welfare. In other words, the total consumption in the regression analysis is the consumption excluding durables, house rent, and medical expenditures.

As controls for household characteristics, vector X_{1i} includes variables such as physical assets owned by the household (farmland, livestock, sum of the value of durable consumption goods, transportation equipment, house buildings, etc.), income sources (number of male working members engaged in non-farm work, existence of remittance receipts, etc.), credit access, education level of the household head, and demographic composition (number of household members, female ratio among them, and dependency ratio).[17]

After attempting several methods of aggregating the sixteen variables presented in Table 3, we report the results with two aggregated variables for drought and flood in two agricultural years of 2002/03 and 2003/04, normalized between zero and one. The robustness of our results with respect to this definition will be investigated below. Since the consumption data in PRHS-II were collected in August-October 2004, the agricultural output in 2002/03 and 2003/04 should have had the most direct effect on household consumption. Production shocks that occurred before these two years may have affected the consumption level reported in PRHS-I. For this reason, we use the shocks in the last two years as village-level shocks that are exogenous to initial consumption and unanticipated by villagers.

Table 4 presents the summary statistics for empirical variables that have been compiled for this analysis. They are weighted by the household size in order to obtain individual-level means and standard deviations, since the regression analysis is conducted in order to gauge individual welfare.

4.2 Estimation results

4.2.1 Sensitivity of consumption to shocks

Table 5 presents the estimation results of equation (1), both excluding (specification (i)) and including cross-terms (specifications (ii)-(iv)). Examining specification (i), it is evident that among household characteristics X_{1i}, five variables have statistically significant coefficients: the size of owned land (negative), number of small livestock animals (negative),

[17] With regard to education and landholding, the use of dummy variables distinguishing zero and positive years of education or positive acreage of owned land was attempted as well; this yielded results that were similar to those reported in this paper. With regard to the access to non-farm jobs, variables characterizing female workers engaged in non-farm jobs were not included because the average was close to zero and the variation was small.

number of male household members who were employed permanently in regular non-farm jobs (positive), remittance receipt dummy (positive), and dependency ratio (positive). The finding that households with larger landholding or larger livestock were lagging behind in consumption growth appears to suggest that growth from 2001 to 2004 was based on non-agricultural sectors. It may be tempting to interpret this finding to indicate that households in which more members were employed in non-farm permanent employment jobs were less vulnerable to a stochastic decline in consumption. However, the positive coefficient may simply reflect the life-cycle improvement in earnings associated with non-farm permanent jobs (e.g., regular promotion). The positive impact of remittance receipt on consumption growth is also consistent with prior expectation. The finding that households with a greater number of dependent household members experienced higher growth in consumption may simply reflect the fact that children (the majority among the dependent members) require larger amount of consumption after they become older by three years.[18] All other variables are insignificant. The proxy variables for credit constraints have a positive sign, as expected from the theoretical model (Deaton, 1991); however, the coefficients were statistically insignificant. The impact of household characteristics remains qualitatively the same when we introduce the cross-terms of natural disasters and region dummies (see specification (ii) in Table 5). These patterns of parameter estimates for b_0 on X_{1i} are robustly found under different specifications. Therefore, parameter estimates for b_0 are not reported in the following tables in order to save space.

With regard to coefficients on village-level production shocks, the coefficients on natural disasters are all negative in specification (i). However, only the coefficient on floods is statistically significant: it indicates that households had to reduce consumption by 37% $(1 - \exp(-0.4654) = 0.3721)$ when their village was hit by a flood that destroyed over 50% of *Kharif* and *Rabi* crops. This implies a substantial decline in welfare. On the other hand, the coefficients on drought damages and health shocks have smaller absolute values and are statistically insignificant. This indicates the existence of some sort of insurance mechanism against droughts and health shocks in the study area on average.

The contrast between droughts/health shocks and floods could be understood by the insurability of shocks within a region. Theoretically, it is easy to insure health shocks within a village since they are idiosyncratic. Drought shocks are more aggregate than health shocks; however, because droughts are highly common in rural Pakistan, villagers may have established an institution to insure against them across villages within a region. On the other hand, it is difficult to insure against floods because they disrupt across-village transportation

[18]When we subdivide the sample into the relatively rich and relatively poor by the median of the welfare ratio, *depratio* has a positive and significant coefficient only among the former. It is negative and statistically insignificant among the poor. This appears to support the life cycle interpretation.

and communication. With disrupted transportation and communication, the institutional arrangement becomes less effective. This is only a speculation and the examination of estimation results using cross-terms will enable us to examine the validity of this speculation.

In order to examine whether there are any regional differences in terms of the extent of consumption smoothing ability against natural disasters, specification (ii) in Table 5 permits the coefficient on Z_v to differ across the three regions. Since no incidence of flood was reported from northern Punjab, the cross-terms that include floods are only for southern Punjab and Sindh. With regard to the effect of droughts and health shocks, all coefficients remain statistically insignificant. Further, with regard to the effect of floods, only the coefficient for Sindh is significant. However, the coefficient for southern Punjab has a large absolute value, thereby suggesting that there is the potential of a negative impact; however, it is not statistically discernible due to the infrequency of floods in this region. In addition, the null hypothesis that the impact of shocks is the same in all regions is not rejected at the 10% level. Therefore, no spatial heterogeneity is found in marginal impacts of natural disasters and idiosyncratic shocks. For this reason, the cross-terms with region dummies are not included in the following specifications.

In order to further examine the heterogeneity in the marginal impact of a natural disaster, household-level characteristics were interacted with village-level shocks (specification (iii) in Table 5). From among the fifteen household-level variables, seven are chosen as potential shifters of the marginal impact. Four of them (size of land holdings, number of household members employed in permanent non-agricultural jobs, dummy for remittance receipts, and dependency ratio) are those variables in X_{1i} in equation (1) that have robustly significant coefficients. The other three (dummy for credit constraint in the formal sector, age of the household head, and education level of the household head) are those variables that were found to be associated with several measures of vulnerability analyzed by Kurosaki (2009). In specification (iii), the regression results including all these cross-terms are reported, while in specification (iv), the model was made parsimonious by deleting statistically insignificant interaction terms.[19]

The following results are revealed from the analysis. More landed households and those with more dependent members were more capable of isolating their consumption from a drought-driven income decline. In addition, the ill-effects of flooding are mitigated if a household is more landed, younger, and more educated. Further, with regard to the impact of idiosyncratic health shocks on consumption, greater land holding and access to formal credit help to mitigate the ill impact of such shocks on consumption. Moreover, access

[19]More concretely, we first retained those cross-terms with the 15% level of significance and re-estimated the model. We then retained those cross-terms with the 10% level in the second analysis and re-estimated the model again. The results of the third regression are reported as the final parsimonious specification.

to formal credit also mitigates the shock due to droughts and floods, although this is not statistically significant in the specifications reported in Table 5.

Now we make inferences on the theoretical mechanisms through the quadruple differencing approach that is explained in Section 3. First, those with relatively less landholdings and limited access to credit are vulnerable to a larger decline in consumption when hit by floods and droughts on the one hand, and by health shocks on the other. This is a pattern consistent with the regime of unequal access to credit markets. It may be interpreted that the amount of landholding has the effect of reducing household vulnerability by improving their ability in intertemporal resource allocation. Since the land sales market is thin in rural Pakistan, it is likely that this ability is due to the collateral and social value of land (Hirashima, 2008). The observed pattern among the coefficient estimates involving land is difficult to explain by the argument based on the heterogenous impact of exogenous shocks on household transient income, since the total income of more landed households must be affected proportionally more by floods and droughts as compared with less landed households. Moreover, the access to formal credit, by definition, improves the ability of households in intertemporal resource allocation; thus, its cross-terms may be interpreted similarly as those for land.

In contrast, households headed by educated and elder household heads and households with a greater number of working members are subject to a larger consumption decline when hit by floods or droughts. From the viewpoint of household ability in intertemporal resource allocation, this appears to be a puzzle. However, this may be clarified from the viewpoint of the theory of full risk sharing. Such households are less risk-averse than other households; thus, it is more efficient for them to bear greater aggregate risk (in return for higher expected values of transfers from the risk-sharing network). With regard to the effect of education, it is found that there is a greater consumption decline due to floods among more educated households, which suggests that educated households are able to behave in a less risk-averse manner in the optimal village-level risk sharing due to the fact that they possess greater human capital. As another support for this interpretation, none of the three shifters (age of household head, education level of household head, and dependency ratio) is statistically significant in $Z_i X_{2i}$. The overall pattern is in favor of the regime under full risk sharing among heterogeneously risk-averse households. At the same time, however, the observed pattern among the coefficient estimates could be consistent with the argument based on heterogenous impact of exogenous shocks on household transient income, if the household income of those with more educated and older household heads, and greater number of working members are less affected by droughts and floods.

Furthermore, the null hypothesis that the impact of village-level shocks is the same across different household characteristics is rejected at the 1% level. Therefore, the marginal impacts of natural disasters are heterogenous, which is consistent with the co-existence of the unequal credit market access and full risk-sharing models among heterogenous villagers.

4.2.2 Robustness of the empirical results

The results in Table 5 were found to be robust to various alterations.[20] Most importantly, different definitions of natural disaster variables were attempted and yielded similar results (Table 6). In the first group of columns in Table 6, regression results based on the default definition are subtracted from those given in Table 5. In the second group of columns (alternative (1)), the results based on disaster variables corresponding to the larger disaster of the last two years instead of their averages are reported, since it is possible that only major disasters matter. In the last group of columns in Table 6 (alternative (2)), results are based on a specification using only the most recent disasters (indices corresponding to the last agricultural year instead of the averages of the last two years) since the impact of disasters may be short-lived.

Without cross-terms, the estimated patterns are similar to those given in Table 5 — only the flood variable has a statistically significant effect on consumption growth. Thus, our finding that floods are difficult to cope with and have a greater impact on consumption, while droughts and health shocks can be insured within a region is confirmed. The negative impact of floods is estimated with a slightly smaller value under different definitions of the disaster variables. Villagers had to reduce consumption by 32% (alternative (1)) or by 17% (alternative (2)) when their village was hit by a flood that destroy 50% or more of crops. Cross-terms of household attributes and droughts/floods reveal a pattern that is similar to that given in Table 5. Under alternative (2), in addition to health shocks, the damage-increasing impact of credit constraint is statistically significant with respect to droughts.

In order to examine whether our assumption of the orthogonality of health shocks to village-level natural disasters holds, we re-estimate the same regressions after deleting the $Z_i X_{2i} b_2$ term. The results of this re-estimation are similar to those already reported (Appendix Table 1). This is as expected since the health shock variables and flood/drought variables are not correlated (the bivariate correlation coefficient was not statistically significant even at the 20% level). Thus, our assumption appears to be valid.

In a different direction for the robustness check, different weights were employed in running the household-level regression. In the default specifications, we used the number of household members in the initial period as the weight to convert the regression results to become consistent with individual-based aggregates. Since there was a change in household size of certain households between the two surveys, weights based on the second survey

[20]Detailed results of these robustness checks are available on request.

and those based on the average of the two were attempted. The results obtained with this specification were almost identical to those reported here (not reported for the sake of brevity).

4.2.3 Vulnerability of food consumption

In order to infer the underlying mechanisms of the vulnerability of households from a different angle, we re-estimated the regression models by replacing the total consumption (excluding medical expenditure) by only food consumption. The regression results are summarized in Table 7, for which detailed results under the default definition of drought and flood variables are given in Appendix Table 2. As indicated in the lower portion of Table 7, the difference in the marginal impact of shocks across household types is highly similar to the one found for total consumption. In other words, the quadruple difference pattern remains the same even when only food consumption is considered. In this sense, the coexistence of consumption smoothing through credit markets and risk sharing is suggested from the dynamics of food consumption as well.

However, an interesting difference is found in the double difference pattern: the coefficient on floods is no longer significant, and assumes a slightly positive or slightly negative value depending on the definition of village-level shock variables; the coefficient on health shocks is highly positive and statistically significant at the 5% level. This implies that households increased consumption when hit by shocks, which is contrary to expectation. Across regions, the positive coefficient on health shocks was most evident in Sindh (specification (ii) in Appendix Table 2). Moreover, since flood damages were also concentrated in Sindh, the insignificant coefficient on floods is also mostly due to the difference in the food consumption dynamics in Sindh. After a more careful examination of the data, we have the following interpretation.[21]

The positive coefficient on health shocks and insignificant coefficient on floods could be due to a change in preference toward food. It is found that both health shocks and floods cause households to increase their budget share for food. Spending more on high-quality food for household members who have been injured and are seriously sick or taking more calories under exhaustive hygienic conditions when hit by floods appears to be rational behavior. It is likely that within-region and inter-village networks in rural Sindh may have contributed to the increase in food consumption in Sindh when villagers were hit by these disasters. Rural

[21] Another possibility could be the problem in the imputation of own-produced food consumption. Especially regarding floods, the local shock may have risen the local price of foods, resulting in a seemingly increased food consumption expenditure even when food consumption quantity did not change or declined. To check whether this is a serious problem, we re-estimated regressions using region-level prices in imputation or using subsample of households whose share of own-produced food consumption was low. The results were qualitatively similar to those in Table 7.

Sindh is known for the existence of big landlords who are closely connected and the patron-client relationships with such landlords at the top (Perera, 2003; Naqvi et al., 1989). In other words, landlord-based networks of patron-client relationships in Sindh could have served as such risk-sharing networks. Thus, the contrast between the total consumption dynamics and food consumption dynamics also suggests the existence of consumption smoothing through a kind of risk sharing across villages within a region.

5 Conclusion

This paper investigated the type of households in rural Pakistan that are vulnerable to natural disasters in terms of a decline in their consumption when their village was hit by natural disasters such as floods and droughts. The regression results associating observed changes in consumption to household characteristics and village-level disaster variables indicated the following results. The sensitivity of consumption changes to village-level shocks differentiated by the characteristics of households is different from that to idiosyncratic health shocks differentiated by similar characteristics. It was found that more landed households and households with greater access to formal financial institutions were less vulnerable to all these shocks. On the other hand, households in which the household head is educated and elderly as well as households with a greater number of working members bore a larger burden of village-level shocks, while they were not vulnerable to idiosyncratic health shocks. The coexistence of unequal access to credit markets and risk sharing among heterogeneous households in terms of risk tolerance may be responsible for these patterns.

There are several possible extensions that could be attempted in the future with regard to the impacts of village-level shocks. First, empirically distinguishing risk sharing, self-insurance, and the heterogenous impact of shocks on household income remains an important challenge. The evidence provided in this paper is only suggestive. Second, the actual mechanisms that enable intra-region and inter-village risk sharing must be identified. From anthropology literature on the rural society in Pakistan, it may be indicated that landlord-based networks of patron-client relationships are a possible mechanism. Since such networks are strongest in rural Sindh, this interpretation appears consistent with the regional contrast that Sindh villagers were protected against certain types of shocks but they suffered from the lowest average consumption level, while northern Punjab villagers enjoyed the highest average consumption level that was mostly self-insured. Third, the investigation of long-term welfare costs of natural disasters through (human) capital investment is highly recommended for further research.

What are the implications of the findings of this paper for the Pakistani Floods of 2010? Our best estimate for the impact of floods is a 20–40% decline in consumption, which is a substantial reduction considering the already low levels of initial consumption. Nevertheless, these estimates must be interpreted as the lower bound since they are based on flood data where between-village variation in damages was large. When there were unprecedented floods all over the country and they have a similar effect on a majority of the villages, risk coping across villages becomes highly difficult due to disrupted communication and transportation, thereby resulting in a huge loss of welfare. The contrast found in this paper with regard to the impact of droughts and floods on household consumption indicates this possibility in a qualitative manner.

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Table 1. Average consumption, poverty, and inequality measures based on expenditures in Pakistan

	PRHS-I (2001)	PRHS-II (2004)
1. Average welfare ratio		
Punjab and Sindh pooled (rural only)	**1.465**	**1.846**
	(0.029)	(0.038)
By regions		
Northern Punjab	**1.848**	**2.190**
	(0.064)	(0.070)
Southern Punjab	**1.546**	**1.886**
	(0.065)	(0.099)
Sindh	**1.175**	**1.617**
	(0.028)	(0.043)
2. Poverty Measures		
Punjab and Sindh pooled (rural only)		
Headcount index	**0.372**	**0.259**
	(0.014)	(0.013)
Poverty gap index	0.0950	0.0680
	(0.0047)	(0.0043)
Squared poverty gap index	0.0354	0.0260
	(0.0023)	(0.0022)
Headcount index by regions		
Northern Punjab	**0.196**	**0.154**
	(0.020)	(0.019)
Southern Punjab	**0.361**	**0.267**
	(0.026)	(0.024)
Sindh	**0.490**	**0.318**
	(0.022)	(0.021)
3. Atkinson inequality measures		
Punjab and Sindh pooled (rural only)	**0.359**	**0.425**
	(0.012)	(0.013)
By regions		
Northern Punjab	**0.336**	**0.394**
	(0.019)	(0.022)
Southern Punjab	**0.359**	**0.461**
	(0.027)	(0.032)
Sindh	**0.305**	**0.392**
	(0.015)	(0.016)

Notes: The inequality aversion parameter for Atkinson's inequality measure is set at 3. Conventional standard errors are reported in parenthesis for the average welfare ratio and poverty measures, while bootstrapped standard errors (the number of replications is 500) are reported in parentheses for inequality measures. Statistics are weighted in order to make figures representative of individual-level summary statistics.

Source: Calculated by the author from PRHS panel data (NOB=1,609).

Table 2. Household-level poverty transition in Pakistan from 2001 to 2004

	Status in PRHS-II (2004)		
Status in PRHS-I (2001)	Below *z*	Above *z*	Total
Punjab and Sindh pooled (rural only)			
Number of sample households			
Below *z*	182	342	524
Above *z*	176	909	1,085
Total	358	1,251	1,609
Transition probability (%)			
Below *z*	34.7	65.3	100.0
Above *z*	16.2	83.8	100.0
Northern Punjab			
Number of sample households			
Below *z*	27	58	85
Above *z*	42	383	425
Total	69	441	510
Transition probability (%)			
Below *z*	31.8	68.2	100.0
Above *z*	9.9	90.1	100.0
Southern Punjab			
Number of sample households			
Below *z*	50	80	130
Above *z*	47	242	289
Total	97	322	419
Transition probability (%)			
Below *z*	38.5	61.5	100.0
Above *z*	16.3	83.7	100.0
Sindh			
Number of sample households			
Below *z*	105	204	309
Above *z*	87	284	371
Total	192	488	680
Transition probability (%)			
Below *z*	34.0	66.0	100.0
Above *z*	23.5	76.5	100.0

Note: "*z*" is the poverty line corresponding to the official one (see footnote 7).
Source: Calculated by the author from PRHS panel data.

Table 3. Incidence of village-level production shocks in Pakistan

	Distribution of damage index* in *Rabi* season (%)					Distribution of damage index* in *Kharif* season (%)				
	0	1	2	3	4	0	1	2	3	4
Drought in the last year (Kharif 2003 and Rabi 2003/04)										
Northern Punjab	47.1	7.1	9.5	36.3	0.0	47.9	7.1	12.9	32.2	0.0
Southern Punjab	0.0	34.1	41.4	24.4	0.0	4.8	24.9	45.3	12.9	12.1
Sindh	61.7	4.4	10.3	15.6	8.2	81.5	5.4	3.7	2.9	6.5
Drought in the year before the last year (Kharif 2002 and Rabi 2002/03)										
Northern Punjab	54.4	7.1	6.4	32.2	0.0	50.8	7.1	3.0	35.7	3.3
Southern Punjab	8.7	37.6	16.4	37.3	0.0	8.5	30.2	56.3	5.1	0.0
Sindh	84.0	0.0	4.8	7.5	3.7	76.7	6.7	6.6	4.1	5.9
Drought in Kharif 2001 and Rabi 2001/02										
Northern Punjab	50.8	7.1	3.0	35.7	3.3	47.7	7.1	9.5	35.7	0.0
Southern Punjab	22.6	65.9	7.3	4.2	0.0	29.3	50.5	20.3	0.0	0.0
Sindh	79.2	7.0	4.7	2.0	7.1	79.7	2.5	3.7	2.0	12.1
Drought in Kharif 2000 and Rabi 2000/01										
Northern Punjab	85.0	0.0	0.0	15.0	0.0	85.0	0.0	0.0	15.0	0.0
Southern Punjab	100.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
Sindh	89.8	5.1	1.1	2.0	2.0	89.8	5.1	1.1	2.0	2.0
Flood in the last year (Kharif 2003 and Rabi 2003/04)										
Northern Punjab	100.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
Southern Punjab	100.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
Sindh	94.3	0.0	0.0	0.0	5.7	72.1	5.7	4.0	3.9	14.2
Flood in the year before the last year (Kharif 2002 and Rabi 2002/03)										
Northern Punjab	100.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
Southern Punjab	100.0	0.0	0.0	0.0	0.0	90.7	4.8	0.0	4.5	0.0
Sindh	69.1	8.0	4.5	6.5	11.9	84.9	0.0	2.8	2.4	9.9
Flood in Kharif 2001 and Rabi 2001/02										
Northern Punjab	100.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
Southern Punjab	100.0	0.0	0.0	0.0	0.0	95.8	4.2	0.0	0.0	0.0
Sindh	87.1	0.0	0.0	5.1	7.7	91.2	0.0	2.3	1.1	5.4
Flood in Kharif 2000 and Rabi 2000/01										
Northern Punjab	100.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
Southern Punjab	100.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
Sindh	98.9	0.0	0.0	1.1	0.0	98.9	0.0	0.0	1.1	0.0

Source: Calculated by the author from PRHS panel data (NOB=1,609).
Note: * The index takes 0 (``No effect'': no report for crop damage), 1 (``Little effect'': yield loss up to 10%), 2 (``Moderate'': 10-25% loss), 3 (``Severe'': 25-50% loss), and 4 (``Disaster'': over 50% loss). Since all of them are mutually exclusive, the sum of the percentage is 100.0.

Table 4. Summary statistics of empirical variables used in the regression analysis

Variable	Definition	Mean	Std.Dev.	Min	Max
Dependent variable					
dlnc	Log difference of the welfare ratio between PRHS-I and PRHS-II (consumption excluding durables, house rent, and medical expenditures).	0.175	0.611	-1.761	2.314
Explanatory variables: Household characteristics and idiosyncratic shocks					
landacre	Size of farmland owned by the household (acres).	4.947	11.679	0	102
livslrg	Number of large livestock animals owned by the household.	2.496	3.019	0	21
livssml	Number of sheep and goats owned by the household.	1.816	3.935	0	50
assets	Value of assets (durable consumption goods, transportation equipment, house buildings, etc.) owned by the household (Rs.1,000).	20.000	56.992	0	2001
nfe_perm	Number of male household members who were employed permanently by the private sector, government, or police.	0.239	0.561	0	5
nfe_casl	Number of male household members who were employed in non-farm activities on daily or contract basis.	0.429	0.742	0	4
remit	Dummy for a household that received remittances from family members living separately.	0.055	dummy	0	1
cc_fml	Dummy for a household that was constrained to the formal credit access.#	0.682	dummy	0	1
cc_inf	Dummy for a household that was constrained to the informal credit access.#	0.101	dummy	0	1
head_age	Age of household head (years).	47.639	14.283	14	99
head_sch	Education level of household head (completed years of schooling).	2.791	3.849	0	21
head_fem	Dummy for a female-headed household.	0.018	dummy	0	1
femratio	The ratio of females in the household size.	0.482	0.143	0	1
depratio	The ratio of dependent members (aged <15 and >60) in the household size.	0.476	0.186	0	1
popwt1	Household size (Nos.).	8.957	4.443	1	42
health_shock	Dummy variable for the household whose members experienced a severe health shock during the two survey periods resulting in medical treatment.	0.071	dummy	0	1
Explanatory variables: Village-level agricultural production shocks					
drought	Index variable* for crop damage due to drought in Rabi 04, Kharif 03, Rabi 03, and Kharif 02.	0.279	0.281	0	1
flood	Index variable* for crop damage due to flood in Rabi 04, Kharif 03, Rabi 03, and Kharif 02.	0.076	0.161	0	0.938

Notes: (1) The subsample used in the regression analyses is those households whose welfare ratio was lower than four in both PRHS-I and PRHS-II and whose size changed by less than or equal to three persons during the two surveys. Due to this selection, the number of households in this table is at most 1,293 (1,290 for cc_fml and cc_inf, and 1,243 for head_sch), against 1,609 in Tables 1 and 2.

(2) Means and standard deviations (Std.Dev.) are weighted by the household size in PRHS 1 in order to obtain individual-level summary statistics.

(3) All household-level variables are taken from the PRHS-I dataset, except for "remit", which corresponds to the remittance receipts in the agricultural year of 2003/04.

Households were regarded as constrained if they needed to borrow from the formal (informal) sector and applied for a loan but rejected; or, if they needed to borrow from the formal (informal) sector but did not apply for the loan because the credit institutions are too far away, there is no guarantee available, no collateral, excessive procedures, etc. The corresponding period for formal loans is "ever until 2000/01" while that for informal loans is "during 2000/01".

* The sum of index variables for the four seasons in the last two years in Table 3 divided by 16.

Source: Calculated by the author from PRHS panel data.

Table 5. Sensitivity of consumption changes to village-level production shocks in Pakistan

	Dependent variable: *dlnc* (change in log consumption)			
	(i) Without cross-terms		(ii) With cross-terms with region dummies	
Explanatory variables	Coef.	S.E.	Coef.	S.E.
Region fixed effects				
intercept	0.0555	(0.1123)	0.0532	(0.1145)
South.Punjab	-0.1097 **	(0.0474)	-0.2412 **	(0.1033)
Sindh	0.2321 ***	(0.0508)	0.2544 ***	(0.0626)
Household characteristics				
landacre	-0.0062 **	(0.0025)	-0.0058 **	(0.0024)
livslrg	-0.0041	(0.0068)	-0.0030	(0.0068)
livssml	-0.0126 **	(0.0063)	-0.0123 *	(0.0064)
assets	0.0003	(0.0002)	0.0002	(0.0002)
nfe_perm	0.0884 **	(0.0347)	0.0871 **	(0.0351)
nfe_casl	0.0077	(0.0254)	0.0094	(0.0257)
remit	0.1223 *	(0.0726)	0.1238 *	(0.0734)
cc_fml	0.0394	(0.0418)	0.0372	(0.0420)
cc_inf	0.0741	(0.0594)	0.0744	(0.0596)
head_age	0.0016	(0.0013)	0.0015	(0.0013)
head_sch	0.0032	(0.0051)	0.0027	(0.0051)
head_fem	-0.0198	(0.1099)	-0.0140	(0.1122)
femratio	-0.1597	(0.1230)	-0.1550	(0.1230)
depratio	0.2561 ***	(0.0944)	0.2501 ***	(0.0947)
popwt1	-0.0054	(0.0060)	-0.0059	(0.0060)
Village-level shocks				
drought	-0.0081	(0.0655)		
drought*North.Punjab			0.0193	(0.0926)
drought*South.Punjab			0.3164	(0.1970)
drought*Sindh			-0.1428	(0.1069)
flood	-0.4654 ***	(0.1410)		
flood*South.Punjab			-1.0140	(0.9604)
flood*Sindh			-0.4286 ***	(0.1450)
Idiosyncratic shocks				
health_shock	-0.0878	(0.0605)		
health_shock*North.Punjab			-0.1028	(0.1151)
health_shock*South.Punjab			-0.0886	(0.0939)
health_shock*Sindh			-0.0605	(0.0980)
F-stat for zero slopes#	4.46 ***		3.76 ***	
F-stat for homogenous impact#			0.90	
R-squared	0.090		0.093	

Notes: NOB is 1,241 (several households whose "head_sch" was missing were excluded). Estimated by weighted least squares with household size as weights. Huber-White robust standard errors are reported in parenthesis, with * 10%, ** 5%, and *** 1% statistical significance levels.

"F-stat for zero slopes" indicates the F statistics for the null hypothesis that the empirical model has no explanatory power. It is distributed as F(20,1220) for specification (i), F(25,1215) for specification (ii), F(41,1199) for specification (iii), and F(27,1213) for specification (iv), under the null. "F-stat for homogenous impact" indicates the F statistics for the null hypothesis of specification (i) against others. It is distributed as F(5,1215) for specification (ii), F(21,1199) for specification (iii), and F(7,1213) for specification (iv), under the null.

Source: Estimated by the author from PRHS panel data.

Table 5. Sensitivity of consumption changes to village-level production shocks in Pakistan (cont'd)

	Dependent variable: *dlnc* (change in log consumption)			
	(iii) With all cross terms with households' initial attributes		(iv) Parsimonious specification	
Explanatory variables	Coef.	S.E.	Coef.	S.E.
Region fixed effects	(Yes)		(Yes)	
Household characteristics	(Yes)		(Yes)	
Village-level shocks and their cross-terms with household characteristics				
drought	0.0986	(0.2936)	-0.4132 **	(0.1686)
drought*landacre	0.0119	(0.0075)	0.0139 **	(0.0069)
drought*nfe_perm	-0.0187	(0.1232)		
drought*remit	-0.3490	(0.2627)		
drought*cc_fml	-0.1979	(0.1435)		
drought*head_age	-0.0060	(0.0043)		
drought*head_sch	-0.0036	(0.0179)		
drought*depratio	0.5984 *	(0.3205)	0.7181 **	(0.3182)
flood	1.0307 **	(0.4614)	0.6296	(0.4108)
flood*landacre	0.0141	(0.0095)	0.0153 *	(0.0089)
flood*nfe_perm	0.1142	(0.3229)		
flood*remit	0.1280	(0.7966)		
flood*cc_fml	-0.1298	(0.2358)		
flood*head_age	-0.0270 ***	(0.0090)	-0.0246 ***	(0.0087)
flood*head_sch	-0.0393 *	(0.0227)	-0.0404 *	(0.0223)
flood*depratio	-0.4542	(0.5199)		
Idiosyncratic shocks and their cross-terms with household characteristics				
health_shock	0.0330	(0.2352)	0.0363	(0.0759)
health_shock*landacre	0.0109 **	(0.0051)	0.0111 **	(0.0050)
health_shock*nfe_perm	-0.1484	(0.0990)		(0.0834)
health_shock*remit	0.1932	(0.2002)		
health_shock*cc_fml	-0.2822 ***	(0.1066)	-0.2773 ***	(0.1004)
health_shock*head_age	0.0000	(0.0032)		
health_shock*head_sch	0.0164	(0.0127)		
health_shock*depratio	-0.0191	(0.2963)		
F-stat for zero slopes#	3.80 ***		4.84 ***	
F-stat for homogenous impact#	2.49 ***		5.03 ***	
R-squared	0.120		0.113	

Table 6. Robustness check with respect to the definition of production shock variables

	Default#			Alternative (1)			Alternative (2)		
	Production shock variables corresponding to the average of the last two years (Kharif 2002, Rabi 2002/03, Kharif 2003, and Rabi 2003/04)			Production shock variables corresponding to the larger of the last two years (Kharif 2002 and Rabi 2002/03, or, Kharif 2003 and Rabi 2003/04)			Production shock variables corresponding to the last year (Kharif 2003 and Rabi 2003/04)		
(i) Without cross-terms									
drought	-0.0081		(0.0655)	-0.0017		(0.0596)	-0.0963		(0.0605)
flood	-0.4654	***	(0.1410)	-0.3789	***	(0.0839)	-0.2167	**	(0.1087)
health_shock	-0.0878		(0.0605)	-0.0890		(0.0601)	-0.0799		(0.0606)
(ii) With cross terms with households' initial attributes, parsimonious									
drought*landacre	0.0139	**	(0.0069)	0.0128	**	(0.0054)			
drought*cc_fml							-0.2358	*	(0.1269)
drought*depratio	0.7181	**	(0.3182)	0.6309	**	(0.2914)	0.5174	*	(0.3010)
flood*landacre	0.0153	*	(0.0089)						
flood*head_age	-0.0246	***	(0.0087)				-0.0132	**	(0.0065)
flood*head_sch	-0.0404	*	(0.0223)	-0.0281	*	(0.0159)	-0.0485	***	(0.0185)
health_shock*landacre	0.0111	**	(0.0050)	0.0102	*	(0.0053)			
health_shock*cc_fml	-0.2773	***	(0.1004)	-0.2758	***	(0.1022)	-0.3188	***	(0.1043)

Notes: See Table 5 for the estimation methodology, number of observations, and list of explanatory variables not reported in this table. The mean (standard deviation) of the alternative shock variables are: Alternative (1), drought 0.332 (0.312), flood 0.119 (0.258); Alternative (2), drought 0.306 (0.304), flood 0.060 (0.189).

Specification (i) is subtracted from (i) in Table 5, and specification (ii) is subtracted from (iv) in Table 5.

Table 7. Sensitivity of food consumption changes to village-level production shocks in Pakistan

	Dependent variable: *dlncf* (change in log food consumption)					
	Production shock=Default		=Alternative (1)		=Alternative (2)	
(i) Without cross-terms						
drought	0.0192	(0.0653)	0.0236	(0.0601)	-0.0134	(0.0619)
flood	-0.0089	(0.1396)	-0.1064	(0.0856)	0.1287	(0.1092)
health_shock	0.1380 **	(0.0593)	0.1309 **	(0.0589)	0.1451 **	(0.0593)
(ii) With cross terms with households' initial attributes, parsimonious						
drought*landacre	0.0119 *	(0.0065)			0.0123 ***	(0.0047)
drought*head_age	-0.0120 ***	(0.0043)	-0.0087 **	(0.0039)	-0.0095 **	(0.0041)
flood*landacre	0.0200 **	(0.0079)	0.0161 ***	(0.0058)	0.0134 **	(0.0055)
flood*head_age	-0.0270 ***	(0.0083)	-0.0135 ***	(0.0049)	-0.0192 ***	(0.0063)
flood*depratio					-0.7853 *	(0.4697)
health_shock*landacre	0.0100 **	(0.0040)	0.0106 ***	(0.0036)	0.0099 **	(0.0040)
health_shock*cc_fml	-0.1936 *	(0.1096)			-0.1946 *	(0.1100)

Notes: See Table 5 for the estimation methodology, number of observations, and list of explanatory variables not reported in this table. The mean (standard deviation) of the dependent variable 0.176 (0.635).

Appendix Table 1. Robustness check with respect to the exclusion of idiosyncratic shock variables

	Dependent variable: *dlnc* (change in log consumption)								
	Production shock=Default			=Alternative (1)			=Alternative (2)		
(i) Without cross-terms									
drought	-0.0086		(0.0656)	-0.0025		(0.0597)	-0.0965		(0.0606)
flood	-0.4524	***	(0.1402)	-0.3722	***	(0.0835)	-0.2069	*	(0.1082)
(ii) With cross terms with households' initial attributes, parsimonious									
drought*landacre	0.0130	*	(0.0071)	0.0122	**	(0.0056)			
drought*cc_fml							-0.2385	*	(0.1271)
drought*depratio	0.7083	**	(0.3179)	0.6256	**	(0.2915)	0.5374	*	(0.3018)
flood*landacre	0.0153	*	(0.0090)						
flood*head_age	-0.0244	***	(0.0086)				-0.0131	**	(0.0065)
flood*head_sch	-0.0421	*	(0.0222)	-0.0290	*	(0.0158)	-0.0488	***	(0.0184)

Notes: See Table 5 for the estimation methodology, number of observations, and list of explanatory variables not reported in this table. All specifications exclude the terms associated with variable *health_shock* from the list of explanatory variables.

Appendix Table 2. Sensitivity of food consumption changes to village-level production shocks

	Dependent variable: *dlncf* (change in log food consumption)					
	(i) Without cross-terms			(ii) With cross-terms with region dummies		
Explanatory variables	Coef.		S.E.	Coef.		S.E.
Region fixed effects						
intercept	0.0071		(0.1151)	0.0054		(0.1157)
South.Punjab	-0.1616	***	(0.0476)	-0.2989	***	(0.1047)
Sindh	0.1969	***	(0.0520)	0.1648	***	(0.0627)
Household characteristics						
landacre	-0.0074	***	(0.0025)	-0.0070	***	(0.0024)
livslrg	-0.0036		(0.0069)	-0.0015		(0.0067)
livssml	-0.0159	***	(0.0056)	-0.0149	***	(0.0056)
assets	0.0002		(0.0002)	0.0002		(0.0002)
nfe_perm	0.0694	**	(0.0346)	0.0688	**	(0.0346)
nfe_casl	-0.0088		(0.0277)	-0.0018		(0.0282)
remit	0.0621		(0.0645)	0.0609		(0.0628)
cc_fml	0.0110		(0.0412)	0.0165		(0.0408)
cc_inf	0.0423		(0.0605)	0.0324		(0.0597)
head_age	0.0011		(0.0014)	0.0009		(0.0014)
head_sch	0.0041		(0.0055)	0.0039		(0.0056)
head_fem	0.0504		(0.0969)	0.0471		(0.0975)
femratio	-0.0739		(0.1264)	-0.0562		(0.1261)
depratio	0.2319	**	(0.0980)	0.2422	**	(0.0974)
popwt1	0.0012		(0.0066)	0.0000		(0.0064)
Village-level shocks						
drought	0.0192		(0.0653)			
drought*North.Punjab				0.0220		(0.0822)
drought*South.Punjab				0.4071	**	(0.2019)
drought*Sindh				-0.1023		(0.1175)
flood	-0.0089		(0.1396)			
flood*South.Punjab				-1.9646	**	(0.8922)
flood*Sindh				0.1109		(0.1429)
Idiosyncratic shocks						
health_shock	0.1380	**	(0.0593)			
health_shock*North.Punjab				0.0059		(0.0895)
health_shock*South.Punjab				-0.0567		(0.0939)
health_shock*Sindh				0.3360	***	(0.0936)
F-stat for zero slopes#	4.47	***		4.56	***	
F-stat for homogenous impact#				2.89	**	
R-squared	0.090			0.104		

Notes: See Table 5.

Appendix Table 2. Sensitivity of food consumption changes to village-level production shocks (cont'd)

	Dependent variable: *dlncf* (change in log food consumption)			
	(iii) With all cross terms with households' initial attributes		(iv) Parsimonious specification	
Explanatory variables	Coef.	S.E.	Coef.	S.E.
Region fixed effects	(Yes)		(Yes)	
Household characteristics	(Yes)		(Yes)	
Village-level shocks and their cross-terms with household characteristics				
drought	0.5372 *	(0.3043)	0.5340 **	(0.2239)
drought*landacre	0.0108	(0.0072)	0.0119 *	(0.0065)
drought*nfe_perm	-0.1096	(0.1160)		
drought*remit	-0.1531	(0.1908)		
drought*cc_fml	-0.1646	(0.1365)		
drought*head_age	-0.0107 **	(0.0044)	-0.0120 ***	(0.0043)
drought*head_sch	-0.0140	(0.0183)		
drought*depratio	0.2727	(0.3374)		
flood	1.1117 **	(0.4582)	1.0508 ***	(0.3848)
flood*landacre	0.0229 ***	(0.0077)	0.0200 **	(0.0079)
flood*nfe_perm	0.0939	(0.3303)		
flood*remit	0.2208	(0.5739)		
flood*cc_fml	0.3851	(0.2391)		
flood*head_age	-0.0287 ***	(0.0088)	-0.0270 ***	(0.0083)
flood*head_sch	-0.0061	(0.0257)		
flood*depratio	-0.4197	(0.5517)		
Idiosyncratic shocks and their cross-terms with household characteristics				
health_shock	0.1480	(0.2528)	0.2022 **	(0.0882)
health_shock*landacre	0.0113 ***	(0.0040)	0.0100 **	(0.0040)
health_shock*nfe_perm	-0.0004	(0.0987)		(0.0834)
health_shock*remit	0.1173	(0.1343)		
health_shock*cc_fml	-0.1164	(0.1120)	-0.1936 *	(0.1096)
health_shock*head_age	-0.0012	(0.0034)		
health_shock*head_sch	0.0241	(0.0166)		
health_shock*depratio	-0.0554	(0.3315)		
F-stat for zero slopes#	4.20 ***		5.25 ***	
F-stat for homogenous impact#	2.28 ***		5.64 ***	
R-squared	0.120		0.112	