UNIVERSITÀ DEGLI STUDI DI TRENTO

DIPARTIMENTO DI ECONOMIA

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Discussion Paper No. 1, 2009

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"Income Shocks, Coping Strategies, and Consumption Smoothing. An Application to Indonesian Data"*

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Abstract

Using the Indonesian Family Life Survey, this study investigates whether Indonesian farmers respond differently to income shocks (crop loss) depending on the level of their asset ownership, and whether their responses are aimed at preserving consumption levels or at accumulating assets. We consider a framework in which assets contribute directly to the income generation process. In this context the need to accumulate assets to ensure future income may lead poor farmers (those with a low level of productive assets) to behave quite differently in terms of both their responses to shocks and their consumption decisions. For them transitory shocks may have long term consequences when the income loss leads to changes in their asset investment decisions. Our results suggest that while non-poor farmers smooth consumption relative to income, poor households use labor supply to compensate the income loss and, on average, they save half of this extra income. These results confirm the importance of savings for poor households, and highlight a crucial role for policies that support savings or, more precisely, the accumulation of productive assets.

Keywords: income shocks, consumption smoothing, asset smoothing

* We gratefully acknowledge Federico Perali, Patrick J. Nolen, Stephen Pudney, Cheti Nicoletti, as well as the seminar participants in the First Riccardo Faini Doctoral Conference in Development Economics, University of Milan, Gargnano (BS), Italy, and in the workshop PRIN 2006/07, University of Pavia.

1 Introduction and literature review

A growing theoretical and empirical literature analyzes the effects of shocks on households' living conditions in developing countries, and on the coping strategies adopted to overcome them. Previous studies investigate whether specific risk-coping strategies are responsive to shocks (Pan 2007; Udry 1995; Rosenzweig and Wolpin 1993; McPeak 2004; Kochar 1999), or whether consumption can be smoothed in relation to transitory income changes (Paxson 1992; Gertler and Gruber 2002; Kazianga and Udry 2004; Jalan and Ravallion 1997).

When analyzing households' responses to shocks a central issue to be considered is the role of assets: when the latter contribute directly to the income generation process (productive assets), shocks may have different consequences and lead to different behavior. In this context there is a trade-off between asset investment and consumption choices, in the sense that selling assets or slowing down asset accumulation could have important implications for future income and, hence, for future consumption. This implies that transitory shocks may have long term consequences when the income loss leads to changes in the asset investment decisions. Empirical studies show that below a given asset threshold, households reduce consumption in order to preserve their stock of assets (asset smoothing), while above that threshold assets are sold to protect consumption (consumption smoothing) (Barrett and Carter 2005; Zimmerman and Carter 2003). Similarly, Hoddinott (2006) shows that the probability of selling assets (animals) in the face of a negative-income shock depends on the prior level of assets.

This work considers the most frequent shock in rural Indonesia, crop loss, and uses the 1993 round of the Indonesian Family Life Survey to explore whether Indonesian farmers respond differently to this shock depending on the level of their asset ownership. We focus on farm households because their main source of income (farm profits) depends on asset holdings.

Various studies have shown that households cope with shocks by adjusting labor supply (Kochar 1999; Maitra 2001; Cameron and Worswick 2003). In this way, consumption smoothing is achieved through ex post income smoothing (Morduch 1995; Dercon 2002). In particular, Cameron and Worswick (2003) study the way in which labor supply responses enable Indonesian households to smooth consumption in the face of a crop loss[1]. Their

[1] "Employment and wages are likely to be more flexible in largely agricultural societies in which a high proportion of the workforce is self-employed or works in the informal sector" (Manning 2000, p. 130). The case of Indonesia is consistent with this framework. The flexibility of Indonesian labor markets and the availability of

approach and results suggest that crop loss is a transitory shock which, in the absence of changes in the labor supply, leads to transitory welfare losses. The need to accumulate assets is not considered by the authors; rather their estimates suggest that all households have a marginal propensity to consume out of permanent income close to 0.9 (statistically different from one). This means that households only save when facing positive transitory shocks. While this seems reasonable above a certain threshold of assets, it appears very unlikely for asset poor households.

This work extends the approach of Cameron and Worswick (2003), and considers the interlinkage between production and consumption decisions. In particular, we distinguish between small, medium and large farms according to the level of productive assets, and we explore the way in which the need to accumulate assets affects the behavior of the small ones (which we call also "poor households"). In order to do so we estimate quantitative measures of the income loss and the household's ability to recover from the shock, as well as the marginal propensity to consume out of both permanent and transitory income. These estimates would help us to understand differences in the consumption behavior between asset poor and non-poor households, and whether permanent income is an appropriate welfare indicator for both groups.

Our results show that household responses do actually differ according to the level of asset ownership: while medium and large farms smooth consumption relative to income, small ones use labor supply to compensate the income loss and, on average, they save half of this extra income. This implies that, for poor households, the extra income generated by the labor supply response to shocks not only enable them to protect consumption, avoiding transitory welfare losses, but supports the asset accumulation process, thus reducing long term consequences. This strengthens Cameron and Worswick's (2003) conclusion about the importance of the development of rural labor markets. However, when asset accumulation is the key determinant of household welfare, policies that support savings or, more specifically, the accumulation of productive assets, may be even more important than the development of labor markets.

The paper is organized as follows. The theoretical model is presented in section II. Section III discusses the data. Section IV and V present the empirical methodology and the results, and section VI concludes.

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alternative employment opportunities for those who lose their jobs, mostly in small-scale enterprises and in the informal sector, supported the adjustments in labor supply as one important aspect of the response to shocks, even in the face of the economic crisis of 1997-98 (Manning 2000).

2 Theoretical Framework

The model developed in this section is a simple intertemporal model with a household farming production function subject to exogenous income shocks. Leisure and asset investment decisions are included in the household optimization problem. Assets are defined as productive (farm assets) and non-productive (financial assets). They have direct effects on income levels, and can also serve as a buffer to smooth consumption against shocks (Rosenzweig and Wolpin 1993; Zimmerman and Carter 2003; Newhouse 2005).

The farm profit function is defined as $\Pi_{ft} = \pi(\Phi_{t-1}, h_t^f, s_t)$, where h_t^f is the labor input, Φ_{t-1} is the level of productive and unproductive assets owned by the household at the end of the previous year, and *s* is a transitory random shock. Shocks are assumed exogenous, and uncorrelated over time. Farm profits increase with positive shocks, and decrease as a consequence of negative shocks, such that $\partial\Pi / \partial s > 0$. The total income of the household comes from farm and off-farm labor. In this paper, we are not interested in examining the trade-off between farm and non-farm labor and, hence, we assume that household members work a fixed amount of hours on the family farm, so that h_t^f is exogenous, and varies with *s* (negative shocks reduce h_t^f). The remaining time endowment ($T_s = T - h_t^f$) can be allocated to either leisure (l_t) or off-farm work. Let y_t^w be the income earned by family members on wage employment, i.e. $y_t^w = w_t(T_s - l_t)$.

Total household income can be written as:

$$I_t = \Pi_{ft}(\Phi_{t-1}, h_t^f, s_t) + w_t(T_s - l_t). \quad (1)$$

Assets[2] evolve according to:

$$\Phi_t = \Phi_{t-1} + \phi_t \quad (2)$$

where ϕ_t is the amount of assets purchased or sold at time t (for simplicity we assume no depreciation and no interest rate).

The budget constraint that the household faces is given by:

$$c_t + p_\Phi(\phi_t) = I_t \quad (3)$$

[2] As mentioned above, assets are a broad definition and include both productive and non-productive assets. However, considering a sample of farm households, it is reasonable to suppose that productive assets constitute the majority of total assets owned by the households.

where the price of the consumption good is normalized to one, and p_Φ is the price of assets. Households can either sell productive assets or decrease financial assets to increase consumption. However, we assume that households face a constraint on assets defined as (Newhouse 2005):

$$\Phi_t \geq \overline{\Phi}(Z) \tag{4}$$

i.e., there is an asset threshold (that may depend on household characteristics, Z) below which no profits are generated[3]. As a consequence,

$$\phi_t \geq g(Z, \Phi_{t-1}) \tag{5}$$

The farm profit equation written above, shows that future productivity is a function of current asset accumulation strategies. Today's sale of assets has important implications for future income and, hence, for future consumption. This form of non-separability between current and future consumption leads households, and especially poor households, to be more cautious in running down assets in the face of transitory shocks. Thus, the trade off captured in this model is not only between consumption and off-farm labor, but also between current consumption and asset accumulation for future consumption (Zimmerman and Carter 2003).

Each period's utility function is defined as $u_t(c_t, l_t)$, where we allow for consumption and leisure choices to be non-separable (Kochar 1999; Kazianga and Udry 2004); to be more specific, we assume that $\partial^2 u_t / \partial c \partial l > 0$.

The household's Bellman equation is defined as:

$$V_t(\Phi_{t-1}, s_t) = \max_{l_t, \varphi_t} \left\{ u(\Pi_{fi}(\Phi_{t-1}, s_t) + w_t(T_s - l_t) - p_\Phi \varphi_t\,,\, l_t) + \beta E_t V_{t+1}(\Phi_t, s_{t+1}) \right\} \tag{6}$$

The first-order conditions for households for which the constraint is not binding are[4]:

$$\begin{cases} \dfrac{\partial u}{\partial c_t} = \beta E_t \dfrac{1}{p_\Phi} \dfrac{\partial V_{t+1}}{\partial \Phi_t} & (a) \\ \dfrac{\partial u}{\partial c_t} = \dfrac{1}{w_t} \dfrac{\partial u}{\partial l_t} & (b) \end{cases} \tag{7}$$

[3] For productive assets, this threshold is assumed to be positive, $\overline{\Phi}(Z) > 0$. Subtracting Φ_{t-1} from both sides, the constraint becomes $\Phi_t - \Phi_{t-1} \geq \overline{\Phi}(Z) - \Phi_{t-1}$, i.e. $\phi_t \geq \overline{\Phi}(Z) - \Phi_{t-1}$. The reduced form becomes $\phi_t \geq g(Z, \Phi_{t-1})$ (equation (5)).

[4] For simplicity, we do not consider the time constraint.

Equations (7a) and (7b) solve the trade off between consumption and asset purchase, and between consumption and leisure, respectively. Looking at equation (7a), a negative shock that decreases farm profits will increase the marginal utility of income, all else equal. Assuming the value function is concave in assets, the household must increase consumption and decrease Φ_t in order to maintain the equality, i.e. the household will choose a lower level of ϕ_t. A similar result comes from equation (7b). A negative shock increases the marginal utility of income, all else equal, and decreases the marginal dis-utility of off-farm work[5]. To maintain the equality (7b) the household reduces l_t. Hence, in the face of a negative shock, households reduce the amount of assets (by either buying less or selling productive assets, or by reducing financial assets), and/or increase the labor market participation to overcome the hardship.

Equation (7) holds only if the household is not constrained in period t, i.e. if $\phi_t > g(Z_t, \Phi_{t-1})$. If the constraint is binding, $\phi_t = g(Z_t, \Phi_{t-1})$, the first-order conditions take the form:

$$\begin{cases} \dfrac{\partial u}{\partial c_t} = \beta E_t \dfrac{1}{p_\Phi} \dfrac{\partial V_{t+1}}{\partial \Phi_t} + \gamma_t & (a) \\ \dfrac{\partial u}{\partial c_t} = \dfrac{1}{w_t} \dfrac{\partial u}{\partial l_t} & (b) \end{cases} \tag{8}$$

where γ_t is the multiplier for the constraint. Equation (8a) means that the marginal utility of consumption for constrained households is greater than the marginal utility that would be optimal without constraints. Substituting (8b) into (8a), we can see that also the marginal utility of leisure is larger for constrained households. This implies that, in general, constrained households consume less and work more than if they were unconstrained, and these effects are even more pronounced when faced with a negative shock.

In the empirical analysis we will use the theoretical prediction of this model to guide the specification and interpretation of the reduced-form equations that will be estimated.

[5] This derives from $\partial^2 u_t / \partial c \partial l > 0$ and from the effect of a negative shock on T_s.

3 The Data

The data used for this study are from the 1993 Indonesian Family Life Survey (IFLS1) (Frankenberg and Thomas 2000). 7224 households were interviewed over a wide range of issues. Only those households that supplied a complete set of income and demographic data are included in the dataset. After dropping income and asset outliers (about 1% of the total sample), and focusing on the rural area, the sample includes 3601 rural households; of these, 2183 are farm households, defined as those who reported they owned a farm and at least one farm asset in the year of the survey. Respondents were asked whether their household had experienced an economic shock in the past five years, the type of shock, when it happened (year and month), what measures were taken, and the costs of overcoming the shock. The survey permits only one occurrence of the same shock in the period 1989-93 to be reported by the same household, and there is evidence that the most recent shocks are more likely to be reported[6].

Nearly 34% of the total rural sample has experienced at least one shock in the past 5 years. The incidence of the different types of shocks is reported in table 1. The most frequent shocks are sickness and crop loss, whereas business loss and unemployment affect only a few households. Focusing on the farm sample, the percentage of households that suffered a crop loss is nearly 24%. Column six of table 1 reports the medians of the percentage of farmers that experienced the same shock in the same village in 1993, considering only villages in which there is at least one household reporting the shock. As expected, crop loss is the most common shock, with a median percentage of 6.7 (and a maximum of 40%).

Since crop loss is the most frequent shock in rural Indonesia, and one of the major sources of risk in poor rural areas, in the empirical analysis we will focus on this type of shock. This choice clearly raises some issues about which sample is to be used. Cameron and Worswick (2003) use the entire sample of rural households. Crop loss is a shock that affects both households that have some farm production and farm workers. As suggested in the introduction, shocks may have different consequences and may lead to different behavior in the two cases. For farm households, assets enter directly in the income generation process and the trade-off between asset accumulation and consumption choices is different than the one for farm workers. Hence, we restrict the sample to farm households[7].

[6] For example, 31% of the crop loss experienced in the period 1988-93, are reported to occur in 1993, and 63% in 1992-93.

[7] As table 1 shows, only 22 non farm households (out of 560) reported a crop loss in the previous five years. Focusing on the year of the survey (1993), they reduce to 3 (out of 166).

Table 1

Number of households reporting shocks by type of shock (1988-93)

	Rural sample		Farm sample		
Type of shock	Nr. of households	per cent	Nr. of households	per cent	Commonality (1993) – medians*
Death	284	7.9	174	7.9	3.7
Sickness	376	10.4	232	10.5	3.9
Crop loss	560	15.6	538	24.3	6.7
Disaster	63	1.8	41	1.9	3.7
Unemployment	65	1.8	25	1.1	3.9
Price falls	239	6.6	215	9.7	4.2

Note. The table reports the number of rural and farm households, and the percentage of all households, reporting shocks of each type over the five year period 1988-93.
* The commonality of shocks is the percentage of households reporting the same shock in the same village in 1993. Villages with no households reporting shocks are excluded from the median.

Table 2 shows the percentage of farm households that use different measures in response to crop losses reported for the period 1988-93 and for 1993 only[8]. Nearly 40% of the total respondents report taking an extra job to overcome a crop loss. Other important responses are "cut down on household expenses", "take a loan" and "sell assets". Indonesian data confirm the suggestion of the literature that informal insurance mechanisms, such as family and community assistance, may be used less in the face of common shocks, like for example crop loss (Alderman and Paxson 1992). As the percentage of households that experience the same shock in the same village increases, the community may provide less insurance against it.

The importance of different responses is likely to vary according to the wealth or size of the farm and, hence, table 2 reports also the percentages of responses by farm-assets quartiles, where the bottom 25% of the asset distribution identifies small farms. Henceforth, we define these households as poor ones ('asset poverty').

As pointed out by other authors (Kochar 1999; Newhouse 2005, Maitra 2001), labor supply adjustment is a measure used particularly by poor farmers. Indeed, the percentage of households that take an extra job decreases as we move from poor to rich farmers. Owners of large farms are more likely to run down assets and to use savings than owners of small farms,

[8] In the estimation we consider only crop losses reported for the year 1993, because we observe consumption only for this year. Therefore we check whether responses to this shock in 1993 are similar to those reported for the previous 5 years.

even if the percentage of households that use savings remains low (poor farmers may need to build a stock of assets to protect themselves from future risk and/or to finance investments).

By examining the main differences between small, medium and large farms reported in the Appendix, table A1, it is possible to see that the higher propensity of small farms to use labor supply, is not correlated with a significantly larger household size or other demographic characteristics. Indeed, the only significant difference (except the obvious one related to assets and income[9]) is in the number of household members with secondary and higher education. Therefore, it seems that the adoption of different strategies may be more related to the values of farm-assets than to other household characteristics. This descriptive evidence suggests that it is important to distinguish between small and large farms in the analysis of income and consumption smoothing behavior.

Table 2

Responses to a crop loss by type of coping strategy and by farm-assets percentiles

Type of coping strategy	1993	1988-93				
	Total	Total	Bottom 25%	25-50%	50-75%	Top 25%
Extra job	39.2	45.0	54.6	50.0	43.9	30.7
Loan	20.0	21.2	24.8	18.0	13.0	29.2
Sell assets	17.5	20.0	14.2	15.6	25.2	25.4
Family assistance	7.2	6.9	3.5	9.4	8.6	6.2
Savings	5.4	4.5	0.7	2.3	3.6	11.4
Reduce expenses	29.0	20.8	22.0	23.4	22.3	15.4

Note. The numbers represent percentages of farms. Because of multiple responses, percentages sum to more than 100%.

[9] Table A1 (Appendix) shows that households that we defined as poor on the basis of the level of their farm assets, are also poor in terms of non-farm assets (both business and non-business) and household income.

4 Empirical Methodology

This section estimates a quantitative measure of the income reduction produced by the crop loss, and of the household's ability to recover from the shock. Several methodologies have been used to measure income shocks. Rosenzweig (1988) uses the difference between a household current income and its mean income over the nine-year period. Jacoby and Skoufias (1997) define the idiosyncratic shock as the deviation of the change in log full income from the village-season-year mean change, and the aggregate shock as the mean change itself. Beegle, Dehejia, and Gatti (2006) measure transitory crop shocks using the reported values of crop loss (due to insects, rodents, and other calamities). Kochar (1999) measures income shock as the residual from a regression of crop profits on variables determining the household's expectations of profits (a set of household dummy variables, reflecting all time-invariant factors, and a set of time-varying demographic variables). Paxson (1992) measures the transitory income component regressing total household income on a set of variables that affect transitory income (in her study, this set consists of deviations of rainfall from its average level).

We use a two step procedure to estimate the permanent and transitory income components. In the first stage we estimate permanent income only for the group of households with no crop loss[10], and use these estimated coefficients to predict income for all households. Our methodology leads to consistent estimates under the assumption that the crop loss is exogenous. In the second stage the difference between observed income and predicted income for households that experienced a crop loss in 1993 is constructed. This difference is regressed on a set of variables that affect the magnitude of the income shock (e.g. farm assets) and the household's ability to cope ex post with the hardship.

Alternatively, we could estimate permanent and transitory income by regressing household income on a vector of variables that permanently affect it, on self-reported shocks (crop loss), and on the coping strategies adopted using the sample of all households. Our methodology provides a better measure of permanent income when there are some unobservable variables that affect the reported income of households who experienced a crop loss and are correlated with some household characteristics used to estimate the permanent income component (e.g.

10 It is worth noting, however, that estimating permanent income, using cross-sectional data instead of panel data, does not allow one to model the dynamics of predicted income, nor to solve the problem of unobserved heterogeneity (Abul Naga and Bolzani 2000).

transfers form relatives and friends which may be correlated with the number of children in the household).

More precisely, we define income for households that do not report a crop loss as:

$$Y_h = \alpha_0 + \alpha_1 X_h^P + \alpha_2 X_h^T + \varepsilon_h \quad (9)$$

where Y_h is the 1993 household income, X_h^P is a vector of variables that determine permanent income (demographic characteristics, location dummies, and wealth indicators), and X_h^T is a set of other variables that may affect household income in a transitory way (winnings, and gift from family/friends). The parameters in (9) can be consistently estimated by applying OLS to the sub-sample of households with no crop loss under the assumption that the crop loss is exogenous[11].

For households that reported a crop loss in 1993, the difference between actual and predicted income is constructed:

$$\Delta Y_h = Y_h^{CL} - \hat{Y}_h \quad (10)$$

where Y_h^{CL} is the current income for households that reported a crop loss, and $\hat{Y}_h$ is the predicted income for these households, on the basis of the parameter estimates from equation (9). This difference can be explained by the sum of the loss produced by the shock and the gains from the ex post coping strategies that are reflected in the reported income (plus the effects of unobservables). To obtain a measure of the crop loss and of the increase in income due to coping strategies, the following regression is estimated[12]:

$$\Delta Y_h = \beta_0 + \beta_1 X_h^S + \beta_2 X_h^{LS} + \beta_3 X_h^L + \beta_4 X_h^A + u_h \quad (11)$$

where X_h^S are variables that affect the size of the income loss (in our case the value of 1992 farm assets)[13], X_h^{LS} and X_h^L are vectors of variables that determine the size of the

[11] Experiencing or reporting a shock may be correlated with pre-shock household characteristics. Given this potential endogeneity of self-reported crop losses, we looked at the distribution of pre-shock characteristics (mainly the value of pre-shock assets owned by the household) of the control group (those who reported no shock) and the treated group (those that reported a shock). No statistically significant differences in the means are observed. We estimated also a treatment-effect model, and we reject the hypothesis of endogeneity of reported crop losses.

[12] As a check for the validity of using the estimates of equation (9) to construct the dependent variable in (11), the following equation is estimated: $Y_h^{CL} = \beta_0 + \beta_1 X_h^S + \beta_2 X_h^A + \beta_3 X_h^{LS} + \beta_4 X_h^L + \beta_5 \hat{Y}_h + u_h$; $\hat{\beta}_5$ is found not to be statistically different from one (F(1,148)=2.46, Prob>F=0.12).

[13] To account for possible non-linearity in the functional form, the coefficient on farm assets is interacted with dummies that indicate whether the farm is small, medium or large (defined as those with 1992 farm assets in the bottom 25%, 25-75%, and in the top 25% of the asset distribution, respectively).

increase in income due to "labor supply" and "sell assets or take a loan", respectively. X_h^A is the value of 1992 non-productive assets owned by the household[14].

The extra labor income given by the labor supply response is estimated using the dummy labor supply (self-reported strategy) interacted with the number of household members aged 13-64. Following Cameron and Worswick (2003) and Kochar (1995), households with more people of working age may increase their labor supply by more.

Least squares estimation of (11) may lead to biased estimates of the parameters because of the endogeneity of the labor supply response. In order to account for this, we estimate a probit equation for the labor supply response and we derive the appropriate selection terms. Equation (11) thus becomes:

$$\Delta Y_h = \beta_0 + \beta_1 X_h^S + \beta_2 X_h^A + \beta_3 X_h^{LS} + \beta_4 X_h^L + \sigma_{12} \frac{f(\hat{\delta} Z_h)}{F(\hat{\delta} Z_h)} LS_h + \sigma_{02} \frac{f(\hat{\delta} Z_h)}{1 - F(\hat{\delta} Z_h)} (1 - LS_h) CL_h + u_h \tag{12}$$

where LS_h is the dummy for labor supply responses to crop loss, CL_h is the dummy for crop loss in 1993, σ_{02} and σ_{12} are the covariances between the error terms on the income equations for the two sub-samples ($LS_h = 0$ and $LS_h = 1$, respectively) and the error term in the probit equation.

We performed a Chow test to check whether all coefficients are the same for $LS_h = 0$ and $LS_h = 1$, and we cannot reject this hypothesis (F(6,149)=0.84, Prob>F=0.54). Therefore, we use (12) to estimate three different shock measures: the income reduction caused by the crop loss (equation (13)), the income variation that includes the labor supply response (equation (14)), and the total effect of the shock (the sum of income loss and income gains; equation (15)):

$$_1\hat{Y}_h^S = \hat{\beta}_0 + \hat{\beta}_1 X_h^S \tag{13}$$

$$_2\hat{Y}_h^S = \hat{\beta}_0 + \hat{\beta}_1 X_h^S + \hat{\beta}_3 X_h^{LS} \tag{14}$$

$$_3\hat{Y}_h^S = \hat{\beta}_0 + \hat{\beta}_1 X_h^S + \hat{\beta}_2 X_h^A + \hat{\beta}_3 X_h^{LS} + \hat{\beta}_4 X_h^L \tag{15}$$

Following Deaton (1997), the consumption equation can be written as[15]:

[14] Non-business and non-farm assets are added as additional regressors because the measure of household income includes the income from the rent/lease/profit-sharing of non-business assets.

[15] A similar approach has been used by Paxson (1992) and Cameron and Worswick (2003). They estimate the level of household savings as a linear function of permanent income, transitory income, the residual from the income equation (unexplained income), and a set of variables that measure the life-cycle stage of the households.

$$C_h = \gamma_0 + \gamma_1 \hat{Y}_h^P + \gamma_2 \cdot ({}_1\hat{Y}_h^S) CL_h + \gamma_3 \hat{Y}_h^{LS} CL_h + \gamma_4 \hat{Y}_h^A CL_h + \gamma_5 \hat{Y}_h^L CL_h + \gamma_6 \hat{u}_h \cdot CL_h + \gamma_7 \hat{\varepsilon}_h \cdot (1 - CL_h) + \gamma_8 Z_h + \nu_h \quad (16)$$

where C_h is household consumption (measured by non-durable annual household expenses[16]), $\hat{Y}_h^P$ is the permanent income component, ${}_1\hat{Y}_h^S$ is the measure of the income reduction due to the crop loss (equation (13)), $\hat{Y}_h^{LS}$ is the extra labor income, and $\hat{Y}_h^A, \hat{Y}_h^L$ are the predicted income gains due to other coping strategies (non-business assets and "take a loan or sell assets", respectively)[17]. $\hat{u}_h$ and $\hat{\varepsilon}_h$ are the fitted residuals from income equations (12) and (9) respectively, and Z_h is a set of variables that measure the life-cycle stage of the household. Following Paxson (1992), the variables included in Z_h are the number of household members in each age category.

From equation (16) we can estimate the marginal propensity to consume out of permanent and transitory income. To examine the different behavior of asset poor and non-poor households, both the permanent income and the measure of the crop loss are interacted with dummies to identify small, medium and large farms. As noted in the introduction, these estimates would help us to understand whether poor households do actually accumulate assets, which income measure drives household consumption behavior, and whether permanent income is an appropriate welfare indicator for poor households.

Paxson includes also the variability of the household's income. From their results, Cameron and Worswick conclude that the increase in income due to the labor supply response is important in allowing rural households to smooth consumption: households that do not change their labor supply when facing the shock, reduce their expenditure by about 79% of the loss in income due to the crop loss. Note that their approach and results imply that all households that do not adopt the labor supply response, whether poor or non-poor, reduce consumption in the face of a shock. Using their methodology on the farm sample instead of the entire rural sample, and distinguishing between small and medium/large farms, we find that non-poor farmers (medium and large farms) insure consumption without having to rely on the labor market, whereas owners of small farms (poor households) are found to reduce consumption even when they increase labor supply.

[16] The expenditure variable used in this paper includes the total value of goods self-produced by the household. Durable goods are not included because it is difficult to impute the appropriate measure of the service flow derived from them.

[17] Few papers estimate a quantitative measure of the increase in income due to ex post responses to shocks (Fafchamps et al. 1998; Cameron and Worswick 2003). However, none of these papers examines how much of the increase in income due to different coping strategies is passed onto consumption.

5 Results

5.1 Income equation estimates

Estimates of the income equation for households that did not experience the crop loss (equation (9)) are reported in the Appendix (table A3). To account for the non-linearity of the income function, the coefficient on farm assets is interacted with dummies that indicate whether the farm is small, medium or large (defined according to quartiles of 1992 farm assets distribution). Results are in line with standard income equation estimates. Coefficients on all types of assets are highly significant[18], and those on farm assets confirm the non-linearity of the income function. Households whose head has a secondary/higher education or is employed in the private and government sector have a higher income, all else equal. Other variables that have a significant effect on household income are the number of income earners, other than that of the head, and non-labor income sources (such as gifts and winnings, and the presence of a household member that receives a pension).

These estimates of the income equation are used to calculate the difference between the observed income and the "expected" income (ΔY_h in equation (10)) for households that report a crop loss in 1993. As can be noted from table 3, the resulting "gross" income loss, i.e. the measured income loss including all recovering measures, for these households is on average about 45 thousands of rupiah, but there is a high variability around the mean. For households that report labor supply response we obtain a positive mean difference between realized and predicted income (175 thousands of rupiah), whereas the mean is negative for the other households (-187 thousands of rupiah)[19].

[18] It should be recalled that the profit function is expressed in the theoretical model as a function of assets at time t-1; therefore, we use the previous year's level of assets. Non-business and non-farm assets are added as additional regressors because the measure of household income includes the income from the rent/lease/profit-sharing of non-business assets.

[19] The difference in the means for the two groups is statistically significant at the 1% level.

Table 3

Descriptive statistics of the difference in incomes for households that reported a crop loss in 1993

Variable	Obs.	Mean	p25	p50	p75
ΔY_h^{CL}	163	-44.57	-627.51	-219.32	221.84
ΔY_h^{CL} *LS	64	175.01	-653.88	-125.87	374.12
ΔY_h^{CL} *(1-LS)	99	-186.52	-600.46	-302.18	136.30

Note. The descriptive statistics differentiate between households that adopted the labor supply response (LS=1) and those who did not (LS=0). The difference in the means is statistically significant at the 1% level.

In order to identify the main components of the estimated difference in income, we estimate equation (12) that includes the appropriate selection terms for the probability of using labor supply. As regards the latter, the probit estimates reported in the Appendix (table A4) [20] show that the probability of adopting labor supply decreases with the possibility of access to the credit market (captured by the value of the land and the presence of at least one financial institution in the village) [21], with the quality of the soil (farmers that cultivate a high-quality soil have higher farm profits[22] and, hence, they may rely on other risk-coping strategies), and with the number of adult members with secondary education. These results suggest that, as already observed in the descriptive analysis (table 2), rich households that can rely on high and good-quality assets are unlikely to change their labor supply decisions after the occurrence of a crop loss. Other variables that have a negative effect on the probability of adjusting labor supply as the result of a crop loss are the age of the head and the presence of an inactive spouse. The number of female household members aged 13-17 and the commonality of the shock have a positive and significant effect.

As the estimates of equation (12) reported in table 4 show, the difference between observed and predicted income for households who experienced a crop loss is the result of a reduction in income due to the shock and some recovery measures adopted as a response to it.

[20] The probit model is estimated over the sample of households that reported a crop loss over the past five years to increase the number of observations.

[21] This is in line with the results of Maitra (2001) who finds that Indian farmers with unrestricted access to credit (medium and large farms) deal with shocks by using state contingent transfers (for example credit), and without changing their leisure and consumption behavior. On the contrary, constrained farmers (small farms) are able to insure consumption against unanticipated income changes only if they adjust their market participation in response to the shock, shifting from own-farm work to the labor market.

[22] Farmers living in villages with a high soil-quality have farm profits that are statistically higher (at 0.01% level) than other farmers.

The former depends on the level of asset ownership: the estimated coefficients on farm assets are all negative and significant, but they decrease, in absolute value, as we move from small to large farms. This finding may be explained with the nonlinearity of the profit function. With decreasing returns on farm assets, the marginal effect of an increase in assets on the income loss is larger for low than for high levels of assets.

The ability of recovering from the shock depends on both the value of non-farm assets and changes in labor supply decisions. In particular, the 1992 value of non-business and non-farm assets has a positive effect, indicating that rich households have a higher ability to recover from the shock (even if the t statistic is not very high; t=1.52). The income gain due to the labor supply response is related to the number of household members aged 13-64: each member aged 13-64 allows households to gain about 433 thousands of rupiah of extra labor income after a crop loss.

From this regression, we construct the measures of the income reduction caused by the crop loss and of the income gains due to labor supply response. Predicted measures are summarized in table 5. The income reduction caused by the crop loss ($_1\hat{Y}_h^S$ in equation (13)) does not vary significantly with the size of the farm, and the mean is about 1277 thousands of rupiah. The average value of the income gain due to labor supply response is 1298 thousands of rupiah, suggesting a significant impact of this coping strategy (considering only households that use extra labor the mean value of the income loss plus the extra labor income is about 87 thousands of rupiah, i.e. on average they recover all the income loss). The total effect of the shock ($_3\hat{Y}_h^S$ in equation (15)) is, on average, positive for households that use the labor supply response (252 thousands of rupiah) and negative for the others (-953 thousands of rupiah).

Table 4

Income equation estimates

Variables	Coeff.	t
Measure of income loss		
1992 farm assets*small farm	-2.03	-2.11
1992 farm assets*medium farm	-0.12	-2.13
1992 farm assets*large farm	-0.02	-2.62
Recovery's measures		
1992 non-business assets	0.05	1.52
LS*N_1364	432.71	2.34
Dummy sell assets or take a loan	353.97	1.29
Other variables		
1^{st} selection term* LS	-121.35	-0.23
2^{nd} selection term* (1-LS)	-1130.89	-2.40
Dummy cut expenditure	140.04	0.72
Intercept	-1001.04	-2.66
Number of obs= 163		
F(9, 153) = 3.05		
R-squared= 0.21		

Note. The table reports the results from equation (12), and estimates the size of the income reduction due to the crop loss and of the increase in income due to coping strategies. The sample is households that had a crop loss in 1993. Both income and assets are measured in thousands of rupiah. Standard errors are robust.

Table 5

Descriptive statistics of predicted variables

Variable	p25	Mean	p50	p75
Income reduction due to the crop loss $\left({}_1\hat{Y}_h^S = \hat{\beta}_0 + \hat{\beta}_1 X_h^S\right)$				
Total sample	-1382.41	-1277.25	-1171.58	-1104.73
Small farms	-1549.70	-1253.68	-1090.45	-1035.58
Medium farms	-1378.13	-1258.26	-1222.68	-1138.44
Large farms	-1333.94	-1340.55	-1160.25	-1112.96
Income gain due to labor supply response $(\hat{\beta}_3 X_h^{LS} \ \ if \ \ LS = 1)$				
Total sample	865.41	1298.12	1298.12	1730.83
Total effect of the shock $\left({}_3\hat{Y}_h^S = \hat{\beta}_0 + \hat{\beta}_1 X_h^S + \hat{\beta}_2 X_h^A + \hat{\beta}_3 X_h^{LS} + \hat{\beta}_4 X_h^L\right) \ \ if \ \ LS = 1$				
Total sample	-194.53	252.30	208.65	610.20
Total effect of the shock $\left({}_3\hat{Y}_h^S = \hat{\beta}_0 + \hat{\beta}_1 X_h^S + \hat{\beta}_2 X_h^A + \hat{\beta}_3 X_h^{LS} + \hat{\beta}_4 X_h^L\right) \ \ if \ \ LS = 0$				
Total sample	-1160.86	-953.28	-941.46	-699.19
Number of households that reported a crop loss in 1993 = 163				
Number of households that adopted the labor supply response in 1993 = 64				

Note. The table presents the descriptive statistics of the measures of income loss due to the crop loss and income gains due to coping strategies.

5.2 Consumption equation estimates

As previously noted, our aim is to examine whether consumption behavior in the face of a crop loss differs according to the level of asset ownership. Hence, we estimate the marginal propensity to consume out of both permanent and transitory income, focusing on the differences between asset poor and non-poor farmers. Results of equation (16) are reported in table 6[23].

A first result is related to the income measure which appears to be relevant for the consumption choices of poor and non-poor farmers. According to the permanent income hypothesis, consumption is determined by permanent income and should be unaffected by transitory income changes. Our estimates suggest that consumption of medium and large farms is indeed determined by permanent income, while the crop loss has no impact on non-durable expenditures[24]. Instead, consumption of small farms is influenced by both permanent and transitory income: coefficients on both types of income are significant (and similar). The implications of this result for consumption smoothing are better grasped if we consider the difference in the estimated marginal propensity to consume out of permanent and transitory income. As suggested by Deaton (1997), a statistically positive difference between these two coefficients would represent evidence that households are willing/able to smooth consumption relative to income. This result is confirmed for medium and large farms (p-value=0.000), but not for small farms. Indeed, the estimated coefficients on permanent income, crop loss, and extra labor income on consumption for small farms are not statistically different (test for the equality of the three coefficients: $F(2,2162)=0.84$, $Prob>F=0.43$)[25].

A second distinction between poor and non-poor households is the magnitude of the marginal propensity to consume out of the relevant income measure. Rich farmers and owners of medium farms consume about 90% and 70% of their permanent income respectively[26]. The marginal propensity to consume out of current income for poor households is about 0.5[27],

[23] Five outliers which belong to the top percentile of the expenditure distribution are excluded from the expenditure regression. All the results reported in table 6 are robust to different definitions of poor and non-poor farmers. Defining the poor as those who belong to the lowest 20% or 30% of farm asset distribution, instead of the lowest 25%, gives similar results.

[24] We cannot reject the hypothesis that the effect of the shock on consumption is the same for medium and large farms ($F(1,2161)=0.80$, $Prob>F=0.373$). Hence, we pool the two groups.

[25] Flavin (1985) explores whether the empirical rejection of the permanent income hypothesis occurs because agents are myopic, or because some agents face liquidity constraints. She finds that the observed excess sensitivity of consumption to current income is due to liquidity constraints. The extent to which consumption is affected by the presence of borrowing constraints is examined also by Zeldes (1989).

[26] The marginal propensities to consume out of permanent income for medium and large farms are statistically different ($F(1,2162)=3.69$, $Prob>F=0.055$).

[27] Test on coefficients:

a) extra labor income=crop loss=permanent income=0.5: $F(3,2162)=0.69$, $Prob>F=0.559$

with the consequence that about one half of the current income is transferred into savings[28]. This is in line with what is suggested by the literature: when excluded from financial markets, poor households have to perform an autarchic saving strategy, to build a buffer stock of assets and to self-finance profitable investments (Barrett and Carter 2005; Fafchamps 1999).

The third result that emerges from table 6 is that different coping strategies that change current income, have different impacts on consumption for poor households. The income generated by the measures "non-business assets" and "take a loan or sell assets", is entirely used to mitigate the consumption reduction due to the crop loss, even if these measures have only a marginal role in compensating the income loss[29]. As noted above, the marginal propensity to consume out of extra labor income is about 0.5, and statistically lower than the one estimated for the other measures.

b) extra labor income=crop loss=permanent income=0.7: F(3,2162)=4.80, Prob>F=0.002.

[28] Using data from rural Burkina Faso, Kazianga and Udry (2004) find that about 50% of changes in transitory income are passed onto consumption, with no significant differences between poor and rich households. Jalan and Ravallion (1997) show that 40% of an income shock is passed onto current consumption for the poorest households, while rich households are protected from almost 90% of an income shock.

[29] Coefficients on "non-business assets" and "take a loan or sell assets" are not statistically different in the consumption equation and, hence, we aggregate the two variables.

Table 6

Expenditure equation estimates

Variables	Coef.	t
$\hat{Y}_h^P$-small farms	0.45	6.28
$\hat{Y}_h^P$-medium farms	0.71	7.71
$\hat{Y}_h^P$-large farms	0.91	10.19
${}_1\hat{Y}_h^S$ - small farms	0.63	3.03
${}_1\hat{Y}_h^S$ - medium/large farms	0.08	0.87
$(\hat{\beta}_2 X_h^A + \hat{\beta}_4 X_h^L)$-small farms	1.13	1.80
$\hat{\beta}_3 X_h^{LS}$ - small farms	0.46	1.88
Transitory positive income	1.20	5.70
$\hat{\varepsilon}_h * (1 - CL)$	0.13	1.22
$\hat{u}_h * CL$	0.36	6.13
members aged 0-5	1.67	0.05
members aged 6-11	185.31	4.72
members aged 12-17	267.16	6.10
members aged 18-64	225.93	6.74
members 65 years or over	126.16	2.02
Intercept	367.80	3.81
R-squared= 0.33		
Number of obs= 2178		

Note. The table reports the results from equation (16). Dependent variable is 1993 non-durable household expenditure. Standard errors are robust.

6 Conclusions

This work uses the 1993 round of the Indonesian Family Life Survey to explore whether Indonesian farmers respond differently to income shocks (crop loss) depending on the level of their asset ownership. We consider a framework in which assets contribute directly to the income generation process. In this context transitory shocks may have long term consequences when the income loss leads to changes in the asset investment decisions.

Various papers have shown the existence of an asset threshold below which households reduce consumption in order to preserve their stock of assets (asset smoothing). Other studies suggest that poor households smooth consumption by adjusting labor supply. In this paper we combine these two streams of literature by examining the role of the extra income generated by the labor supply response in the consumption and asset accumulation choices of poor households. More precisely, we construct quantitative measures of income shocks and households' ability to cope with them, and we use these measures to estimate the marginal propensity to consume out of both permanent and transitory income. These estimates help us to understand which income measure drives household consumption behavior for the two groups, and whether permanent income is an appropriate welfare indicator for all households.

The theoretical framework that underlines the analysis is a life-cycle model, in which income includes farm profits and off-farm labor income. Productive and unproductive assets, together with an exogenously determined amount of labor, determine farm profits; the remaining amount of time can be allocated to either leisure or wage market. A negative shock reduces profits (and the amount of farm labor) and increases the marginal utility of off-farm labor income. The model predicts that the marginal utility of leisure and of consumption are both greater when assets are below a household specific asset threshold. This implies that, in general, constrained households consume less and work more than if they were unconstrained, and these effects are even more pronounced in the face of a negative shock.

The descriptive analysis suggests that the coping strategies adopted to overcome a crop loss are indeed quite different between asset poor and non-poor households. The latter are more likely to run down assets and to use savings, while the former are more likely to adjust their labor supply, even if the percentage of households that use extra labor is high in both groups. This evidence is supported also by the econometric analysis. Poor households that cannot rely on high and good-quality assets use labor supply to compensate the income loss and, on average, they succeed in doing it: the total effect of the shock – income loss plus income gains – for households that use the labor supply response is positive.

As regard consumption behavior, there are two main differences between poor and non-poor households. First, while medium and large farms smooth consumption relative to income, this is not so for small farms: for the latter, the main components of transitory income (crop loss and the extra labor income) have an effect on consumption that is statistically significant and equal to the one associated with permanent income. This means that consumption for poor households is driven by current income, and therefore permanent income is not an appropriate welfare indicator for them. The second distinction between poor and non-poor households concerns the marginal propensity to consume out of the relevant income measure: while the latter consume a fraction of their permanent income close to one, the former save about a half of their current income. More precisely, asset poor households transfer into savings half of their permanent and half of the extra labor income due to the labor supply response. Instead, the income gain from other coping strategies is not used to accumulate savings: what poor households receive from taking a loan or selling assets is entirely transferred onto consumption.

These results confirm the need for poor households to accumulate assets, and suggest that in this case policies that support savings, more precisely the accumulation of productive assets, may be even more important than the development of labor markets.

We expect these policy-implications to be relevant also for other countries, but it would be useful to confirm this intuition by carrying out similar analyses on different datasets.

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Appendix

Table A1 summarizes the sample characteristics for the main variables for small, medium and large farms. We can see that households with a low level of farm assets (small farms) are also poor in terms of non-farm assets and households income. There are no other significant differences between farms, except the number of household members with secondary and higher education.

Table A2 summarizes the sample characteristics for the main variables included in the income regressions presented in tables A3 and 4. The mean for dummy variables represents the proportion of that group: for example, 81% of the household heads work as self-employed, and 13% as private or government workers. 26% of the heads are illiterate and 35% did not complete the elementary level.

Table A1
Sample means of household characteristics by 1992 value of farm assets

	Bottom 25%	25-75%	Top 25%
1993 Crop loss	0.08	0.07	0.07
	(0.27)	(0.26)	(0.26)
Labor supply as a response to a 1993 crop loss	0.51	0.37	0.30
	(0.51)	(0.46)	(0.46)
Own farm land	0.45	0.97	0.99
	(0.50)*	(0.17)	(0.07)
Business ownership	0.23	0.26	0.28
	(0.42)	(0.44)	(0.45)
'92 value of business assets (excluding zeroes)	489.70	482.20	4460.96
	(1467.00)	(1674.23)	(29347.50)*
'92 value of non-business assets	1907.59	3050.02	5819.95
	(4198.26)*	(6488.73)*	(16482.29)*
Household income	676.29	793.12	1624.23
	(1049.87)*	(1174.43)*	(2159.15)*
Head inactive	0.04	0.06	0.04
	(0.20)	(0.23)	(0.19)
Head employee	0.17	0.13	0.11
	(0.38)	(0.33)	(0.31)
Head years of education	3.53	3.82	4.62
	(3.40)	(3.58)	(4.19)*
Household size	4.57	4.48	4.87
	(2.03)	(1.96)	(2.09)
Number of income earners (other than head)	0.67	0.68	0.75
	(0.91)	(0.91)	(0.92)
Number of male adults with secondary education	0.20	0.26	0.42
	(0.40)	(0.51)	(0.67)*
Number of female adults with secondary education	0.10	0.16	0.27
	(0.40)	(0.40)	(0.50)*
Number of male adults with higher education	0.01	0.02	0.05
	(0.09)	(0.13)	(0.23)*
Number of female adults with higher education	0.003	0.01	0.02
	(0.06)	(0.10)	(0.15)*

Note. The table reports mean characteristics of farm households, by the size of the farm (quartiles of 1992 farm assets distribution). Income and assets are in thousands of rupiah. Standard errors are in parentheses.
* the difference in the means is statistically significant at the 5-percent level.

Table A2
Sample means of variables included in the income regression

Variable	Mean	Std. Dev.	Min	Max
Shocks				
1993 Crop loss	0.08	0.26	0	1
1993 Labor supply	0.03	0.17	0	1
"take a loan or sell assets" (1993)	0.03	0.16	0	1
Household economy				
Household income	970.97	1506.37	-100	18464
1992 farm asset	5551.32	15204.49	0	268025
1992 business assets	399.60	7811.01	0	356650
1992 illiquid non-business assets	3936.08	9829.80	0	275430
1992 liquid non-business assets	190.53	628.64	0	9500
whether a household member receives a pension	0.02	0.13	0	1
whether the household receives winnings	0.17	0.38	0	1
whether the household receives gifts	0.16	0.37	0	1
Nr. of income earner other than the head	0.69	0.92	0	6
Work status of the household head				
Head is inactive	0.05	0.21	0	1
Head is employed	0.13	0.34	0	1
Head is self-employed	0.81	0.39	0	1
Head is family worker	0.01	0.11	0	1
Education of the household head				
Head unschooled	0.26	0.44	0	1
Head incomplete primary	0.35	0.48	0	1
Head completed primary	0.23	0.42	0	1
Head secondary education	0.14	0.34	0	1
Head higher education	0.02	0.12	0	1
Household size	4.59	2.01	1	16
Electricity in the village	0.76	0.43	0	1

Note. The table reports the sample means of key variables used in the income equations. Household income and assets are in thousands of rupiah.

Table A3
Income equation estimates
(for households that did not report a crop loss in 1993)

Variables	Coeff.	t
Permanent income variables		
1992 farm assets*dummy small farm	-0.44	-1.99
1992 farm assets*dummy medium farm	0.02	0.94
1992 farm assets*dummy large farm	0.02	4.41
1992 business non-farm assets	0.01	3.87
1992 non-business assets	0.03	3.14
Head employee	1207.49	8.71
Head self-employed	171.95	1.93
Head complete primary educ	84.78	1.44
Head secondary educ	819.31	6.20
Head higher educ	1899.87	4.20
Number of income earners	151.55	4.32
Pension (if someone receives a pension)	1279.46	3.60
Household size	140.95	3.32
Household size squared	-10.91	-2.80
Electricity in the village	83.07	1.48
Intercept	-262.86	-1.51
Positive transitory income variables		
Winnings	381.71	3.99
Gift	146.27	2.01
Number of obs= 2020		
F(28, 1991) = 16.34		
R-squared= 0.37		

Note. The table presents the results from equation (9) and estimates the predicted income for households that did not report a crop loss in 1993. Dependent variable is 1993 household income. This regression includes also provincial dummies. Both income and assets are measured in thousands of rupiah. Standard errors are robust.

Table A4
Probit equation for the labor supply response

Variables	Coeff.	z
Land value	-0.00004	-3.44
Dummy if credit in village	-0.30	-2.43
Proportion of other households experiencing a crop loss in the same village	1.17	3.64
Age of household head	-0.02	-3.43
Nr. of adult members with secondary education	-0.14	-1.81
Nr. of females aged 13-17	0.22	1.95
Spouse is inactive	-0.36	-2.69
Poor soil quality in village	0.38	2.03
Average soil quality in village	0.41	2.79
intercept	0.25	0.91
Number of obs=532 Pseudo R-squared = 0.11 Percentage correctly predicted = 64.85		

Note. The table reports the results from the probit regression that estimates the probability of responding with labor supply to a crop loss. Dependent variable is a dummy that equals one if the household had a labor supply response in the face of a crop loss over the period 1988-93.

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