

# Consumption Insurance and Vulnerability to Poverty: A Synthesis of the Evidence from Bangladesh, Ethiopia, Mali, Mexico and Russia

EMMANUEL SKOUFIAS  
and AGNES R. QUISUMBING

*This paper synthesises the results of five IFPRI studies using household panel data from Bangladesh, Ethiopia, Mali, Mexico and Russia, which examine the extent to which households are able to insure their consumption from specific economic shocks and fluctuations in their real income. The extent of consumption insurance is defined by the degree to which the growth rate of household consumption covaries with the growth rate of household income. All the case studies show that food consumption is better insured than non-food consumption from idiosyncratic shocks. Adjustments in non-food consumption appear to act as a mechanism for partially insuring ex-post food consumption from the effects of income changes. Food consumption is also more likely to be covered by informal insurance arrangements at the community level than non-food consumption. Households use a portfolio of risk-coping strategies, but may not be equally able to use them. Poorer households may be less able to use mechanisms that rely on initial wealth as collateral. In this regard, public transfer programmes may have a more redistributive effect.*

*Cet article synthétise les résultats de 5 études de l'IFPRI qui utilisent des panels de données concernant le Bangladesh, le Mali, l'Éthiopie, le Mexique et la Russie, et s'interrogent sur la capacité des ménages à assurer leur consommation par rapport à des chocs économiques spécifiques et des fluctuations de leur revenu réel. L'importance de l'assurance-consommation est définie par le degré de la covariance entre le taux de croissance de la consommation des ménages et celui du revenu des ménages. Toutes les études de cas montrent que la consommation*

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Emmanuel Skoufias is at the World Bank, Washington, DC and Agnes R. Quisumbing is at the International Food Policy Research Institute, Washington, DC. Funding for the research was provided by the World Bank as part of work being undertaken by the International Food Policy Research Institute on consumption smoothing and vulnerability. The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors. They do not necessarily reflect the view of the World Bank or IFPRI. The authors would like to thank Stefan Dercon, Lant Pritchett, Paul Glewwe, and Emil Tesliuc for helpful comments and suggestions. All errors and omissions are the authors'.

*alimentaire est mieux couverte que la consommation non-alimentaire par rapport aux chocs idiosyncratiques. Les ajustements de la consommation non-alimentaires semblent constituer un mécanisme ex-post d'assurance partielle des effets des changements de revenus sur la consommation alimentaire. Cette dernière est mieux à même d'être couverte par des arrangements informels au niveau communautaire que la consommation non-alimentaire. Les ménages utilisent un portefeuille de stratégies de couverture de risque, mais ne sont pas tous également capables d'en tirer parti. Les plus pauvres sont peut-être moins en mesure de faire usage de mécanismes fondés sur des garanties constituées par la richesse initiale du ménage. Dans cette perspective, les programmes publics de transfert pourraient avoir un effet plus redistributif.*

## I. INTRODUCTION AND MOTIVATION

During the last few years the increasing recognition that there are considerable flows into and out of the poverty pool [e.g. *Baulch and Hoddinott, 2000*] has focused interest in household vulnerability as the basis for a social protection strategy. A social protection scheme may be more effective in protecting households from the adverse effects of poverty by adopting a forward looking approach that identifies not only the groups of households that are presently poor but also the households that are vulnerable to economic shocks and other risks [*Holzmann and Jorgensen, 2000*]. Whether households can effectively insure their consumption against shocks may be an important element determining their vulnerability to poverty, particularly if shocks have long-term effects.

This paper brings together empirical work conducted by International Food Policy Research Institute (IFPRI) researchers which investigates linkages among the degree of consumption insurance, households' vulnerability to poverty, and household coping mechanisms using the same approach in five different countries. We define the degree of consumption insurance as the extent to which the growth rate of household consumption covaries with the growth rate of household income. This definition explicitly acknowledges that households may adopt a variety of risk management strategies and instruments. Households in a community, for example, may informally agree to insure each other or provide state contingent transfers and remittances to friends and neighbours [*Rosenzweig, 1988; Besley, 1995; Morduch, 1999*]. Households may undertake *ex-ante* income-smoothing strategies and adopt low return-low risk crop and asset portfolios [*Rosenzweig and Binswanger, 1993*]. Households may use their savings [*Paxson, 1992*], take loans from the formal financial sector to carry them through the difficult times [*Udry, 1994*], sell assets [*Deaton, 1992*], or send their children to work instead of school in order to supplement income [*Jacoby and Skoufias, 1997*]. These actions enable households to spread the effects of income shocks through time. Additional strategies include

the management of income risk through *ex-post* adjustments in labour supply such as multiple job holding, and engaging in other informal economic activities [Morduch, 1995; Kochar, 1998].<sup>1</sup>

The risk sharing literature suggests that attempts to insure consumption from shocks have implications on the extent to which the growth rate of consumption is correlated with the size of the shock. In fact, in its extreme version the perfect risk sharing hypothesis implies that, once aggregate shocks are taken into consideration, the growth rate of consumption would be independent of any idiosyncratic shock affecting the resources of or the income available to the household [e.g. Mace, 1991; Cochrane, 1991; Deaton, 1992; Townsend, 1994]. The measure of consumption insurance adopted here builds on these insights. This measure implicitly assumes that the greater the correlation between the growth rate of household consumption and income, the less effective is the risk management strategy adopted by the household.

We begin by discussing the theoretical framework behind the proposed measure of insurance, and its relation to other measures that have been empirically implemented in the recent literature. Section III summarises the main findings from the five studies representing five very different socio-economic environments: Bangladesh, Ethiopia, Zone Lacustre in Mali, Mexico and Russia. All five studies investigate the extent to which households manage to protect their consumption from specific shocks such as loss of productive time due to illness (Mali, Bangladesh and Ethiopia), loss of livestock (due to theft or death) and wage and employment shocks (Russia). In addition all five studies examine how household consumption correlates with income changes. At this aggregate level three main questions are addressed. The first concerns the extent to which households are able to smooth their food and non-food consumption across time. The second examines the relationship between consumption insurance and vulnerability to poverty. In the Bangladesh, Ethiopia and Russia case studies, repeated observations per household are used to construct a household-specific consumption insurance measure.<sup>2</sup> This allows one to examine the partial correlation of household consumption insurance with household characteristics and the extent to which households' ability to insure their consumption is correlated with the current status of poverty of the household, the probability of a household becoming poor over time, and the proportion of time a household spends in poverty.

Finally, the third question relates to the different strategies households adopt in order to smooth their consumption. In particular, is consumption smoothing achieved primarily through cross-sectional risk pooling institutions, credit markets that spread the effects of income shocks through time, or by adjustments in labour supply and occupation? Understanding the specific strategies that households adopt to buffer income fluctuations is critical to the design of an effective social safety net system in any country. Chronic and transient poverty

could be simultaneously reduced by providing the appropriate risk management instruments to households that do not have access to them.

## II. AN ECONOMIC FRAMEWORK FOR UNDERSTANDING VULNERABILITY TO RISK

The theoretical model guiding the empirical analysis is based on the consumer's optimisation problem assuming a complete market for state contingent commodities [e.g., Deaton, 1992]. This assumption may be considered as a simple approximation to all the formal and informal arrangements across space and over time that households can enter into in order to protect themselves from risk. Households within a given insurance community, such as a family, or a village or a city or even a nation, are assumed to purchase state contingent commodities so as to maximise

$$V^h = \sum_{s=1}^S \sum_{t=1}^T \pi_s \vartheta_t(c_{ts}^h) = \sum_{s=1}^S \sum_{t=1}^T \pi_s (1 + \delta)^{-t} \vartheta(c_{ts}^h) \quad (1)$$

where  $\vartheta_t(c_{ts}^h)$  is the period-specific utility function of household  $h$  in period  $t$  as a function of its consumption in state  $s$  and in period  $t$ , assumed to be discounted to the present by the subjective discount rate  $\delta$ , and  $\pi_s$  is the probability of state  $s$  (assumed to be the same for all households). With the ability to buy in period 1 a unit of consumption in state  $s$  at time  $t$  for  $p_{st}(1+r)^{-t}$ , and assuming that household  $h$  has initial assets  $A_1^h$  and labour income in period  $t$  and state  $s$ , denoted by  $y_{st}^h$ , the lifetime budget constraint of household  $h$  can be expressed as

$$\sum_{s=1}^S \sum_{t=1}^T p_{st} c_{st}^h (1+r)^{-t} = A_1^h + \sum_{s=1}^S \sum_{t=1}^T p_{st} y_{st}^h (1+r)^{-t}. \quad (2)$$

Thus the existence of the market in contingent claims allows the problem to be written as the maximisation of expected utility subject to an expected value budget constraint. The first order optimisation condition for (1) subject to (2) with the associated Lagrange multiplier for household  $h$ , denoted by  $\theta^h$ , is

$$\lambda_t(c_{st}^h) = \vartheta'_t(c_{st}^h) = \theta^h \left( \frac{1 + \delta}{1 + r} \right)^t \frac{p_{st}}{\pi_s} = \theta^h \mu_t, \quad (3)$$

where  $\mu_t = \left( \frac{1 + \delta}{1 + r} \right)^t \frac{p_{st}}{\pi_s}$ , and  $\lambda_t(c_{st}^h)$  is the marginal utility of consumption in period  $t$ . Thus the main implication is that the marginal utility of consumption has a two-factor structure, consisting of a household-specific component  $\theta^h$  and a time-specific component  $\mu_t$ .

Given a specific functional form for the utility function such as an isoelastic utility function  $\vartheta(c_t) = \frac{1}{1-\rho} c_t^{1-\rho} f(z_t)$  where  $f(z_t)$  is a function allowing for the influence of time-varying taste factors, equation (3) may be expressed, after

logarithmic transformation, as<sup>3</sup>

$$\ln c_t^h = -\rho^{-1}(\ln \theta^h - \ln f(z_t) + \ln \mu_t),$$

which after first-differencing over time, yields

$$\Delta \ln c_t^h = -\rho^{-1}(-\Delta f(z_t) + \Delta \ln \mu_t). \quad (4)$$

Equation (4) implies that the growth rate in household consumption between time  $t - 1$  and  $t$ , after controlling for the influence of time-varying taste factors, is a function only of the growth rate in the aggregate or covariate risk summarised by the term  $-\rho^{-1}(\Delta \ln \mu_t)$ .

The version of equation (4) that is more commonly encountered in the empirical literature [e.g. *Ravallion and Chaudhuri, 1997; Jacoby and Skoufias, 1998*] is of the form

$$\Delta \ln c_{hvt} = \sum_v \delta_{tv}(D_{tv}) + \beta \Delta \ln y_{hvt} + \delta X_{hvt} + \Delta \varepsilon_{hvt} \quad (5)$$

where  $\Delta \ln c_{hvt}$  denotes the change in log consumption or the growth rate in total consumption per capita of household  $h$ , in period  $t$  (i.e., between round  $t$  and round  $t - 1$ ), in community  $v$ ,  $\Delta \ln y_{hvt}$  is the growth rate of income,  $X$  is a vector of household or household head's characteristics,  $\delta$ ,  $\beta$  and  $\delta$  are parameters to be estimated,  $\Delta \varepsilon_{hvt}$  is a household-specific error term capturing changes in the unobservable components of household preferences, and  $D_{tv}$  denotes a set of binary variables identifying each community separately by survey round. This set of survey round/community interaction terms is meant to control for the role of aggregate or covariate risk faced by households in the insurance community.

In this specification, the parameter  $\beta$  provides an estimate of the extent to which *idiosyncratic* income changes play a significant role in explaining the household-specific consumption growth rate. Unlike specific models of intertemporal consumption such as the permanent income model of consumption which predicts that with perfect credit markets, only unanticipated income changes affect consumption growth [e.g., *Deaton, 1992*], the idiosyncratic income changes in equation (5) can be both anticipated and unanticipated.<sup>4</sup> The set of binary terms  $D_{tv}$  identifying communities by survey round serves two interrelated functions. Firstly, they control for the role of aggregate (or covariate) shocks common to all households within any given community and survey round, i.e. the term  $-\rho^{-1}(\Delta \ln \mu_t)$  in equation (4).<sup>5</sup> Secondly, given that consumption and income are in logarithms, they also account for potential differences in the round to round inflation rate across communities.<sup>6</sup>

Much of the focus of the empirical literature on risk sharing in developing and developed countries alike has focused on testing the prediction derived under complete risk sharing which states that  $\beta = 0$  [see *Townsend, 1994; Mace, 1991;*

Jacoby and Skoufias, 1998].<sup>7</sup> Although complete risk sharing is frequently rejected, estimated values of  $\beta$  are generally low (or close to zero) which implies that the growth rate of consumption is related to the (contemporaneous) growth rate of income, but certainly less than what one would expect under an alternative hypothesis (e.g.  $\beta = 1$ ) as implied by complete autarky and the complete lack of any risk sharing tools. These findings provide strong indications that households engage in risk management strategies aimed at insulating, at least partially, consumption changes from income changes. As in Amin, Rai, and Topa [2003], the measure of consumption insurance adopted here interprets higher estimated values of  $\beta$  as signifying a higher covariance between income and consumption changes and thus a higher vulnerability of consumption to income risk.<sup>8</sup>

Undoubtedly, the data requirements associated with the estimation of regression (5) are quite severe. Not only is it necessary to have a panel household survey but the survey must also collect information on both household consumption and income. Moreover, if the coefficient  $\beta$  summarising the partial covariance between consumption and income changes is to be estimated with some precision at the household level, it is necessary to have at least three or four repeated observations per household in the panel.<sup>9</sup> To the extent that repeated observations per household in most panel surveys do not exceed two or three, one may have to settle with estimating the degree of consumption insurance for groups of households with a group defined by some observable (and preferably time invariant) characteristic.

We now relate this measure of consumption insurance to other measures of vulnerability encountered recently in the literature. Firstly, the estimated value of the coefficient  $\beta$  provides a measure of the *degree of consumption insurance*, or the extent to which consumption growth is insured from idiosyncratic income shocks. A measure of vulnerability commonly encountered in the literature is that of *vulnerability to poverty*, typically measured by the probability that the consumption of a household will fall below a predetermined poverty line within a fixed time interval [see Pritchett et al., 2000; Chaudhuri et al., 2001; Christiaensen and Subbarao, 2001]. Vulnerability to poverty attempts to predict (*ex-ante*) the probability that a household may become poor during a fixed time interval, whereas the degree of consumption insurance focuses on the extent to which households are successful (*ex-post*) at insulating their consumption from changes in their income opportunities and other shocks. It is possible, though perhaps not very likely, for an apparently non-poor household to be well insured, and yet be vulnerable to poverty.<sup>10</sup> Households may avoid taking risky but profitable opportunities or practice income smoothing as a substitute for consumption smoothing [Morduch, 1994]. In that sense, the degree of income risk may in fact be endogenous. Others may be able to smooth their consumption through coping strategies that deplete their assets, such as selling their livestock [Rosenzweig and Wolpin, 1993], withdrawing their children from school when

there are shortfalls in income [*Jacoby and Skoufias, 1997*], or using assets as a buffer for consumption [*Deaton, 1992*]. As a consequence of all these risk management and risk-coping strategies, households may appear to be more insured, when in fact their vulnerability to future poverty may be increasing. Clearly, the extent to which consumption insurance is informative about vulnerability to poverty is a question that can only be addressed empirically.<sup>11</sup> One advantage of our proposed approach is the opportunity to determine the extent to which lack of insurance is correlated with the probability of a household becoming poor (or vulnerability to poverty).

Another important aspect of the consumption insurance measure is that it is based on the covariance of consumption *and* income changes and not solely on the variance of consumption *or* income changes. Thus it does not necessarily follow that households with a higher variance in income (or income growth) or a higher variance of consumption (or consumption growth) will be also less insured. In other words, if the variance of income growth faced by a household increases, this does not necessarily imply that the household will be more vulnerable to risk. In contrast, measures of vulnerability to poverty are to a large extent related or even synonymous with increases in the variance of consumption within a cross-section of households [*as in Chaudhuri et al., 2001*] or the variance of consumption growth [*as in Pritchett, et al., 2000; Kamanou and Morduch, 2002*].<sup>12</sup>

Thirdly, the focus on income risk implicitly assumes that all shocks experienced by a household affect the growth rate of household consumption through their impact on the contemporaneous growth rate on household income. Put differently, the growth rate of household income is assumed to act as a ‘sufficient statistic’ for all the shocks experienced by the household. Following the same general approach to defining vulnerability, Dercon and Krishnan [2000], for example, use shocks instead of income. For example, their measure of vulnerability to poverty is basically determined by the coefficients of shock variables (or an index constructed of various shock variables) estimated from a regression equation such as

$$\Delta \ln c_{htv} = \sum_{iv} \delta_{iv}(D_{iv}) + \sum_i \beta_i S(i)_{htv} + \gamma X_{hvt} + \Delta \varepsilon_{hvt} \quad (6a)$$

where  $S(i)$  denotes shocks such as crop damage due to pests, illness and other shocks. One practical advantage of using income as opposed to specific shocks as in (6a) is that information available on shocks that might have impacted on the household can be used as an instrument for the change in household income to account for the role of measurement error in income.<sup>13</sup>

Another advantage of the proposed insurance measure is the opportunity to determine exposure to risk arising from idiosyncratic risk and covariate risk separately as well as in combination. While the discussion so far has focused on the coefficient of idiosyncratic income changes (that is after controlling for covariate

risk or community round effects), with minor changes in the specification of equation (5) one may also analyse consumption variability arising from aggregate risk. One option is to simply exclude from the equation to be estimated the set of binary variables  $D_{tv}$  summarising covariate risk, as in equation (6b) below.

$$\Delta \ln c_{htv} = \alpha + \tilde{\beta} \Delta \ln y_{htv} + \delta X_{hvt} + \Delta \varepsilon_{hvt}. \quad (6b)$$

In this case the coefficient  $\tilde{\beta}$  provides an estimate of consumption variability inclusive of both idiosyncratic and aggregate shocks. To the extent that risk sharing takes place and covariate risk has a significant role in explaining household consumption changes, then it is expected that  $\tilde{\beta} > \beta$  with the difference  $\gamma = \tilde{\beta} - \beta$  summarising the role of covariate risk in the growth rate of consumption.<sup>14</sup>

A related specification with weaker theoretical foundations is that of equation (7) below [Deaton 1997; Ravallion and Chaudhuri, 1997].

$$\Delta \ln c_{htv} = \alpha + \beta \Delta \ln y_{hvt} + \gamma \Delta (\overline{\ln y_{vt}}) + \delta X_{hvt} + \Delta \varepsilon_{hvt}. \quad (7)$$

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 community income denoted by  $\Delta (\overline{\ln y_{vt}})$ . In a purely autarkic world, where there is no pooling of resources and risk sharing, the growth rate in the average community income should have no impact on the growth rate of consumption of any one household. Evidence that the growth rate in average community income has a significant role in the growth rate of household consumption (i.e.,  $\gamma \neq 0$ ) is consistent with the hypothesis that some risk sharing is taking place within communities.<sup>15</sup>

One drawback of this approach, however, is its symmetric treatment of positive and negative shocks. The consumption insurance approach implicitly suggests that the distinction between positive and negative shocks is irrelevant. However, the factors that determine whether one can deal with positive shocks (including access to safe assets and savings instruments) rather than negative shocks (selling assets, receiving transfers, or obtaining credit) may be quite different in general and between households.<sup>16</sup> While credit may be hard to obtain, savings (via livestock or grain stores) is likely to be easier. Thus, interpreting  $\beta$  from (5) as a measure of vulnerability – rather than a measure of consumption insurance – could lead to wrong inferences about the vulnerability of households.<sup>17</sup>

### III. CONSUMPTION INSURANCE AND POVERTY: SUMMARY AND DISCUSSION OF FINDINGS

The five case studies discussed here cover very geographically diverse areas. The Bangladesh data come from a four-round panel survey of 957 households

conducted at four-month intervals between June 1996 and September 1997 in 47 villages in three sites in Bangladesh, each site chosen as part of an impact evaluation of a programme disseminating new agricultural technologies [Quisumbing, 2002a]. The Ethiopia case study uses four rounds of the Ethiopian Rural Household Survey (ERHS) [Quisumbing, 2002b]. The first three rounds of this survey were conducted in 1994/95 while the fourth round was conducted in 1997. The ERHS covers approximately 1,500 households randomly selected from 15 villages all across Ethiopia. The villages themselves were chosen to represent the major farming systems used in Ethiopia.

The Mali case study [Harrower and Hoddinott, 2002] uses panel data from 275 households from 10 villages surveyed between 1997 and 1998 for four rounds from the Zone Lacustre area in the northern region of the Niger River Valley. The Mexican case study [Skoufias, 2002b] uses survey data from the sample of rural households surveyed three times between October 1998 and November 1999 as part of the evaluation of PROGRESA, a national conditional cash transfer programme designed to increase human capital investment. This survey covers close to 24,000 rural households from 506 villages assigned into treatment and control groups for the purposes of the evaluation. Finally, the data set used in the Russia case study [Skoufias, 2002a] is from phase two of the Russian Longitudinal Monitoring Survey (RLMS) for the years 1994, 1995, 1996, 1998 and 2000 (rounds V–IX). The RLMS is a household-based representative survey of Russia collected by the Population Center at the University of North Carolina.<sup>18</sup> It is an unbalanced panel containing repeated observations for more than 2,800 households.

#### *Consumption and Vulnerability to Specific Shocks*

All five studies examine whether the incidence of specific shocks has a significant negative impact on the growth rate of household consumption from round to round. In each country study equation (6b) is estimated by appropriately defining what constitutes an insurance group. The four studies using household level data from surveys in rural areas (i.e. Bangladesh, Ethiopia, Mali, and Mexico) identify an insurance community by the village in which the household resides. In contrast, in the Russia study, which contains households in both urban and rural areas, the insurance group is defined as the set of households within a primary sampling unit (PSU).<sup>19</sup>

The details associated with the construction of per capita consumption and per capita income can be found in the individual country studies; the Appendix contains more information on the variables used in the regressions. Here, we focus our discussion on the comparison of changes in food and non-food consumption in the five studies.

Table 1 presents the estimated coefficients of the idiosyncratic shocks on the growth rate of monthly per capita food consumption, while Table 2 contains the

TABLE 1  
LEAST SQUARES DETERMINANTS OF CHANGE IN FOOD CONSUMPTION PER CAPITA

|   | (1)<br>Bangladesh<br>(rural areas) | (2)<br>Ethiopia<br>(rural areas) | (3)<br>Mali Zone Lacustre<br>(rural areas) | (4)<br>Mexico (control<br>sample rural areas) | (5)<br>Russia<br>(urban areas) |
|---|------------------------------------|----------------------------------|--|---|--------------------------------|
| Ln (value of livestock losses)  | 0.005 (0.69)                       |                                  |  |   |                                |
| Female illness  | -0.002 (0.25)                      |                                  |  |   |                                |
| Male illness  | 0.011* (1.72)                      |                                  |  |   |                                |
| Rainfall index (1 is best)  |                                    | -0.047 (0.64)                    |  |   |                                |
| Livestock disease index (1 is best)                                     |                                    | 0.261** (2.23)                   |  |   |                                |
| Lack of water or grazing land (1 is best)                               |                                    | 0.036 (0.38)                     |  |   |                                |
| Crop index (1 is best)  |                                    | -0.035 (0.53)                    |  |   |                                |
| Days lost due to illness (1 is best)                                    |                                    | 0.010 (0.87)                     |  |   |                                |
| Crops were attacked by insects  |                                    |                                  | -0.030 (0.60)                              |   |                                |
| At least one member of household lost<br>productive time due to illness |                                    |                                  | 0.038 (1.04)                               |   |                                |
| Lost livestock due to theft or death                                    |                                    |                                  | 0.034 (0.76)                               |   |                                |
| Land cultivated less than land available                                |                                    |                                  | 0.023 (0.45)                               |   |                                |
| Lost land?  |                                    |                                  |  | 0.011 (0.62)                                  |                                |
| Lost harvest?   |                                    |                                  |  | 0.009 (0.70)                                  |                                |
| Lost animals?   |                                    |                                  |  | 0.007 (0.20)                                  |                                |
| Lost home/other items?  |                                    |                                  |  | -0.036 (0.68)                                 |                                |
| Owed wages  |                                    |                                  |  |   | -0.055* (1.81)                 |
| On forced leave   |                                    |                                  |  |   | 0.054 (0.28)                   |
| Unemployed  |                                    |                                  |  |   | -0.122** (3.31)                |

Notes: Dependent variable is change in log per capita of food consumption. \* Significant at the 10% level; \*\* significant at the 5% level. Absolute value of t-statistics is in parentheses. Standard errors are corrected for heteroskedasticity using the Huber-White method.

TABLE 2  
LEAST SQUARES DETERMINANTS OF CHANGE IN NON-FOOD CONSUMPTION PER CAPITA

|   | (1)<br>Bangladesh<br>(rural areas) | (2)<br>Ethiopia (rural<br>areas) | (3)<br>Mali Zone Lacustre<br>(rural areas) | (4)<br>Mexico (control<br>sample rural areas) | (5)<br>Russia<br>(urban areas) |
|---|------------------------------------|----------------------------------|--|---|--------------------------------|
| Ln (value of livestock losses)  | -0.003 (0.25)                      |                                  |  |   |                                |
| Female illness  | 0.000 (0.00)                       |                                  |  |   |                                |
| Male illness  | 0.003 (0.30)                       |                                  |  |   |                                |
| Rainfall index (1 is best)  |                                    | -0.121 (1.15)                    |  |   |                                |
| Livestock disease index (1 is best)                                     |                                    | 0.107 (0.68)                     |  |   |                                |
| Lack of water or grazing land (1 is best)                               |                                    | -0.214 (1.50)                    |  |   |                                |
| Crop index (1 is best)  |                                    | -0.003 (0.03)                    |  |   |                                |
| Days lost due to illness (1 is best)                                    |                                    | -0.019 (1.14)                    |  |   |                                |
| Crops were attacked by insects  |                                    |                                  | 0.142 (0.93)                               |   |                                |
| At least one member of household lost<br>productive time due to illness |                                    |                                  | 0.232** (2.30)                             |   |                                |
| Lost livestock due to theft or death                                    |                                    |                                  | -0.244** (2.14)                            |   |                                |
| Land cultivated less than land available                                |                                    |                                  | 0.042 (0.34)                               |   |                                |
| Lost land?  |                                    |                                  |  | -0.062* (1.89)                                |                                |
| Lost harvest?   |                                    |                                  |  | 0.014 (0.63)                                  |                                |
| Lost animals?   |                                    |                                  |  | -0.038 (0.65)                                 |                                |
| Lost home/other items?  |                                    |                                  |  | -0.056 (0.62)                                 |                                |
| Owed wages  |                                    |                                  |  |   | -0.098** (2.19)                |
| On forced leave   |                                    |                                  |  |   | -0.201 (0.97)                  |
| Unemployed  |                                    |                                  |  |   | -0.174** (3.10)                |

Notes: Dependent variable is change in log per capita of food consumption. \* Significant at the 10% level; \*\* significant at the 5% level. Absolute value of t-statistics is in parentheses. Standard errors are corrected for heteroskedasticity using the Huber-White method.

respective coefficients for the growth rate of non-food consumption. The reference period for the shocks is roughly the same as the reference period for consumption, so shocks can be interpreted as contemporaneous shocks.<sup>20</sup> In each country study, the coefficients of the various shock variables were estimated by running a regression with all the shock variables included at once in the regression. In all cases the standard errors of the estimated coefficients were corrected for unknown forms of heteroskedasticity in the error term of the regressions using the formula of White [1980].

The estimated impact of the various shocks on food consumption does not yield a very clear picture. One would expect that the types of shocks examined here, if they are significant, would have a negative effect on food consumption. Surprisingly only in urban Russia does the incidence of wage arrears and unemployment seem to affect food consumption negatively. In Ethiopia, better livestock disease outcomes increase food consumption.<sup>21</sup> In most other cases, shocks do not have a significant effect on food consumption. For example, in both Bangladesh and Mali, the loss of livestock appears to have no significant role on the growth rate of food consumption per capita. In Mali and Ethiopia, illness does not affect food consumption. This suggests that households are able to insulate their food consumption from this type of shock. In fact in rural Mexico it appears that household food consumption is completely insured from any of the five idiosyncratic shocks examined in that case study.

Examination of the impact of the same shocks on the growth rate of non-food expenditures raises some intriguing possibilities. For example, wage arrears and unemployment continue to have a significantly negative impact in urban Russia. Moreover, the (negative) coefficients of these shocks on non-food consumption are slightly larger than for food consumption. This suggests that non-food expenditures may absorb more of the shock in order to insulate food consumption. This interpretation is reinforced by the estimates of the impact of livestock death in Mali and the impact of land loss in Mexico. In both cases these shocks have a negative effect on non-food consumption and no effect on food consumption.<sup>22</sup>

Some caution is warranted in the interpretation of results. One plausible explanation for the overall pattern of these findings may be due to the lack of any substantial variation of these shocks within smaller insurance communities. As discussed earlier, the estimates in Tables 1 and 2 are obtained by estimating equation (6b) with community and round interaction effects that control for the presence of covariate or aggregate effects in the community. To the extent that these shocks are fairly common among households in the same insurance community, then the coefficient signs of the idiosyncratic shock variables may be the consequence of strong collinearity with the covariate shocks included in the regression. We investigate this possibility in more detail in the Bangladesh, Ethiopia and Mexico studies, where the coefficients of the shock variables

including community round shocks can be contrasted with those obtained when community round shocks are excluded from the regression.<sup>23</sup> In the Bangladesh case, there is no perceptible difference between the estimates with or without covariate shocks. For Ethiopia, however, the strong aggregate component of self-reported idiosyncratic shocks is readily apparent. Positive rainfall shocks, which are not significant in the regression that controls for aggregate shocks, are surprisingly negative and significant in regressions for total consumption and food consumption per capita. The livestock shock is no longer significant, while better crop outcomes have a significant positive effect on total consumption and non-food consumption. In the case of Mexico (estimates reported in Table 1 here), the coefficients of the shock variables are positive but not significant when covariate shocks are controlled for. The same coefficients turn negative when the village round dummies are excluded from the regressions, suggesting that concerns about vulnerability to idiosyncratic shocks may be justified.

A more serious caveat arises from the estimation of the effects of shocks on food and non-food consumption separately. First, a formulation that allows the changes in consumption of a commodity (group) only to be a function of community level variables in the presence of complete insurance (when  $\beta = 0$ ) requires that the marginal utility of food be independent of the levels of non-food consumption, or that preferences are strongly separable (additive) – a strong restriction on the structure of preferences.<sup>24</sup> In the extreme case of autarky, where the community dummies control for price changes, the coefficients on food and non-food,  $\beta_f$  and  $\beta_{nf}$ , would be income elasticities. The insignificant coefficients of income changes in the food consumption regression may therefore reflect the low income elasticity of food rather than the differential ability to protect food and non-food consumption.

#### *Consumption and Household Income*

An alternative test for the hypothesis of complete risk sharing is whether the growth rate of household food consumption is independent of the growth rate in household income (after controlling for aggregate or covariate shocks). This specification presumes that all of the shocks experienced by the household between rounds affect household consumption solely through the growth of household income.<sup>25</sup> As before, under the null hypothesis of complete insurance, idiosyncratic changes in household income should have no role in explaining household-specific consumption growth rates, i.e.  $\beta = 0$ .

The estimates of equation (5) for total as well as for food and non-food consumption per capita are presented in Table 3. Although not reported here, it is important to note that in all five countries, covariate shocks, as proxied by the community survey round terms were significant determinants of consumption changes in the estimation of equations (5). The estimates obtained using total (food plus non-food) consumption suggest that on average total consumption is

TABLE 3  
THE IMPACT OF CHANGES IN LOG HOUSEHOLD PER CAPITA INCOME ON LOG HOUSEHOLD PER CAPITA CONSUMPTION: OLS ESTIMATES

|                                 | Bangladesh<br>(rural areas) | Ethiopia<br>(rural areas) | Mali Zone Lacustré<br>(rural areas) | Mexico<br>(control sample rural areas) | Russia<br>(urban areas) |
|---------------------------------|-----------------------------|---------------------------|-------------------------------------|--|-------------------------|
| Total consumption per capita    | 0.03** (2.41)               | 0.02* (1.88)              | 0.076** (4.30)                      | 0.037** (7.26)                         | 0.182** (16.88)         |
| Food consumption per capita     | 0.03** (1.96)               | 0.01 (0.55)               | 0.018 (1.55)                        | 0.028** (5.42)                         | 0.176** (15.26)         |
| Non-food consumption per capita | 0.06** (2.76)               | 0.06** (4.08)             | 0.227** (5.24)                      | 0.062** (6.89)                         | 0.198** (11.71)         |

Notes: \* Significant at the 10% level; \*\* significant at the 5% level. Absolute value of t-statistics is in parentheses. Standard errors are corrected for heteroskedasticity using the Huber-White method.

not insured from idiosyncratic income changes in Ethiopia, Mali, Mexico and Russia. The estimates obtained by separating food and non-food reveal a richer picture. In most instances food consumption appears to be better insured (or have a lower covariance with income) from idiosyncratic changes in income in comparison to non-food consumption. Whereas non-food consumption is significantly correlated with idiosyncratic income shocks in all five countries, food consumption seems to be completely insulated from idiosyncratic income shocks in Mali and Ethiopia. Even in Russia where income changes significantly affect both food and non-food consumption, the effect seems to be lower for food than for non-food. These estimates confirm that food consumption is more likely to be covered by informal insurance arrangements than non-food.<sup>26</sup>

Additional information on the extent to which food and non-food consumption are differentially covered by risk sharing arrangements can be obtained from Table 4, where the estimated coefficients of the growth rate in average community income (i.e. of the parameters  $\gamma$  from equation (7)) are reported. The estimates provide strong evidence supporting the role of partial insurance and community risk sharing in food consumption. Thus changes in the growth rate of average community income seem to have a positive and significant role in the growth rate of food consumption of individual households in all countries except Ethiopia. In contrast, no evidence of risk sharing is found with respect to non-food expenditures in Mali, Mexico, and Russia. Thus there are considerable indications that the available options for insuring non-food consumption are limited in comparison to those for food consumption.

One potential shortcoming of the ordinary least squares (OLS) estimates discussed so far is that they may be biased due to measurement error in the income variable and imputation errors in the calculation of the food consumption of households.<sup>27</sup> We attempt to correct for these using instrumental variables.

Table 5 presents the income coefficient estimates using instrumental variables for the changes in household income. In each of the country studies, the set of instruments used included the various shock variables discussed earlier in the analysis.<sup>28</sup> The instrumental variable (IV) estimates presented in Table 5 reveal some substantial differences from the results obtained from the OLS estimates. The coefficients of income changes on food consumption are generally higher suggesting that the concerns about measurement and imputation errors may have some foundation. Compared to the OLS coefficients, the coefficient of the instrumented income growth variable is higher in all of the regression equations regardless of the consumption measure used. However, the lower coefficients of income in the regression equations for food relative to the equations for non-food consumption, continue to support the earlier interpretation that adjustment in non-food consumption expenditures appears to partially insure *ex-post* the consumption of food from the effects of income changes.

TABLE 4  
 IMPACT OF CHANGE IN MEAN LOG VILLAGE INCOME ON LOG PER CAPITA CONSUMPTION: OLS ESTIMATES

|                                 | Estimates of $\gamma$       |                           |                                    |  |                         |
|---------------------------------|-----------------------------|---------------------------|------------------------------------|--|-------------------------|
|                                 | Bangladesh<br>(rural areas) | Ethiopia<br>(rural areas) | Mali Zone Lacustr<br>(rural areas) | Mexico<br>(control sample rural areas) | Russia<br>(urban areas) |
| Total consumption per capita    | 0.14** (3.60)               | -0.05* (-1.66)            | 0.129** (2.98)                     | 0.077** (4.17)                         | 0.219** (5.18)          |
| Food consumption per capita     | 0.25** (6.41)               | -0.04 (-1.31)             | 0.121** (3.79)                     | 0.116** (6.10)                         | 0.342** (7.24)          |
| Non-food consumption per capita | 0.21** (3.28)               | -0.01 (-0.36)             | -0.021 (0.23)                      | -0.048 (1.44)                          | -0.023 (0.32)           |

Notes: \*Significant at the 10% level; \*\*significant at the 5% level. Absolute value of t-statistics is in parentheses. Standard errors are corrected for heteroskedasticity using the Huber-White method.

TABLE 5  
 THE IMPACT OF CHANGES IN LOG HOUSEHOLD PER CAPITA INCOME ON LOG HOUSEHOLD PER CAPITA CONSUMPTION: INSTRUMENTAL  
 VARIABLE ESTIMATES

|                                 | Bangladesh<br>(rural areas) | Ethiopia<br>(rural areas) | Mali Zone Lacuire<br>(rural areas) | Mexico<br>sample rural areas | Russia<br>(urban areas) |
|---------------------------------|-----------------------------|---------------------------|------------------------------------|------------------------------|-------------------------|
| Total consumption per capita    | 0.17** (2.60)               | 0.04 (1.11)               | 0.396 (1.29)                       | -0.158 (0.55)                | 0.344** (4.62)          |
| Food consumption per capita     | 0.09 (1.48)                 | 0.03 (0.61)               | 0.011 (0.05)                       | -0.180 (0.59)                | 0.303** (3.64)          |
| Non-food consumption per capita | 0.26** (2.35)               | 0.19** (3.32)             | -0.03 (0.06)                       | 0.750 (1.22)                 | 0.478** (3.82)          |

Notes: \*Significant at the 10% level; \*\*significant at the 5% level. Absolute value of t-statistics is in parentheses. Standard errors are corrected for heteroskedasticity using the Huber-White method.

In sum the instrumental variable estimates presented above suggest that the proposed estimate of household consumption insurance is likely to be subject to opposing and possibly reinforcing biases arising from measurement error in income, imputation errors in the construction of food consumption and possible endogeneity bias in income. Clearly the extent to which estimates of the consumption insurance measure proposed will be consistent will depend critically on the availability of adequate instrumental variables for the changes in household income.

#### *Identifying Household-specific Capacity to Insure*

Three of the country studies (Bangladesh, Ethiopia and Russia) took the extra step of estimating a household-specific estimate of the covariance between total consumption (and food consumption separately) and income growth rate over the rounds of the available surveys. Given the acute shortage of degrees of freedom associated with having at most four observations on consumption and income growth rates, household-specific estimates of  $\beta$  were derived using an alternative but equivalent approach to estimating regression equation (1) [Mace, 1991; Townsend, 1994]. For brevity, we will describe how the household-specific measure of vulnerability was constructed in the Russia study. First, round-specific means by community (PSU) were estimated for the change in the log of total expenditure per capita and the change in the log of income per capita. Second, the household-specific growth rates in total consumption and income were expressed as deviations from the round- and community-specific means, respectively. Third, limiting the sample to the households with at least three observations on changes in the log of consumption and income per capita changes, one regression for each of the 2,867 households satisfying this restriction was estimated. A household-specific vulnerability measure was then constructed based on the different coefficients obtained from the 2,867 household-specific regressions estimated.<sup>29</sup>

As constructed the household-specific consumption insurance measure reflects the ability of households to insure their total consumption from idiosyncratic income risk. In order to examine the possible sensitivity of the measure to the exclusion of the aggregate shocks, the Russia case study constructed an alternative measure that is inclusive of both aggregate and idiosyncratic shocks by skipping the first two steps above and simply regressing the household-specific growth rate in consumption on the household-specific growth rate in income.

In terms of the notation used above the vulnerability measure for household  $h$  was constructed based on the coefficient  $\beta_1^h$  derived from the regression (without a constant term)<sup>30</sup>

$$\Delta \ln c_{htv} - \Delta(\overline{\ln c_{vt}}) = \beta_1^h(\Delta \ln y_{htv} - \Delta(\overline{\ln y_{vt}})) + \Delta \varepsilon_{htv}, \quad (8)$$

whereas the household-specific vulnerability measure inclusive of both aggregate and idiosyncratic shocks was based on the coefficient  $\beta_2^h$  derived from the regression

$$\Delta \ln c_{hiv} = \beta_2^h (\Delta \ln y_{hiv}) + \Delta \varepsilon_{hiv}. \quad (9)$$

Table 6 presents coefficients of per capita consumption from a regression of the estimated consumption insurance measures (i.e.,  $\beta_1^h$  or  $\beta_2^h$ ) on observed household characteristics (at the initial round of observation of each household) (columns 1 and 2 of Table 6), for Russia, Bangladesh and Ethiopia. For comparison the same consumption insurance measures were constructed based on food consumption instead of total consumption in equations (8) and (9) above. These corresponding estimates are presented in columns 3 and 4 of Table 6.

As the low R-squareds of the regressions reveal, observed household characteristics explain a very small fraction of the variance of the estimated household-specific degree of consumption insurance. For Russia, irrespective of whether consumption insurance is measured based on insurance from idiosyncratic shocks to income or not [see Skoufias, 2002a], the main variables that are significantly correlated with the level of household consumption variability are mainly those identifying the region where the household is located. Except for the variable identifying whether a household has members that are retired, all other household characteristics do not appear to have a significant role in explaining differences in household consumption insurance. Both measures of insurance also seem to be negatively correlated with the total consumption per capita. Thus, *ceteris paribus*, in a cross-section of households wealthier (poorer) households are more (less) able to insure. Lastly, practically the same picture emerges if one were to construct an insurance measure based solely on food consumption instead of total consumption (compare estimates in panel B with those in panel A of Table 6).

Results from Bangladesh and Ethiopia are more lacklustre [see Quisumbing, 2002a, 2002b for details]. While the variability of food consumption in Bangladesh (or an inability to insure food consumption from idiosyncratic shocks) is negatively related to per capita consumption, indicating that wealthier households are better able to insure, the consumption insurance measure does not correlate significantly with other observed household characteristics. Only the proportion of adolescent females significantly increases the variability of total consumption. In Ethiopia, the number of male adults increases variability of food consumption with respect to idiosyncratic and aggregate shocks, while the number of females decreases it. However, none of the other covariates – including per capita consumption – is significant.

To further investigate the potential uses of the consumption insurance measures employed here, the Bangladesh, Ethiopia and Russia studies also examined whether they are significantly associated with the proportion of time a



household spends in poverty and the probability that a household is ever poor.<sup>31</sup> The former variable is constructed simply by dividing the total number of rounds classified as poor by the number of rounds, while the latter is a binary variable taking the value of 1 if the household is classified as poor in any of the survey rounds. The poverty status of a household in any given round was determined by comparing total per capita consumption in the survey round with the relevant poverty line. The consumption insurance measure presented in Table 7 is the variability of food consumption with respect to income.

In Russia, food consumption variability, defined here by the partial covariance between the growth rate in food consumption and income, has no significant role in explaining the proportion of time a household spends in poverty. This result holds irrespective of whether vulnerability to risk is defined to include or exclude the role of aggregate shocks. However, food consumption variability appears to be positively and significantly correlated with the probability of a household ever becoming poor (even after controlling for the initial level of household consumption per capita). In Ethiopia, food consumption variability, inclusive of aggregate shocks, is positively correlated with the proportion of time spent in poverty as well as the probability of being poor in any round. The effect becomes weaker once only idiosyncratic shocks are considered, emphasising the importance of aggregate shocks in Ethiopia. For Bangladesh, however, food consumption variability is not significantly correlated with any of the poverty measures. Similar analyses showed that the variability of total consumption is a positive and significant determinant of the proportion of time spent in poverty only for Russia. Given the large budget share spent on food in Ethiopia, variability in food consumption is probably only one indicator of vulnerability to poverty in general. It is possible that households that are chronically poor – those that spend a large proportion of the time in poverty – have adopted consumption habits that minimise the variability in food consumption as a survival strategy. Thus, while food consumption variability can predict the probability that a household is poor, it may precisely be the chronically poor who adopt minimum-variability food consumption strategies.

#### IV. SHOCKS AND FAMILY RISK-COPING MECHANISMS

Having established that households are only partially able to insure, we now examine the mechanisms used to cope with idiosyncratic and aggregate shocks. Overall, the results reported in the five case studies reveal that households employed a portfolio of strategies rather than a single coping strategy. However, differences in country settings and institutional context are immediately apparent in the choice of coping mechanisms. The coping strategies examined included getting (or having) a second paying job (Russia and Mexico), getting involved in informal economic activities (Russia), receiving remittances from friends and relatives (Bangladesh, Mali, Mexico and Russia), receiving public transfers or

TABLE 7  
THE DEGREE OF FOOD CONSUMPTION INSURANCE AND POVERTY: RUSSIA, BANGLADESH, AND ETHIOPIA

|  | The proportion of time spent in poverty |         | The probability of being poor in any round |         | The proportion of time spent in poverty |         | The probability of being poor in any round |         |
|--|---|---------|--|---------|---|---------|--|---------|
|  | Coeff.                                  | t-value | Coeff.                                     | t-value | Coeff.                                  | t-value | Coeff.                                     | t-value |
|  | 1                                       |         | 2  |         | 3                                       |         | 4  |         |
| <i>Russia</i>  |   |         |  |         |   |         |  |         |
| Degree of food consumption insurance (incl. aggregate shocks)  | -0.209                                  | -0.37   | 0.060                                      | 4.94**  |   |         |  |         |
| Degree of food consumption insurance from idiosyncratic shocks |   |         |  |         | -0.463                                  | 0.85    | 0.035                                      | 3.10**  |
| <i>Bangladesh</i>  |   |         |  |         |   |         |  |         |
| Degree of food consumption insurance (incl. aggregate shocks)  | 0.00                                    | 0.52    | 0.00                                       | 0.33    |   |         |  |         |
| Degree of food consumption insurance from idiosyncratic shocks |   |         |  |         | -0.01                                   | -0.85   | -0.04                                      | -1.41   |
| <i>Ethiopia</i>  |   |         |  |         |   |         |  |         |
| Degree of food consumption insurance (incl. aggregate shocks)  | 0.01                                    | 2.20**  | 0.01                                       | 1.92*   |   |         |  |         |
| Degree of food consumption insurance from idiosyncratic shocks |   |         |  |         | 0.04                                    | 1.86*   | 0.03                                       | 1.59    |

*Notes:* Regressors included the age and education of the household head, whether the household is female headed, occupational dummies, household size and demographic characteristics, land and asset holdings, and site or regional dummies. The coefficients in columns 2 and 4 are the marginal effects on the probability of falling into poverty (dF/dx). The poverty status of a household is determined relative to poverty lines described in the text.\* Significant at the 10% level; \*\* significant at the 5% level. The t-statistics reported are based on standard errors corrected for heteroskedasticity using the Huber-White method.

participating in public safety net programmes (Bangladesh, Ethiopia), getting into debt (Bangladesh, Ethiopia, Mali, Mexico and Russia), selling assets such as poultry or livestock (Bangladesh, Mali, Mexico and Russia), and cultivating land (Russia). The Mali study also examined such additional coping strategies as diversification and changes in the composition of food consumption, while the Bangladesh and Ethiopia studies examined whether different categories of households were equally able to use risk-coping mechanisms. Regressions on the use of coping mechanisms in response to the idiosyncratic shocks are presented in Table 8. To the extent possible, the case studies employed techniques that control for the potential role of unobserved household heterogeneity in determining how households respond to shocks, but using the same technique was not possible in all studies because of data differences.

The first two panels of Table 8 present the results from Mali and Russia, which both employ fixed effects logit. In Russia, households appeared to complement their self-insurance strategies, consisting of adjustments in labour supply, and selling assets such as land, with informal risk sharing strategies that spread risk over time and households. The same general patterns were also observed in Mali where households made additional adjustments by changing the composition and frequency of food consumption (such as serving less preferred foods more frequently, or serving less food to men or women or children). Moreover, in Mali, there were significant differences between the coping strategies of asset poor and asset rich households.

In the Mexico case study, fixed effects logit analysis was not possible because information on how households might respond to idiosyncratic shocks is collected in only one round (November 1999) of the survey. The estimated marginal effects of the various shock variables on the probability of adopting a specific response are reported in the third panel of Table 8 for households in the control villages that were not included in the PROGRESA conditional subsidy programme.<sup>32</sup> Overall the results for households in control villages reveal that there is no single strategy that is used most frequently by households. Harvest loss, for example, appears to trigger multiple household responses including the selling of animals, borrowing and receiving help from government and relatives.<sup>33</sup>

In the Bangladesh and Ethiopia case studies, in all survey periods a large number of households made use of coping mechanisms such as incurring debt, selling assets, receiving transfers from friends or relatives, and participating in public safety net programmes. Thus, the lack of variation in entry and exit into programmes or types of coping mechanisms made fixed effects logit estimation inappropriate, as it led to the exclusion of the majority of the sample from estimation. Both fixed and random effects estimation procedures were used instead; only the fixed effects results are reported in the fourth and fifth panels of Table 8.

On the basis of the fixed effects results, it seems that household coping mechanisms are not responsive to idiosyncratic shocks in Bangladesh. However,

TABLE 8  
IDIOSYNCRATIC SHOCKS AND HOUSEHOLD COPING MECHANISMS

|  | Mali, fixed effects logit |                      |                          |                   |  |
|--|---------------------------|----------------------|--------------------------|-------------------|--|
|  | Outmigration              | Remittances received | Positive livestock sales | Positive net debt | Aid from family and friends (food gifts) |
| Crops were attacked by insects                                       | 0.083 (0.25)              | 0.268 (0.70)         | 0.272 (0.83)             | 1.577** (5.76)    | 0.554 (1.40)                             |
| At least one member of household lost productive time due to illness | -0.037 (0.14)             | 0.135 (0.42)         | -0.194 (0.73)            | -0.679** (3.06)   | 0.157 (0.44)                             |
| Lost livestock due to theft or death                                 | 0.673** (2.15)            | -0.332 (0.94)        | 1.102** (3.57)           | 1.128** (4.24)    | 1.078** (2.69)                           |
| Land cultivated less than land available                             | -0.805** (2.45)           | 0.326 (0.92)         | 0.174 (0.55)             | -0.006 (0.03)     | 0.329 (0.90)                             |

*Notes:* All shock variables are included simultaneously in the regression. Additional regressors included but not reported include: time varying regressors: household size, age composition of household, gender composition of household and survey round. Z-value reported in parentheses.

|                 | Russia, fixed effects logit |                     |                   |               |                               |
|-----------------|-----------------------------|---------------------|-------------------|---------------|-------------------------------|
|                 | Get a 2nd job               | Informal activities | Receive transfers | Borrow money  | Sold assets last three months |
| Owed wages      | 0.41** (2.29)               | 0.04 (0.36)         | -0.03 (0.27)      | 0.28** (3.12) | -0.31 (-1.45)                 |
| On forced leave | 2.90** (2.68)               | -0.29 (0.54)        | 0.01 (0.02)       | -0.01 (0.05)  | -1.54 (-1.43)                 |
| Unemployed      | -0.54** (2.32)              | -0.64** (4.94)      | 0.17 (1.47)       | 0.34** (3.26) | 0.32 (1.6)                    |

*Notes:* All three shock variables are included simultaneously in the regression. Additional regressors included but not reported: a constant term, binary variables describing the age/gender composition of the household in each round, the round of the survey, and whether the household is headed by a female of working age or a retired male or female. Z-values in parentheses.

TABLE 8 – Continued

|                        | Mexico, households in control villages, probit |                  |                |                                |                |                            |
|------------------------|--|------------------|----------------|--------------------------------|----------------|----------------------------|
|                        | Sold animals?                                  | Sold other/land? | Borrowed?      | Received help from government? | Worked more?   | Received help from family? |
| Lost land?             | 0.01** (4.29)                                  | 0.00** (2.13)    | 0.00 (1.12)    | 0.00 (0.93)                    | 0.06 (6.20)    | 0.01** (2.24)              |
| Lost harvest?          | 0.06** (11.18)                                 | 0.02** (5.15)    | 0.10** (15.97) | 0.03** (9.35)                  | 0.29** (30.19) | 0.08 (16.17)               |
| Lost animals?          | 0.06** (6.56)                                  | 0.00** (2.25)    | 0.02** (2.78)  | 0.00 (0.25)                    | -0.01 (0.72)   | -0.00 (1.03)               |
| Lost home/other items? | 0.00 (0.83)                                    | 0.01** (3.06)    | 0.13** (7.85)  | -0.00 (-0.24)                  | 0.12** (7.54)  | 0.03** (2.81)              |

Notes: 1—All shock variables are included at the same time in the regression. Additional regressors included but not reported: a constant term, variables describing the age and gender composition of the household in each round, the age of the household head, whether the household is headed by a female, the education level of the household head, binary variables for the type of occupation of the head, an index summarizing the asset holdings of the household, the eligibility status of the household for PROGRESA benefits, and binary variables describing whether other government programmes operate in the locality (DIF, LICONSA, PROBECAT, Tortilla Solidaridad, Empleo Temporal, Educ. Scholarship), prior to October 1997. Z-values reported in parentheses. 2—All coefficients reported are in terms of marginal effects on the probability of the respective outcome (dF/dx).

|                                | Bangladesh, fixed effects |                 |               |                    |
|--------------------------------|---------------------------|-----------------|---------------|--------------------|
|                                | Net debt                  | Net asset sales | Remittances   | Food for education |
| Ln (value of livestock losses) | -26.12 (1.07)             | 26.38 (0.98)    | -19.34 (0.96) | 0.10 (0.58)        |
| Female illness                 | -6.18 (0.30)              | -5.54 (0.25)    | 4.60 (0.27)   | 0.14 (0.95)        |
| Male illness                   | 25.21 (1.09)              | -43.12* (1.72)  | 6.06 (0.32)   | 0.21 (1.28)        |

Notes: All three shock variables are included simultaneously in the regression. Additional regressors included the age of the household head, whether the household is female headed, household size and demographic characteristics. t-statistics in parentheses.

## Ethiopia, fixed effects

|   | Net debt        | Transfer receipts | Free distribution | FFW earnings   | Women's income |
|---|-----------------|-------------------|-------------------|----------------|----------------|
| Rainfall index (1 is best)                | -34.14 (1.08)   | 9.31 (0.15)       | 0.92 (0.48)       | 1.57 (1.57)    | -0.25 (0.14)   |
| Livestock disease index (1 is best)       | -2.38 (0.06)    | -60.39 (0.78)     | -1.08 (0.45)      | 0.47 (0.38)    | 0.48 (0.22)    |
| Lack of water or grazing land (1 is best) | -23.40 (0.71)   | 64.19 (1.01)      | -1.40 (0.71)      | -1.43 (1.38)   | -1.47 (0.80)   |
| Crop index (1 is best)                    | -91.35** (3.77) | 231.67** (4.98)   | -3.30** (2.28)    | -2.91** (3.82) | 1.64 (1.22)    |
| Days lost due to illness                  | -9.51* (-1.68)  | -3.52 (0.32)      | 0.18 (0.53)       | 0.29 (1.63)    | -0.03 (0.11)   |

Notes: All shock variables are included simultaneously in the regression. Additional regressors included a dummy for a female-headed household, age and age squared of the household head, the number of male and female adults, and the dependency ratio. t-statistics in parentheses.

Notes for *whole of table 8*: \* Significant at the 10% level; \*\* significant at the 5% level. Absolute value of t-statistics is in parentheses. Standard errors are corrected for heteroskedasticity using the Huber-White method.

random effects regressions that include controls for time-invariant characteristics of households show that these characteristics are important determinants of the use of risk-smoothing mechanisms. For example, poorer households may not be equally able to make use of private coping mechanisms such as credit. Net debt is higher for households whose heads have secondary or more schooling, as well as those with more non-land assets, possibly because the latter can be used as collateral. Remittances are higher in households whose heads have at least primary schooling and for larger families, and in households with a higher proportion of adult females. This may reflect kin support networks, such as brothers who make remittances to their adult sisters, often in exchange for her inheritance [Subramanian, 1998]. In contrast to private coping mechanisms, public transfers seem to have a more redistributive impact. Both food for education (FFE) and relief go to households with smaller landholdings; relief also is directed towards households with lower values of non-land assets. There is some indication that public transfers also serve some consumption-smoothing function; FFE receipts increase with a female illness shock and relief receipts increase with livestock losses.

In Ethiopia, the use of private and public risk-smoothing mechanisms seems to decrease in response to a favourable idiosyncratic shock, in this case, favourable crop outcomes. Favourable crop outcomes reduce net debt, receipts from free distribution of food aid, and earnings from food for work, although they surprisingly increase transfer receipts from friends, family members, and government programmes. However, fixed effects estimates do not enable one to discern whether different categories of households are equally able to use these consumption-smoothing mechanisms. Similar to the Bangladesh case study, the Ethiopia case study estimated the levels (not changes) in net debt, net asset sales, remittance receipts, and public transfers, taking into account household characteristics, idiosyncratic shocks, and individual heterogeneity.

Results not reported here [Quisumbing, 2002b] suggest that idiosyncratic shocks do not appear to significantly affect levels of net debt, but transfer receipts decrease when rainfall and livestock disease outcomes are better. Transfer receipts may also tend to favour wealthier households: receipts are positively correlated with education of the head, land area and the value of household assets. While receipts from free distribution of food aid decrease with favourable rainfall and livestock disease outcomes, free distribution does not necessarily reach the poorest households. Free distribution receipts (a sub-set of transfer receipts) are higher for households with more education and with larger areas cultivated, and also decrease with the number of male and female adults, consistent with earlier results in Quisumbing [2003]. Food for work (FFW) receipts increase with worse livestock disease, crop damage, and illness outcomes, but are unexpectedly positively affected by good rainfall. Unlike free distribution, FFW seems to be better targeted to poorer households. Female income from various activities, while expectedly correlated

with female headship, is also higher for households with larger land areas and non-land assets. Levels of female income also increase with favourable livestock disease outcomes, which is expected since a large portion of women's income is obtained from the sale of livestock and dairy products.

#### V. CONCLUDING REMARKS

This paper has summarised five studies using household panel data from Bangladesh, Ethiopia, Mali, Mexico and Russia, all examining the extent to which households are able through formal and/or informal arrangements to insure their consumption from specific economic shocks and fluctuations in their real income.

Building on the recent literature on consumption smoothing and risk sharing, we attempt to relate a household's degree of consumption insurance (or consumption variability) to its vulnerability to poverty. The consumption insurance measure is defined by the degree to which the growth rate of household food consumption covaries with the growth rate of household income. An advantage of the proposed measure of consumption insurance is the opportunity to determine consumption variability arising from idiosyncratic risk and covariate risk either separately or in combination. It is also independent of the poverty status of a household or the level of the poverty line. However, some of the disadvantages of this measure are as follows. First, it requires repeated observations (panel data) on households. Second, the survey must collect information on both household consumption and income. Third, it is subject to a variety of biases arising from measurement error in income, imputation error in food consumption and endogeneity of income. The availability of repeated observations per household allows the construction of a household-specific measure of consumption insurance based on total as well as food consumption. This in turn provides the opportunity to examine in more detail the extent to which consumption variability is correlated with the incidence of poverty.

The empirical estimates of one of three studies (Russia) provide some tentative confirmation that consumption variability with respect to income changes is negatively associated with the level of household consumption and positively associated with the incidence of poverty. No significant evidence is found on the role of consumption variability and the proportion of time a household spends in poverty. Estimates from Bangladesh suggest that the household-specific variability of food consumption is negatively associated with the level of household consumption, but neither the variability of food nor total consumption is significantly associated with the probability of being poor or the proportion of time spent in poverty. For Ethiopia, neither measure of consumption variability is correlated with household per capita consumption, but the degree of food consumption variability is positively and significantly associated with the proportion of time spent in poverty as well as the probability of being poor. It is possible that, as a survival strategy, the chronically

poor adopt food consumption strategies that are less variable; the significance of the food consumption variability measure in Ethiopia may indicate an even more precarious existence.

Is this measure of consumption variability useful in assessing vulnerability to risk? The consumption insurance measure adequately captures sensitivity to risk and income fluctuations. However, it falls short of being a measure of *vulnerability* for a number of reasons.<sup>34</sup> First, it does not allow for differences between positive and negative shocks, nor distinguishes between responses to unanticipated risk and anticipated fluctuations. From a policy perspective, one would be more concerned with the inability to cope with the consequences of a negative shock, rather than a positive shock. Second, the consumption variability measure is not related to the size of income risk faced by the household. It has been pointed out [Dercon, 2002] that using the measure of consumption insurance as a measure of vulnerability to risk is consistent only if income risk is identical across households and only if it is exogenous. The results on risk-coping mechanisms – which show that households diversify income sources to cope with risk – make the assumption of exogenous income risk unwarranted.

Have we advanced our understanding of households' ability to cope with risk? Most tests of consumption smoothing allude to the role of community-based insurance mechanisms as underlying observed risk sharing, but are silent as to the particular types of mechanisms used. In examining the various risk-coping strategies used by households, the case studies have shown that households use a portfolio of strategies, but that households are not equally able to use them. In particular, poorer households may be less able to use mechanisms that rely on initial wealth as collateral. In this regard, public transfer programmes may have a more redistributive effect. How useful is each strategy in smoothing consumption fluctuations, and what is the relative importance of each strategy? It would be useful to quantitatively establish the role played by each of these strategies in smoothing consumption, in order to judge their importance in the household's risk-coping portfolio.

The results of this study provide empirical confirmation of the potential benefits associated with a more effective social protection strategy. Given that households differ in their ability to protect themselves from shocks, there may be significant gains associated with the adoption of a social protection system that not only provides support for the critically poor but also assists households, and communities to better manage risk. As this study suggests, the targeting of social safety net programmes, for example, need not be based solely on the current poverty status of the household or whether a shock impacted on a household. Targeting can be effectively complemented with indicators of the ability of the household to protect its consumption from such shocks. Devoting efforts to identify households that are less able to insure their total or food consumption, in particular, may be an important consideration to be introduced in targeting social safety net systems of developing countries.

## APPENDIX: REGRESSION SPECIFICATIONS

Tables 1 and 2 present estimates of equation (6a)

$$\Delta \ln c_{htv} = \sum_{iv} \delta_{iv} (D_{iv}) + \sum_i \beta_i S(i)_{htv} + \gamma X_{hvt} + \Delta \varepsilon_{htv}$$

where  $\Delta \ln c_{htv}$  denotes the change in log consumption or the growth rate in total consumption per capita of household  $h$ , in period  $t$  (i.e., between round  $t$  and round  $t - 1$ ), in community  $v$ ,  $S(i)$  denotes shocks such as crop damage due to pests, illness and other shocks,  $X$  is a vector of household or household head's characteristics,  $\delta$ ,  $\beta$ , and  $\gamma$  are parameters to be estimated,  $\Delta \varepsilon_{htv}$  is a household-specific error term capturing changes in the unobservable components of household preferences, and  $D_{iv}$  denotes a set of binary variables identifying each community separately by survey round. The dependent variable in Table 1 is the change in log per capita food consumption, while that in Table 2 is the change in log per capita non-food consumption.

In the Bangladesh case study, the vector of shocks includes livestock losses due to death, male illness, and female illness. In the Ethiopia case study, shocks include: a rainfall shock index, a livestock disease index, an index for livestock problems due to lack of water or grazing land, a crop damage index, and days lost due to illness. Because the indices are constructed so that 1 is best and 0 worst, we expect that the coefficients of the shock indices would be positive; that is, positive shock outcomes would increase consumption. The Mali case study uses four representations for shocks: whether crops had been lost to insect infestation, whether the household had been unable to cultivate all land available to it, whether livestock had been lost due to theft or death, and whether at least one member of the household was unable to participate in economically productive activities because of illness. In the Mexico study, four types of shocks were included: whether the household lost land, whether it experienced harvest losses, whether it experienced livestock (animal) losses, and whether it lost other assets or a home. In the Russia case study, the shocks include wage arrears, having a household member on forced leave, and having a household member who is unemployed. To illustrate how these shock indices were constructed, in the case of wage arrears, the shock variable takes the value of 1 if the following three conditions are satisfied (equals 0 otherwise): (i) one (or more) working household member reports that he or she is owed wages in the current round; (ii) none of the household members was owed any wages from their primary job in round  $t - 1$ ; and (iii) no household member received payments in-kind in lieu of wages. Thus the shock variable regarding wage arrears signifies whether the household is a new entrant in the pool of households that were already owed wages from their primary job. Conditions (i) and (ii), modified appropriately, are also applied to

construct the binary variables signifying whether any household member is on forced leave or unemployed.

The vector  $X_{hvt}$  consists of time-varying attributes such as the change in household size between rounds, a dummy variable for a female-headed household, and age and age squared of the household head (Bangladesh, Ethiopia). In the Mali case study, household characteristics included whether the household was a female-headed household, the change in household size, whether the household was in the top two quintiles of consumption expenditure, the age of the household head, and membership in the dominant ethnic group (Sonrhai). In the Mexico study, which is based on the PROGRESA evaluation sample, the  $X$  vector includes a dummy variable  $PRO$ , which takes the value of 1 for households in PROGRESA/treatment villages and 0 for households in control villages. Additional regressors included but not reported in the tables include variables describing the age and gender composition of the household in each round, the age of the household head, whether the household is headed by a female, the education level of the household head, binary variables for the type of occupation of the head, an index summarising the asset holdings of the household, and binary variables describing whether other government programmes operate in the locality (DIF, LICONSA, PROBECAT, Tortilla Solidaridad, Empleo Temporal, Educ. Scholarship) prior to October 1997. Finally, in the Russia case study, the vector  $X$  is specified to contain family size in rounds  $t$  and  $t - 1$ , the age (and age squared) of the household head and binary variables indicating whether the household is headed by a female, a retired male, or a retired female.

Table 3 presents estimates of equation (5)

$$\Delta \ln c_{hvt} = \sum_{iv} \delta_{iv}(D_{iv}) + \beta \Delta \ln y_{hvt} + \delta X_{hvt} + \Delta \varepsilon_{hvt}$$

where  $\Delta \ln y_{hvt}$  is the growth rate of income and the other variables are as defined above. Equation (5) is estimated separately for total consumption, food consumption, and non-food consumption. The difference between equations (5) and (6) is that the growth rate of income is a regressor in the former, and a vector of shock variables replaces the growth rate of income in the latter. All other variables in the  $X$  vector are identical.

#### NOTES

1. According to the terminology of Seigel and Alwang [1999], the preceding actions represent a combination of *ex-ante* risk mitigating and *ex-post* coping actions both aimed at smoothing consumption. Households may adopt *ex-ante* risk-reducing management strategies such as diversifying the mix of income generating activities from their given asset base [Morduch, 1994, 1995].
2. The Russia case study has five repeated observations per household while the Bangladesh and Ethiopia studies have four.

3. Cochrane [1991], Mace [1991] and Townsend [1994, 1995] provide more detailed expositions of the functional forms for preferences.
4. Other terms used to characterise income changes are ‘permanent’ versus ‘transitory’. These are related to the terms ‘anticipated’ and ‘unanticipated’ but which set of terms is used depends on whether a study adopts a microeconomic model of expectation formation (such as the rational expectations hypothesis) or a statistically oriented approach to decomposing a time series in income growth. For a paper that attempts to delineate among the predictions of various models of intertemporal consumption, see Jacoby and Skoufias [1998].
5. Note that including the community/round interaction dummies is equivalent to deviating all variables from their respective community/round mean. For more detailed discussion of this equivalence see Deaton [1997].
6. When prices and wages are available, one may also want to include these as explanatory variables (first-differenced) in regression equation (6b) [e.g., see Dercon and Krishnan, 2000].
7. Note that if consumption and leisure are non-separable and labour leisure choices are endogenous, the rejection of the hypothesis that  $\beta = 0$  does not necessarily imply the absence of risk sharing among households [Cochrane, 1991].
8. Schechter [2001] and Ligon [2001] explore the same idea for Bulgaria and India, respectively.
9. The higher the number of time observations per household the lower the variance of the estimated coefficient  $\beta$ .
10. Along similar lines, it is also possible for a wealthy household to be quite vulnerable to risk and yet not vulnerable to poverty.
11. To a large extent our emphasis on consumption insurance instead of vulnerability to poverty originates from the belief that, for any meaningful progress in measuring the latter, one must be willing to adopt a specific model for the intertemporal allocation of consumption and credit constraints faced by households.
12. Interestingly none of the vulnerability to poverty measures proposed to date seems to consider the few known facts about the variance of consumption over time. Deaton and Paxson [1994], for example, demonstrate that within any given cohort the variance of consumption increases over time and this variance may differ across cohorts. This implies that at any given point in time any attempt to characterise the variance of consumption changes of households must take into account the age distribution of the population since different households are likely to be at different points in their lifecycle.
13. This approach is taken in all of the IFPRI papers surveyed here. Details are discussed in the next section of the paper.
14. This point is also noted by Deaton [1990].
15. Deaton [1997] first noted that the coefficient of idiosyncratic income changes in specification (7) will be (mechanically) identical to the coefficient of idiosyncratic income changes in specification (5), where the community/survey round interaction dummies are used instead of the change in village mean income.
16. This draws heavily from Dercon [2002].
17. Empirically, one can distinguish between positive and negative shocks, although in the present paper we impose the same coefficient on income changes.
18. The project description at [www.cpc.unc.edu/rms](http://www.cpc.unc.edu/rms) provides complete information about the RLMS survey and its sampling procedure.
19. In principle, insurance arrangements are easier to organise and implement in small or closely-knit communities than in larger groups, where the moral hazard, incentive and information difficulties are more severe.
20. The only difference is the illness shock, which typically has a two-week recall period. Food consumption uses both a one-week and one-month recall period, while non-food consumption uses a longer reference period (one month for frequently purchased items, and since the last survey round for more infrequently purchased items).
21. The shock variables in the Ethiopia study are as defined by Dercon and Krishnan [2000], where a value of 1 indicates the best outcome. Thus, these shocks should be interpreted as positive shocks, and positive coefficients imply that consumption increased as a result of positive shocks.

22. The relatively higher coefficients of these shocks for non-food than for food consumption might also be explained in terms of underlying household preferences. *Ceteris paribus*, in so far as the incidence of these shocks represents a decrease in household income then the quantity demanded for luxury goods (non-food) will decrease more than for necessities (such as food that has an income elasticity less than 1).
23. For Mexico, see table 2 panels a and c in Skoufias [2002b]. Results for Bangladesh and Ethiopia are available from the authors.
24. We thank Stefan Dercon for pointing this out.
25. Of course, shocks arising from changes in household structure may not be completely captured by changes in household income, nor compensated by the per capita adjustment factor, which controls only for changes in household size, not household structure. Note, however, that owing to the short time interval between rounds, household structure does not change substantially from round to round. In work not reported here, we disaggregated household size into different demographic categories but the overall results were not appreciably different.
26. As already pointed out in Note 22, the relative differences in the size of the estimated income coefficients for food and non-food may also be attributed to preferences. Food is typically a necessity with a lower ( $< 1$ ) income elasticity while non-food is a luxury good with a higher ( $> 1$ ) income elasticity.
27. Measurement error in the income variable biases coefficients toward zero while imputation errors in food consumption may bias the income coefficients upward [Deaton, 1997].
28. In all five country studies, the shock variables used as identifying instruments in the first stage regressions, were significant and negatively correlated with the growth rate of income. Other instruments included changes in income from sources that were not likely to be correlated with crop production. Tests on the excluded instruments rejected the null hypothesis that they were equal to zero.
29. It is necessary to acknowledge that the low degrees of freedom associated with each household-specific regression result in very high standard errors for the estimated  $\beta$  or consumption insurance measure of each household. Also, as noted earlier, there remain potential complications due to measurement errors in the income variable. In the absence of a better alternative it was determined that it was worthwhile to explore this approach in spite of the limitations just noted. In order to minimise the potential influence of extreme outliers, values of household-specific  $\beta$ 's less than the 1 percentile and greater than the 99th percentile of the distribution of  $\beta$ 's across all households were excluded from the later stages of the analysis.
30. Equations (8) and (9) were also estimated with an intercept term. This did not result in any remarkable changes in the estimates reported in Tables 6 and 7.
31. It should be noted that a similar approach was adopted in the Bangladesh study and it yielded no significant correlation between vulnerability and the probability of 'ever being poor' and 'being always poor'.
32. All shock dummy variables were included simultaneously in the probit regression. Estimation using random effects (at the village level) probit did not lead to any substantive change in the results obtained using simple probit. The case study also included separate estimates for PROGRESA (treatment) villages.
33. The analysis in Skoufias [2002b] also suggests that there does not appear to be any significant differences in how households in PROGRESA villages respond to these shocks. The only notable difference is that households in PROGRESA villages seem to respond differently than households in control villages when there is shock leading to the loss of animals. Relative to households in control villages, they are less likely to respond by selling animals or borrowing, or working more, and more likely to receive help from relatives. Also, the loss of other household items or the loss of a home is more likely to result in receiving help from the government. There are also indications that the presence of the PROGRESA programme induces households to use adjustments in their labour supply less frequently than households in control villages.
34. We are grateful to Stefan Dercon for most of the points raised in this paragraph.

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