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

Gabriella Berloffa[+] and Francesca Modena[*]

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 to behave quite differently in terms of both their responses to shocks and their consumption 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: shocks; coping strategies; consumption smoothing; asset smoothing

JEL Classifications: D12; D81; O12

[+] Department of Economics, University of Trento.
[*] Corresponding author. Department of Economics, University of Trento, Via Inama, 5, 38122 Trento (IT). Phone: +39 0461 282277; Fax: +39 0461 282222; francesca.modena@unitn.it.

INTRODUCTION

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 2009; 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 2006; Jalan and Ravallion 1999).

When analyzing households' responses to shocks a central issue to be considered is the amount and composition of households' (non-human) assets: when a high proportion of the latter is used to generate income ('directly' productive assets: physical capital, livestock, plants, etc.), 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 (productive) assets or slowing down asset accumulation could have important implications for future income and, hence, for future consumption. Various theoretical papers have shown that households choices may be characterized by multiple equilibria when borrowing is limited and there are some forces that create locally increasing returns to wealth, such as the existence of high- and low- return production processes with the former requiring a minimum project size or being riskier. The existence of multiple equilibria implies that asset accumulation may bifurcate: households that are not 'too far', in some sense, from the asset level where increasing returns occur, are likely to pursue an autarchic accumulation strategy; as the distance from that level increases, this strategy may no longer be rational or feasible. The critical asset threshold below which the asset accumulation strategies change is known as the Micawber threshold (e.g. Zimmerman and Carter 2003, Carter and Barrett, 2006).

If a household suffers a loss of productive assets, falling below this threshold, it might indeed fall into a poverty trap. This implies that transitory shocks may have long term consequences, when the income loss leads to changes in the asset investment decisions. For this reason, households close to the threshold are likely to engage in asset smoothing (reducing consumption in order to preserve their stock of assets), rather than consumption smoothing (selling assets in order to preserve consumption), when hit by income shocks.

While the theoretical literature offers insights as to when such a threshold will occur (existence of increasing returns and limited access to capital), determining whether this threshold exists in specific contexts is an empirical matter. Lybbert et al. (2004) find evidence of such a threshold for Ethiopian pastoralists: the propensity to recover from shocks to herd sizes depends heavily on whether they have fallen below a critical minimum herd size. Santos and Barrett (2005) show that the critical herd size varies according to pastoralists' herding ability. Hoddinott (2006) obtains similar results for small farmers in Zimbabwe: the probability of selling assets (animals) in the face of a negative-income shock depends on the prior level of assets .

In Indonesia, access to capital was quite easy until the mid '80s. Indeed, since 1965 the Indonesian government has assisted the agricultural sector and the rural non-farm activities through various subsidized credit programs (BIMAS, P4K, KIK, KMKP, KCK, KUPEDES, KKPA, KKU, KUK, KMK-BPR, KPKM, KPT-PUD, etc.; see …). These programs successfully introduced new technologies and increased rice production (achieving self-sufficiency in 1984), but at the cost of low repayments and high arrears (Fitri, 2006). Over the '80s, two banking reforms abolished restrictions on interest rates and ceilings on credit expansion, making access to capital more difficult for low-income households[1], despite the

[1] There is however some evidence that even the earlier programs of subsidized credit have given more benefit to better-off households, while poor households tended to be excluded (Zaini, 2000, Kristiansen, 2003).

liberalization of rules governing the establishment of new banks and branch offices which contributed to the development of a banking system reaching out to villages.

Beside the existence of different agricultural production technologies, increasing returns are clearly present in the savings opportunities of Indonesian households. Since the mid '80s, savings mobilization has been an integral part of BRI's strategy (Bank Rakyat Indonesia, the most extensive of all banks in Indonesia, with units in more than 80% of sub-districts), with the design of specific savings accounts like SIMPEDES, with low minimum deposits to serve the needs of low income customers. However, interest rates offered on these accounts increase with the deposit size, providing greater incentives for households who can afford higher saving amounts. Indeed Johnston and Morduch (2008) found that the propensity to have a savings account rises with income; Cole, Sampson, and Ziav (2009) report that in 2008 only 32% of rural Indonesian households had a bank savings account. A study by Allianz AG, GTZ and UNDP in 2006 based on qualitative research, highlighted some of the reasons for not having a saving account reported by the poor themselves: they could not afford the minimum deposit to open an account and/or the minimum balance to maintain the account, bank branches were too far away with prohibitive transportation costs and they would have been embarrassed to deposit the small amounts that they had in the bank (Allianz AG, GTZ and UNDP, 2006).

The saving program launched by the government in 1995 (TAKESRA or "Prosperous Family Saving" particularly targeted to low income women, which encourages the formation of small saving groups with the government providing a limited amount of savings that families are encouraged to keep in order to use at a later stage) is too limited to overcome the difficulties of low-income households, and other incentives should be provided in order to encourage saving accumulation. For example, a randomized experiment carried out in 2008 on unbanked households, showed that modest financial subsidies could have large effects,

significantly increasing the share of households that open a bank savings account, even without financial literacy training (Cole, Sampson, and Ziav, 2009).

Since these institutional features are the necessary conditions for the presence of different asset-accumulation regimes for poor and non-poor households, this paper investigates whether Indonesian farmers respond differently to the most frequent shock in rural Indonesia, crop loss, 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. We do not model explicitly the choice between different technologies (high-risk high-return and low-risk low-return) because we want to focus on ex-post risk coping strategies. Therefore, we simply assume the existence of an asset threshold (that may depend on household characteristics) below which profits are null.[2]

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[3]. Their approach and results suggest that, in the absence of changes in the labor supply, crop losses lead only to transitory welfare losses. The need to accumulate assets is not considered by the authors; rather their estimates imply that all households have a marginal propensity to consume out of permanent income close to 0.9 (statistically different from one). This means

[2] We neither model the household fertility decision which, as noted by a referee, could represent an optimal ex-ante strategy in the presence of risk (i.e. accumulating a "buffer-stock" of potential labor supply). As regards this issue, Kreager and Schröder-Butterfill (2008) highlight the very high mobility of younger populations in Indonesia (which represents a continuation and redevelopment of labor patterns involving demands for seasonal, circular, and periodic migration), and note that "if children are prone to leave, then couples are unlikely to embark on childbearing with the idea that family size is decided simply by their fertility or that children can be counted on as an enduring source of labour and support."

[3]The flexibility of Indonesian labor markets and the availability of 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).

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 paper uses the 1993 round of the Indonesian Family Life Survey to extend the approach of Cameron and Worswick (2003), by considering the interlink between production and consumption decisions. In particular, we distinguish between asset-poor and non-poor farms according to the total value of productive assets owned by the household (the former are those in the bottom quartile of the asset-value distribution, and the latter are all the other ones), and we explore the relationship between income and consumption for the two groups. 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 will 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 non-poor farms smooth consumption relative to income, asset-poor 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, partially 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 both avoid the loss of productive assets (through e.g. micro-insurance) and provide incentives for their accumulation, may be even more important than the development of labor markets.

While policies aimed at employment creation have received quite a lot of attention from the Indonesian government[4], micro-insurance is still not considered as a priority area and incentives for asset accumulation are entirely confined to the provision of subsidized credit. Indeed, the regulation of the President of the Republic of Indonesia regarding the national medium term development plan, 2010-2014, explicitly recognizes the need of "increasing the budget for labor intensive infrastructure projects" as a fiscal stimulus for "handling the effect of workers who were discharged and reducing the unemployment rate", and of "providing interest subsidies and small loans" to prevent "widespread discharges of workers and increasing business community resilience" (Ministry of National Development Planning, 2010). The World Bank is trying to draw the attention of Indonesian authorities towards the development of the insurance market in rural areas (a specific conference has been organized in Jakarta on the 26-27th October, 2011). While we think that this is surely an important step forward, we suggest that insurance against crop losses should be explicitly considered and that it needs to be coupled with specific incentives for asset accumulation.

The remaining of the paper is organised 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.

[4] During the 1980s and 1990s, subsequent governments have implemented various schemes (typically *Padat Karya*, PK) to create jobs through workers' engagement in public works. Formally, PK has now shut down, but many departments have small versions of it still operating. In 2007 BAPPENAS (the National Development Planning Agency) in collaboration with the ILO commissioned a policy paper to address the employment problems of the poor in Indonesia, particularly those located in rural areas. The report presented the design of an Employment Guarantee Programme for Indonesia, which aims to create jobs in unskilled activities at pre-determined wages for a maximum period of three months for a targeted (poor) population. To our knowledge, this program has not been implemented yet. The government has also for a long time formally and financially stimulated rural cottage industry clustering to encourage horizontal and vertical linkages and thereby rural employment and development. Examples include the PIR program (which aimed at establishing business dynamics in remote or lagging areas, creating a system of satellite smallholdings which surround and sell their products to large-scale, often government owned, estates), the BA program (with which large scale companies were invited to take initiatives and make partnerships with small-scale, preferably rural enterprises), and state-initiated or –funded cooperatives. These programs contributed to create significant new employment opportunities in rural areas, but have lost credibility because of widespread misuse of power and corruption by involved government officers (see Kristiansen, 2003).

THEORETICAL FRAMEWORK

The model developed in this section is a simple intertemporal model of utility maximization, with the budget constraint containing a farm-profit function subject to exogenous income shocks. Leisure and asset investment decisions are included in the problem. Assets are defined as 'directly productive' (assets used for farm production: land, equipment, plants and livestock, etc.) and 'indirectly 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 all non-human assets (directly and indirectly productive) 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 farm labor is fixed and exogenous[5] (h_t^f, which includes both household and hired labor), and varies with *s* (negative shocks reduce h_t^f). The remaining household time endowment (T_S) 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:

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

[5] Benjamin (1992) showed that in rural Java there is an active labor market where households engage in both the hiring and selling of labor, and that farm employment is independent of family composition. The higher propensity of farmers to employ both hired and family labor compared to other developing countries is in line with the widespread use of sharecropping arrangements in Indonesia.

Assets[6] evolve according to:

$$\Phi_t = \Phi_{t-1} + \phi_t \tag{2}$$

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:

$$c_t + p_\Phi(\phi_t) = I_t \tag{3}$$

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[7]. 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

[6] As mentioned above, assets are a broad definition and include both productive and financial assets. However, since we consider only farm households, productive assets constitute the majority of total assets owned by the households (excluding the value of the house where people live).

[7] 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)).

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 2006); to be more specific, we assume that $\partial^2 u_t / \partial c \partial l > 0$.

The household's Bellman equation is defined as (McPeak, 2004):

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

The first-order conditions for households for which the constraint is not binding are[8]:

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

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, other things 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, other things equal, and decreases the marginal dis-utility of off-farm work[9]. 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

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

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

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 (5). 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.

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 that they owned a farm[10] and at least one farm asset in the year of the survey.

Table 1 illustrates some characteristics of these households, compared to the (rural) non-farm and the non-rural sub-sample. Demographic variables are not very different in the three groups: households are slightly smaller and there is a higher incidence of female-headed households in the rural non-farm sample. Marked differences arise instead in educational levels: more than 60% of household heads have not completed the primary school in rural areas, compared with only 32% in the non-rural sample; similarly, the number of members who have completed the higher secondary school is about 0.2 in rural areas and 0.9 in urban ones.

As regards expenditures and income, there is an improvement in the average economic conditions moving from the farm to the non-farm and to the non-rural households: per-capita expenditures are more than double in urban areas compared to farm households, and annual income is four times larger. An increasing pattern emerges also for the average amount of each income component (conditional on the household receiving that type of income). In each group there is a clear diversification of income sources: for example, farm profits represent on average only half of the total income of farm households, the other half coming from either non-farm business or wages/salaries, and other types of income (such as pensions, insurances, winnings or gifts). Also the type of assets owned by the household (non related to farm and non-farm businesses) are quite different in the three groups: farm households have the highest proportion of home-ownership and the lowest of the other type of assets (vehicles, savings and other receivables).

[10] The precise question in the survey is: "during the past 12 months is there a householder who has worked in a farm business but not as a farm worker on someone's else land?" There are also about 406 farm households who live in urban areas, but we do not include these in the analysis because their environment may be completely different from that of the rural ones.

Table 1

Some descriptive statistics for farm and non-farm households.

	Farm	Non-farm	Non-rural
Demographics			
Household size	4.60	4.17	4.73
N. of members <18	1.99	1.82	1.88
N. of females>17	1.34	1.28	1.51
Head's age	46.96	44.83	45.03
Head male	0.89	0.77	0.84
Head with no primary	0.62	0.61	0.32
Head with higher secondary	0.07	0.10	0.27
N. of members with higher secondary	0.21	0.24	0.88
Expenditures			
Monthly per-capita expend.	41.85	47.95	94.29
Monthly per-capita food exp.	26.58	30.24	49.97
Income			
Annual total income	971.00	1280.20	3506.18
N. sources	1.86	1.35	1.59
Have farm business	0.95	0.00	0.11
Net profits farm-business	400.39	0.00	504.31
Have non farm business	0.24	0.34	0.33
Net profits non-farm busn.	530.48	758.57	1586.99
Have wage income	0.26	0.52	0.54
Annual wage income	1294.79	1291.58	4499.09
Have other income	0.40	0.48	0.60
Annual other income	299.70	934.23	793.65
Household assets			
Own house they live in	0.94	0.85	0.66
Own vehicles	0.20	0.33	0.39
Own savings	0.14	0.18	0.32
Own other receivables	0.09	0.10	0.13

Notes: Variables in italics are dummy variables; the corresponding number indicates the proportion of households with the stated characteristic. Means of income components are conditional on receiving that type of income.

Table 2

Proportion of farm households owning different assets

	Total	Poor[a]	Non-poor
only Land (L)	1.5	1.5	1.5
only small equipment (SE)	7.0	28.0	0.0
only L, SE	19.7	17.7	20.4
only L, SE, Plants or Livestock (Pl/Li)	32.7	14.3	38.8
L, Pl/Li, no tractor or heavy equip. (TR/HE)	21.4	6.9	26.3
L, TR/HE, other assets	3.8	0.4	4.9
L, other assets	5.3	3.8	5.9
No land, other assets	8.6	27.5	2.3
Total	100.0	100.0	100.0

[a]: Households whose value of assets invested in the farm is in the bottom quartile of the (farm) asset-value distribution.

Table 2 reports the type of assets owned by farm households. Within this group we separately identify those households whose self-reported total value of farm assets in 1992 was in the bottom quartile of the asset-value distribution (we call these 'asset-poor' farms). About 15% of all farm households do not own land, and half of these have only small equipment (like saws, axes, plows, etc.), which is not so surprising given the widespread use of various sharecropping arrangements in Indonesia. Only a very small proportion (3.8%) own tractors or other heavy equipment (like farming machines, generators, etc.), whereas the majority (52.4%) have land and small equipment (with or without plants or livestock). The asset-poor farms are quite different in that more than half of them do not own land (55.5% vs. 2.3% for non-poor), and a much lower proportion own plants or livestock (21.2% vs. 65.1%).

The asset-poor farms are also quite different in terms of education, expenditures, income and ownership of household assets (see table A1 in the appendix): they have lower education, their per-capita expenditures are about three quarters of the non-poor ones, and their total income about 63%. Their farm profit and other income are less than a half of the non-poor ones, and a slightly higher proportion of them receive wage income (31% vs. 24%). Less than 10% of them have either savings or other receivables. With these characteristics, it is quite clear that the strategies to cope with a negative income shock are quite limited for these households, and that the only assets that many of them could sell are the productive ones (with the only exception of the house they live in).

Our dataset allows us to have information on whether households 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 it. 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[11].

About 34% of the total rural sample, and 41% of farm households have experienced at least one shock in the past 5 years. The incidence of the different types of shocks is reported in table 3. Since for the same year households may report more than one shock, we also illustrate the proportion of households who experienced the occurrence of different shocks simultaneously and which combinations are the most frequent ones[12].

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%. This type of shock is also the most common, with a median percentage of farmers that experienced it in the same village equal to 6.7 (and a maximum of 40%). More than 90% of households who experienced at least one shock do not report more than one shock in the same year; when they do, it is more common that they report a combination of shocks in which crop loss is included (7.2% in the rural sample; 5.7% for farm households), and within these, a combination of crop loss with non-demographic shocks (in particular price falls). Moreover, only 2.8% of all those reporting a crop loss declare to have experienced a demographic shock (sickness or death of a householder) in the previous year.

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 those that have only farm workers. As

[11] For example, 31% of the crop loss experienced in the period 1988-93, are reported to occur in 1993, and 63% in 1992-93.
[12] We thank an anonymous referee for pointing out the importance of analyzing the joint occurrence of different shocks.

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[13].

Table 4 shows the percentage of farm households that use different measures in response to crop losses (both for the period 1988-93 and for 1993 only[14]), and whether these measures are used in isolation or in combination with other measures. Nearly 40% of the total respondents report taking an extra job to overcome a crop loss, and in almost all cases (90.8%) this is the only measure taken. Other important responses are 'cut down on household expenses', 'take a loan' and 'sell assets', whereas help from the family is much less important[15]. Only about 16% of households use more than one measure to overcome the shock.

The type of response changes with the value of assets invested in the farm (see table 4): labor supply adjustment is a measure used particularly by poor farmers (the percentage of households that take an extra job decreases from 54.6% to 30.7% as we move from poor to rich farmers; see also Kochar 1999; Newhouse 2005, Maitra 2001); the opposite happens if we consider selling assets and using savings. The proportion of households taking a loan and cutting expenditures do not increase or decrease linearly as farms' assets increase: taking a loan is a relevant choice also for poor farmers, and if they reduce expenditures, they are more likely than wealthier farmers to do it as an additional measure (probably because of their already low level of per-capita expenditures).

[13] As table 3 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).

[14] 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.

[15] This may be due to the fact that we are considering the response to crop loss and that in many cases this type of shock is experienced by many villagers at the same time. Indeed, as the literature suggests, 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).

Table 3

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

	Rural sample		Farm sample		
Type of shock:		%		%	Commonality medians[b]
Death	284	7.9	174	7.9	3.7
Sickness	376	10.4	232	10.5	3.9
Crop loss (CL)	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 (PF)	239	6.6	215	9.7	4.2
Joint occurrence:					
Only 1 type of shock	1138	92.8	829	91.3	
CL and Sickness/death	23	1.9	23	1.5	
CL and Dis/Unemp/PF	47	3.8	42	4.6	
Other mix (no CL)	18	1.5	14	1.5	

[a] In the top panel, the table shows the number and percentage of rural and farm households reporting each type of shock over the five year period 1988-93. In the bottom panel, we consider whether households have reported only one type of shock or various combinations of them in the same year. In this panel, percentages refer to the total of households who reported at least one shock in the period 1988-93.

[b] 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 4

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

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
Combinations:						
Only[b] extra job	27.4	35.6	43.3	40.6	33.1	24.8
Only loan	14.6	14.7	17.7	11.7	10.1	19.4
Only sell/savings	20.7	16.9	7.1	13.3	21.6	26.4
Only reduce exp.	20.1	14.7	12.1	18.7	18.0	10.1
Mixed	15.8	16.4	18.4	14.1	15.1	17.8

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

[b] "Only" may include family assistance.

The higher propensity of asset-poor farms to use labor supply cannot be attributed to a significantly larger household size or other demographic characteristics. Indeed, table A1 in the appendix shows that the only significant difference (except the one related to assets and income) 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 value or type of farm-assets than to other household characteristics. Table A2 in the appendix shows indeed that those who have only land or those who have livestock are less likely to take an extra job to overcome the shock, whereas they are more likely to either use loans (the former) or to sell their assets (the latter)[16]. Increase in labor supply is especially relevant for those who either have no land (the majority of the "other" category in table A2), or who have plants. While the asset-poor farms include almost all those who have no land, the proportions of the other groups are quite similar, so that having a low value of assets invested in the farm does not represent only a particular type of agricultural activity, but it captures the poorer farmer in each group.[17]

Finally, we examine how the self-reported cost of overcoming the shock is related to both the joint occurrence of shocks and the type of response adopted[18]. As can be observed in table 5, while the joint occurrence of other shocks together with a crop loss implies a larger

[16] Land transfers are not common in Indonesia, because of both traditional and legal reasons. Legally, the only transfers that are not allowed are transfers of the right of ownership to foreigners, to individuals possessing a foreign nationality in addition to his Indonesian nationality or to corporations, except those which have been determined by the government. However, all the various and complex tenures created by the Basic Agrarian Law (1960) cannot be considered as legally secure because they remain continually liable to forfeiture to the State. In practice, the adat (traditional) law plays quite a crucial role: the Supreme Court confirmed the validity of adat transactions which do not rely at all on formal registration structures. Adat land property rights institutions and the mode of land transfers have evolved from the lineage or extended family ownership along matrilineal lines to joint and single family ownership. However, even under single family ownership, there is no right to sell without the approval of family members. The right to sell without approval is granted only to land acquired by clearing forest or by purchasing land. (See Wright, 1999, and Otsuka et al., 2001)

[17] We considered also how the responses strategy vary with the distance from urban centers (the sub-district capital in our data). As reported in table A3 in the appendix, households who live far from the sub-district capital are more likely to take an extra job and less likely to take a loan, than those who live close to it, whereas there is no significant difference for the other measures. Therefore we will include the distance variable in our empirical analysis.

[18] When households report that they have taken more than one measure to overcome the shock, they only report the overall cost, not the different amounts that are attributed to each single type of response. Instead, when they report more than one shock in a given year, they report the cost for each type of shock.

overall cost for the year (more than 500 thousand rupiah compared to less than 300), the part of this cost attributed to the crop loss is somewhat smaller than in the case of a single shock. As regards the type of response, there is no difference in the medians (but an increasingly larger mean) between taking an extra job, cutting expenditures or taking a loan, whereas both the mean and the median point towards a larger cost for those who either sell assets/use savings or use mixed strategies.

This descriptive evidence suggests that it is important to distinguish between asset-poor and non-poor farms in the analysis of income and consumption smoothing behavior, and it will guide our choice of variables in the different models to be estimated.

EMPIRICAL METHODOLOGY

In this section we present the empirical strategy that we adopt to obtain 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 a 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).

Table 5

Cost of overcoming the shocks by combination of shocks and type of response

	Cost of overcoming the crop loss		Cost of overcoming all shocks in the year		
	Mean	Median	Mean	Median	N.obs
By combination of shocks:					
1988-93					
Only crop loss (CL)	334.38	150	296.11	100	466
CL+ other shocks	242.14	120	509.25	325	71
1993					
Only CL	285.15	100	255.36	100	133
CL+ other shocks	211.98	100	518.78	275	30
By type of response:					
Extra job[a]	230.65	100			191
Cut expend./Help from family	320.38	100			79
Take a loan[a]	361.89	100			79
Sell assets/use savings[a]	387.83	200			91
Mixed	363.83	150			88

[a]: It may also include financial help from family as an additional measure to the one specified.

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[19], 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.[20]

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, gift from family/friends, or shocks different from crop loss). 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[21].

[19] 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 2006).

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

[21] 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.

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

$$\Delta Y_h = Y_h^{CL} - \hat{Y}_h \tag{10}$$

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 unobservable characteristics). To obtain a measure of the crop loss and of the increase in income due to coping strategies, the following regression is estimated:

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

where X_h^S are variables that affect the size of the income loss (in our case the value of 1992 farm assets)[22], X_h^{LS} and X_h^L are vectors of variables that determine the size of the 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, which may have an additional effect on the ability to recover from the shock[23].

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.

[22] To account for possible non-linearity in the functional form, the coefficient on farm assets is interacted with dummies that indicate whether the 1992value of assets invested in the farm is in the bottom 25%, in the 25-75%, interval or in the top 25% of the asset distribution.

[23] 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: $Y_h^{CL} = \beta_0 + \beta_1 X_h^S + \beta_2 X_h^A + \beta_3 X_h^{LS} + \beta_4 X_h^L + \beta_5 \hat{Y}_h + u_h$; where $\hat{Y}_h$ is the income predicted using the coefficient estimates from (9). $\hat{\beta}_5$ is found not to be statistically different from one (F(1,148)=2.46, Prob>F=0.12).

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[24]:

[24] 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. Paxson includes also the variability of the household's income.

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

where C_h is household consumption (measured by non-durable annual household expenses[25]), $\hat{Y}_h^P$ 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)[26]. $\hat{u}_h$ 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 farms in the bottom, medium (25-75%), and top quartile of the asset-value distribution. 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 these households.

[25] 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.

[26] 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.

RESULTS

Income equation estimates

Estimates of the income equation for households that did not experience the crop loss (equation (9)) are reported in the Appendix (tables A4 and A5). Since the distance from urban centers may affect the whole income generating process (with different returns on education, assets, etc.), we estimate different models for households that are close or distant from the sub-district capital[27]. 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 in the bottom, medium (second and third), and top quartile of 1992 farm assets distribution.

Results are in line with standard income equation estimates. Coefficients on non-farm assets are highly significant for close households, but not for distant ones. Those on farm assets confirm the non-linearity of the income function, with large and positive returns for the top quartile and a negative effect for the bottom one (much larger for distant households). Households whose head has secondary/higher education or is employed in the private and government sector have a higher income, other things equal. Other variables that have a significant effect on household income are the number of income earners other than the head (with a much smaller and non-significant effect for distant households), 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 6, the resulting income loss for these households is on average about 24 thousands of rupiah, but there is a high variability around

[27] Close and distant households are defined as those that live respectively less or more than 13 km away from the sub-district capital. 13 km is the third quartile of the distance distribution in our dataset.

the mean. For households that report labor supply response we obtain a positive mean difference between realized and predicted income (245 thousands of rupiah), whereas the mean is negative for the other households (-119 thousands of rupiah)[28]. Within this group, the loss is much more pronounced for those who reported a joint occurrence of multiple shocks (-438 thousands of rupiah).

In order to identify the main components of this 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 A6) [29] show that the probability of adopting labor supply decreases with the value of the land, the possibility of access to the credit market [30], the experience of a demographic shock (together with the crop loss), the age of the head, the number of adult members with secondary education, the presence of an inactive spouse, and the quality of the soil (farmers that cultivate a high-quality soil have higher farm profits[31] and, hence, they may rely on other risk-coping strategies). Distance from the sub-district capital, the commonality of the shock, the number of female household members aged 13-17, all increase this probability. These results suggest that, as already observed in the descriptive analysis, 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.

As the estimates of equation (12) reported in table 7 show, the difference between observed and predicted income for households who experienced a crop loss is the result of a

[28] The difference in the means for the two groups is statistically significant at the 1% level.
[29] 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. Note that in this model we have included two exogenous variables (dummy if credit in village and the proportion of other households experiencing a crop loss in the same village) that affect labor supply but that are plausibly excludable from the second-stage income equation.
[30] 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.
[31] Farmers living in villages with a high soil-quality have farm profits that are statistically higher (at 0.01% level) than other farmers.

reduction in income due to the shock and some recovery measures adopted as a response to it. The former depends on the level of asset ownership, and on having experienced other shocks together with the crop loss. The estimated coefficients on farm assets are all negative and significant, but they decrease, in absolute value, as we move from asset-poor to asset-rich 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 to recover from the shock depends positively on the value of non-farm assets, indicating that rich households have a higher ability to recover from the shock, but the effect is not significant. The labor supply effect is instead significant; the income gain is related to the number of household members aged 13-64, with each member allowing households to gain about 425 thousands of rupiah of extra labor income after a crop loss. The distance from the sub-district capital (expressed in kilometers), increases the income loss due to crop loss, and this may be a sign of both a larger size of the shock and a lower ability to recover from it (e.g. because of a lower income obtained from the extra-job or from selling assets).

From this regression, we construct the measures of the income reduction caused by the crop loss[32] and of the income gains due to the labor supply response. Predicted measures are summarized in table 8. 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 1010 thousands of rupiah. The average value of the income gain due to labor supply response is 1274 thousands of rupiah, suggesting a significant impact of this coping strategy. 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 (445 thousands of rupiah) and negative for the others (-812 thousands of rupiah).

[32] If there are omitted variables in the regression reported in table 7 which are uncorrelated with the value of 1992 farm assets, the income reduction caused by the crop loss will have a different mean, but its variability across households, captured by $\hat{\beta}_1 X_h^S$, will not be affected.

Table 6

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

Variable	Obs.	Mean	p25	p50	p75
ΔY_h^{CL}	163	24.13	-585.62	-85.04	293.62
ΔY_h^{CL} *LS	64	245.60	-619.79	17.07	461.65
ΔY_h^{CL} *(1-LS)	99	-119.04	-537.09	-203.02	215.70
ΔY_h^{CL} *(1-LS)*joint	20	-437.93	-758.80	-463.03	-171.38

[a] The descriptive statistics differentiate between households that adopted the labor supply response (LS=1) and those who did not (LS=0). Within this second group we also distinguished those who reported a joint occurrence of various shocks (joint=1). The difference in the means is statistically significant at the 1% level.

Table 7

Income loss equation estimates[a]

Variables	Coef.	t
Variables that affect the size of the loss		
1992 farm assets*asset-poor farm	-1.82	-1.96
1992 farm assets*medium farm	-0.12	-1.90
1992 farm assets*asset-rich farm	-0.02	-3.53
Other shocks occurred in the same year	-467.45	-2.41
Recovery's measures		
1992 non-business assets	0.04	1.41
LS*N_1364	424.80	2.60
Dummy sell assets or take a loan	290.63	1.09
Other variables		
Dummy cut expenditure	159.48	0.84
Distance from sub-district capital	-7.76	-2.54
1st selection term* LS	-183.61	-0.46
2nd selection term* (1-LS)	-1096.73	-2.31
Intercept	-632.27	-1.58
Number of obs= 159		
F(11, 147) = 3.54		
R-squared= 0.24		

[a] 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.

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 (productive) 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. Estimates of equation (16) are reported in table 9[33].

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 non-poor farms is indeed determined by permanent income, while the crop loss has no impact on non-durable expenditures (the coefficient is small and not significant)[34]. Instead, consumption of asset-poor farms is influenced by both permanent and transitory income: coefficients on both types of income are significant. 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 non-poor farms (p-value=0.000), but not for asset-poor farms. Indeed, the estimated coefficients on permanent income, crop loss, and extra labor income on consumption for asset-poor farms are not statistically different (test for the equality of the three coefficients: $F(2,2057)=1.14$, $Prob>F=0.32$)[35].

[33] Five outliers which belong to the top percentile of the expenditure distribution are excluded from the expenditure regression. All the results reported in table 9 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. We also tested whether the joint occurrence of crop loss together with other shocks and the distance from the sub-district capital had an effect on expenditures, but both these variables were not significant, with an F test for their joint exclusion equal to $F(2, 2057) = 0.21$, $Prob > F = 0.81$.

[34] We cannot reject the hypothesis that the effect of the shock on consumption is the same for farms in the medium and top quartile of the asset-value distribution ($F(1,2056)=0.57$, $Prob>F=0.451$). Hence, we pool the two groups.

[35] 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

Table 8

Descriptive statistics of predicted variables[a]

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	-1117.06	-1009.99	-900.44	-804.23
Asset-poor farms	-1130.32	-930.42	-823.22	-717.50
Medium farms	-1101.05	-984.26	-924.99	-856.03
Asset-rich farms	-1391.90	-1145.75	-876.85	-806.33
Income gain due to labor supply response $(\hat{\beta}_3 X_h^{LS}\ \ if\ \ LS = 1)$				
Total sample	849.60	1274.41	1274.41	1699.21
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	4.69	444.59	423.27	849.88
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	-1033.15	-812.14	-736.07	-521.27
Number of households that reported a crop loss in 1993 = 163				
Number of households that adopted the labor supply response in 1993 = 64				

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

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).

Table 9

Expenditure equation estimates[a]

Variables	Coef.	t
$\hat{Y}_h^P$ - asset-poor farms	0.45	5.81
$\hat{Y}_h^P$ - medium farms	0.73	7.05
$\hat{Y}_h^P$ - asset-rich farms	0.98	8.50
${}_1\hat{Y}_h^S$ - poor farms	0.76	3.31
${}_1\hat{Y}_h^S$ - non-poor farms	-0.24	-1.57
$(\hat{\beta}_2 X_h^A + \hat{\beta}_4 X_h^L)$ - poor farms	1.30	1.94
$\hat{\beta}_3 X_h^{LS}$ - poor farms	0.48	2.21
Transitory positive income	1.36	5.49
$\hat{u}_h * CL$	0.23	1.59
$\hat{\varepsilon}_h * (1 - CL)$	0.44	5.64
members aged 0-5	-7.33	-0.2
members aged 6-11	188.45	4.62
members aged 12-17	291.85	6.12
members aged 18-64	201.02	5.46
members 65 years or over	149.17	2.15
Intercept	403.61	4.07
R-squared= 0.33		
Number of obs= 2075		

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

A second distinction between poor and non-poor households is the magnitude of the marginal propensity to consume out of the relevant income measure. Non-poor farmers consume about 90% and 70% of their permanent income respectively[36]. The marginal propensity to consume out of current income for poor households is about 0.5[37], with the consequence that about one half of the current income is transferred into savings[38]. 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[39]. 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.

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

[36] The marginal propensities to consume out of permanent income for farms in the medium and top quartile of the asset-value distribution are statistically different (F(1,2057)=3.92, Prob>F=0.048).

[37] Test on coefficients:

a) extra labor income=crop loss=permanent income=0.5: F(3,2057)=0.79, Prob>F=0.498
b) extra labor income=crop loss=permanent income=0.7: F(3,2057)=3.94, Prob>F=0.008.

[38] Using data from rural Burkina Faso, Kazianga and Udry (2006) 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 (1999) 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.

[39] 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.

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 regards consumption behavior, there are two main differences between poor and non-poor households. First, while non-poor farms smooth consumption relative to income, this is not so for asset-poor 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, and 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
Some characterisitcs of asset-poor and non-poor farms[a]

		Poor	Non-poor
Demographics	Household size	4.57	4.62
	N. of members <18	2.13	1.94
	N. of females>17	1.28	1.36
	Head's age	43.5	48.11
	Head male	0.87	0.9
	Head with no primary	0.68	0.6
	Head with higher secondary	0.05	0.07
	N. of members with higher secondary	0.13	0.24
Expenditures	Monthly per-capita expend.	32.96	44.82
	Monthly per-capita food exp.	23.23	27.7
Income	Annual total income	676.19	1069.48
	N. sources	1.84	1.86
	Have farm business	0.95	0.95
	Net profits farm-business	220.25	460.05
	Have non farm business	0.21	0.24
	Net profits non-farm busn.	537.66	528.37
	Have wage income	0.31	0.24
	Annual wage income	1462.11	1224.9
	Have other income	0.37	0.42
	Annual other income	139.89	346.24
Household assets	*Own house they live in*	0.89	0.96
	Own vehicles	0.14	0.22
	Own savings	0.09	0.15
	Own other receivables	0.07	0.10
	Total value of hhd assets	1917.08	4708.61
Non-farm business	*Total value of bus.assets*	112.76	499.47

[a] Poor farms are defined as those with a value of assets invested in the farm in the bottom quartile of the asset-value distribution. Income and assets are in thousands of rupiah.

Table A2

Responses to a crop loss by type of coping strategy and by assets owned

	Land[a]	Plants	Livestock	Plants and Livestock	other	Total
Only[b] extra job	28.7	44.2	29.0	36.0	41.3	35.6
Only[b] reduce exp.	14.8	12.5	9.7	6.5	12.7	11.0
Only[b] loan	21.3	10.8	11.8	13.0	17.5	14.7
Only[b] sell/savings	13.9	13.3	31.2	18.7	4.8	17.0
Only[b] family assistance	5.7	4.2	3.2	2.2	3.2	3.7
Mixed	14.8	11.7	14.0	22.3	19.1	16.4
Missing	0.8	3.3	1.1	1.4	1.6	1.7
Total	100	100	100	100	100	100
N.of observ.	122	120	93	139	63	537

[a] It includes those who have only land and those who have land and small equipment.
[b] It includes also those who have received family assistance together with the measure indicated.

Table A3

Responses to a crop loss by type of coping strategy and distance from the sub-district capital[a]

	< 13 km	>= 13 km
Only[b] extra job	29.2	39.4
Reduce exp./Family assist.	13.9	9.3
Only[b] loan	18.3	12.5
Only[b] sell/savings	18.3	16.1
Mixed	17.3	15.8
Missing	1.0	2.1
N.of observ.	202	335

[a] 13 km is the third quartile of the distance distribution in our dataset.
[b] It includes also those who have received family assistance together with the measure indicated.

Table A4
Income equation estimates (non-distant households)[a]
(for households that did not report a crop loss in 1993)

Variables	Coef.	t
Permanent income variables		
1992 farm assets*asset-poor farm	-0.33	-1.10
1992 farm assets*medium farm	0.02	0.91
1992 farm assets*asset-rich farm	0.03	3.99
1992 business non-farm assets	0.01	4.19
1992 non-business assets	0.03	2.93
Head employee	1239.15	7.28
Head self-employed	111.72	0.98
Head complete primary educ	130.53	1.75
Head secondary educ	838.25	5.06
Head higher educ	1652.92	3.05
Number of income earners	179.91	4.13
Pension (if someone receives a pension)	1171.56	3.19
Household size	179.00	2.71
Household size squared	-14.55	-2.3
Electricity in the village	48.11	0.58
Intercept	-333.92	-1.38
Positive transitory income variables		
Winnings	385.19	2.91
Gift	175.13	1.69
Negative transitory income variables		
Shocks (other than crop loss)	-110.82	-1.47
N. of obs=1420		
F(29, 1390) = 11.55		
R-squared= 0.36		

[a] The table presents the results from equation (9) and estimates the predicted income for households that did not report a crop loss in 1993 and whose distance from the sub-district capital is below the third quartile of the distance distribution (13 km). 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 A5
Income equation estimates (distant households)[a]
(for households that did not report a crop loss in 1993)

Variables	Coef.	t
Permanent income variables		
1992 farm assets*asset-poor farm	-0.65	-2.58
1992 farm assets*medium farm	0.03	0.75
1992 farm assets*asset-rich farm	0.02	2.3
1992 business non-farm assets	0.07	0.9
1992 non-business assets	0.00	0.19
Head employee	987.02	4.45
Head self-employed	165.51	1.39
Head complete primary educ	-5.27	-0.06
Head secondary educ	634.60	3.43
Head higher educ	2551.10	4.46
Number of income earners	59.24	1.08
Pension (if someone receives a pension)	1736.25	1.35
Household size	102.52	2.21
Household size squared	-5.22	-1.43
Electricity in the village	71.66	0.74
Intercept	-97.01	-0.44
Positive transitory income variables		
Winnings	461.64	3.60
Gift	110.14	1.08
Negative transitory income variables		
Shocks (other than crop loss)	-124.92	-1.72
N. of obs=598		
F(29, 568) = 7.08		
R-squared= 0.43		

[a] The table presents the results from equation (9) and estimates the predicted income for households that did not report a crop loss in 1993 and whose distance from the sub-district capital is above the third quartile of the distance distribution (13 km). 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 A6
Probit equation for the labor supply response[a]

Variables	Coef.	z
Land value	-0.00004	-3.48
Farm has hard stem plants	0.39	3.06
Joint demographic shock	-0.72	-2.56
Distance from sub-district capital (km)	0.01	1.88
Dummy if credit in village	-0.20	-1.53
Proportion of other households experiencing a crop loss in the same village	0.96	2.49
Age of household head	-0.02	-4.00
Nr. of adult members with secondary education	-0.23	-2.74
Nr. of females aged 13-17	0.25	2.14
Spouse is inactive	-0.34	-2.41
Poor soil quality in village	0.46	2.39
Average soil quality in village	0.33	2.17
intercept	0.24	0.81
Number of obs=506 Pseudo R-squared = 0.15 Percentage correctly predicted = 67.39		

[a] 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.