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Abstract

The empirical literature of household savings tends to treat savings as "a black box" defined as annual income *minus* consumption. This paper takes a unique approach to reconstruct the cash and asset balances using the detailed household transaction data of farm households in rural India and generates the long monthly and seasonal panel data. We have found that households - both the poor and the relatively affluent in terms of landholding classes - cope with temporary shocks quite well using crop inventory, currency and capital assets, rather than livestock, as buffer. The importance of portfolio adjustment in smoothing consumption is also confirmed by the system equation in which both portfolio and production decisions are made endogenous. It is concluded that not only the level but also the diversification of household assets are important for buffering consumption.

The JEL codes: O16, D12, C33
Key Words: Buffer Stock, Savings, Consumption, Credit, Portfolio Adjustment, India

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1. Introduction

The traditional literature on savings and consumption smoothing focused on the aspect of 'buffer-stock' savings in contrast to the traditional literature of life-cycle saving by modelling either the liquidity constraints of households (Deaton, 1990, 1991, 1992, 1997, Zeldes, 1989) or the precautionary nature of savings (e.g., Kimball, 1990, Carroll, 1997). Buffer-stock savings are particularly important in investigating rural poverty in developing countries because of the salient features of rural economy associated with its uncertainty or risk, e.g., due to the dependence on the agricultural sector, poor health services, low level of sanitation, and lack of access to formal credit. All of these factors combined lead to welfare deterioration among the poor and their economic development (Carter and Lybbert, 2012). However, most of the papers, except a few (e.g. Carter and Lybbert), treat savings as "a black box" defined as annual income minus consumption. The main aim of this paper is to shed a light on the black box by disaggregating the savings in various subcomponents and examine the extent to which households in rural India buffer their consumption by adjusting their household.

Much of the empirical literature has focused on the role of precautionary or buffer-stock savings for household risk-coping in the context of developing countries, in and outside India. For instance, using the annual ICRISAT data, Rosenzweig and Wolpin (1993) focused on the role of bullocks for credit-constrained households in rural India as a buffer stock for consumption. One of their main findings is that sales of bullocks increase when incomes are low, and purchases increase when incomes are high. However, Lim and Townsend (1998), through a close investigation of how rural farming households financed their deficit based on the monthly ICRISAT data, conclude that livestock - including bullocks and major capital assets - play little part in smoothing intertemporal

shocks. They insist that buffer stock of crop inventory and currency, together with credit or insurance, are much more important. Chaudhuri and Paxson (1994), also using the monthly ICRISAT data in India, investigate the impact of seasonality in income on seasonality in consumption. They conclude that seasonal patterns in consumption are common across households within villages but are not related to income seasonality. Based on the seasonal data of rainfall, Jacoby and Skoufias (1998) reach a similar conclusion by estimating the household response to anticipated and unanticipated income shocks.

Outside India, Carter and Lybbert (2012) device a technique to understand the coexistence of consumption and asset smoothing regimes based on the poverty trap model of Barrett et al. (2011), assuming that assets are not merely buffer stocks, but contemporarily act as productive assets with positively-diminishing returns. They employ a Hansen threshold estimation method, for data from rural Burkina Faso between 1981 and 1985, which is a period where households are faced with severe drought. Carter and Lybbert find that while those who are richer in assets - proxied by tropical livestock units - managed to smooth their consumption pretty well, the asset poor tend to preserve their assets and smooth consumption limitedly. There exists a critical herd size threshold that separates households with high versus low consumption smoothing, and those with such high smoothing levels who rely primarily on livestock to achieve it (Carter and Lybbert, 2012). Lee and Sawada (2010) assess the precautionary savings motive, or "prudence", in Pakistan, based on 14 rounds of survey from 1986 to 1991. Their results confirm the theory of precautionary savings behavior among Pakistani households, particularly among those facing liquidity constraints. Using the same sample as Carter and Lybbert (2012), Kazianga and Udry (2006) find little evidence of consumption smoothing behavior. They confirm that households with subsistence income in Burkina Faso do not liquidate their assets - conserving their livestock - in favor of current

consumption and households who face land-income volatility to a greater extent saved more given their income shocks. With the same dataset, Fafchamps et al. (1998) show that livestock sales did not adequately serve as precautionary savings, particularly against negative income shocks, such as drought. Drawing upon a data set from Thailand, Paxson (1992) concludes that most of the transitory income attributed to rainfall shock is saved, that is, the saving behavior of farmers accords with the theoretical predictions of buffer-stock savings. The literature suggests that household savings matter in risk-coping, but the role of livestock savings/dissavings is generally limited, that is, household assets other than livestock are likely to be important.

The contribution of this paper to the above empirical literature is threefold. Firstly, we look at not just the change in stock of a single asset, such as bullocks, but also the *total* portfolio adjustment of households that face various risks: the possibility exists that the sale of bullocks and the purchase of other items, for example consumer durables, may take place simultaneously. In this paper, we will focus on dynamic changes in the portfolio of households, such as those pertaining to livestock, production capital or consumer durables, which has been largely neglected in the empirical literature. Here, we will empirically examine how households mitigate income risk by portfolio adjustment. Second, we will explicitly take account of household portfolio adjustment by system equations in which 1) transitory income, changes in a variety form of household assets, and expenditure are simultaneously estimated and, 2) some forms of savings, namely, changes in financial assets, agricultural inputs, and production capital are allowed to affect transitory income shocks. Most of the past literature on household savings assumes that savings in themselves do not affect income. However, in rural economies, this is not a realistic assumption, because 1) physical assets have roles of production assets as well as savings or accumulation and, 2) transitory changes in financial assets or credit availability are key factors to

transitory income changes. The idea is similar to Behrman et al.'s (1997) study which incorporates the sequential decision-making process in agricultural production in estimating saving function.[1]

The rest of the paper is organized as follows. The next section discusses the ICRISAT Village Level Studies. The specifications and empirical results in which transitory and permanent income are decomposed appear in Section 3. Section 4 discusses the methodologies and results of system equations whereby portfolio adjustment effects are estimated. The last section offers our concluding remarks.

2. Data

In this study, we construct monthly data on income, consumption, savings, and credit using the ICRISAT data - both monthly and seasonal data - between 1975/76 and 1984/85.[2] This dataset is well-known for its high quality and influence in the emergence of several of development economics' core findings (Walker and Ryan, 1990; Dercon et al., 2013). The survey is structured in such a way that households are stratified according to their landholding classes. 40 households in each village consist of four classes: the landless, small farmers, middle farmers, and large farmers. Our analysis is based on the household transaction module, the production modules, the household member schedule and the general endowment schedule in the ICRISAT data set. One of

[1] The main difference between our study and Behrman, Foster, and Rosenzweig' s (1997) is that while the former deals with the portfolio of the entire household savings, the latter uses only a component of the savings, namely 1) net changes in financial assets, 2) net borrowing, and 3) transfers to friends and relatives.

[2] Admittedly, the data are not recent. We are currently carrying out a similar research project using the more recent ICRISAT monthly panel data on India in 2009-12. Preliminary results using the new data suggest that (i) households respond to transitory income shocks by adjusting total savings (defined as the difference of income and expenditure on goods and services *except* consumer durables (Paxson, 1992)) and (ii) they do not use livestock as buffer stocks savings. These are broadly consistent with the findings of this paper and suggest that the pattern of household savings and portfolio adjustment behavior has not changed over the last three decades. The advantage of this study over our on-going project based on the recent data is that the former covers the monthly and seasonal data for the longer period (7 years, 1976/77-1982/83), which is still rare despite the increased availability of household data in developing countries. The first year (1975/76) and the final two years (1983/84-1984/85) have been dropped from the final estimations taking account of the consistency between the data recorded in the transaction modules and the income or consumption data.

the distinguished features of the ICRISAT data set is the unusually detailed information that the household transaction module records.[3] As the contribution of the analysis in this paper is closely associated with the use and adjustment of data in the transaction module, we will first briefly describe its features.

The main purposes of the transaction module are to assess the income position of households, to compute consumption quantities and expenditures, and to record production expenditures and changes in the debt or credit positions of the household (Singh et al., 1985). In principle, the transaction module records all market transactions of households, including purchases, sales, gifts, credit, and other market transactions with recall of about four-week intervals (Lim and Townsend, 1998).[4] The interview on this schedule was continued every month in the first week during the period 1975/76 (crop year from July 1975 to June 1976) to 1984/85 in three Indian villages, namely Aurepalle, Shirapur, and Kanzara.[5] All the cash and kind transactions after the previous interview were recorded in cash value either as cash inflow or as cash outflow, which make it possible to calculate monthly income, consumption, and changes in different components of the household asset.[6] Appendix provides the details on how variables on monthly asset changes have been created using the transaction module.

[3] Although the ICRISAT data set itself has been widely used in the literature, few studies have used the original information found in the transaction module.

[4] Lim and Townsend (1998) describe in detail the structure of the transaction module and the way of constructing the monthly data on income, consumption, and asset change. We closely follow their methods and aggregate them to the seasonal data.

[5] In the other seven villages where the survey was carried out, transaction data were collected for only three or four years for the selected timeframe.

[6] There have been some discussions as to whether the data on consumption (own consumption of home production in particular) and grain stock are correctly recorded. Ravallion and Chaudhuri (1997) – based on the technical details given by Gautam (1991) - note a systematic underreporting problem in the ICRISAT data on own consumption of crop outputs produced at home. They argue that Townsend (1994) overestimates the degree of risk sharing in the village mainly due to the measurement-error problem. We have corrected the transaction data following Gautam in retrieving the cash and asset balances using the transaction data.

3. The Specification and the Empirical Results

Firstly, we compare the coefficient of variation (CV) of monthly consumption with the CV of monthly income in each year. Table 1 shows the results in four different landholding classes, namely, the landless, small farmers, medium-sized farmers, and large farmers. For all the landholding classes, the CV of monthly consumption is significantly lower than the CV of monthly income at a 1 percent level, which implies that households smooth consumption during a single crop year. However, Table 1 also suggests that the extent to which households stabilise their consumption varies across different landholding classes. Although the average CVs of income of large and medium farmers are relatively higher (about 170 percent) and those of small farmers and the landless are lower (about 100 percent), the average CVs of consumption are almost the same across different landholding classes (about 50 percent). This result corresponds to that of Townsend (1994), who shows that variation in consumption is surprisingly lower than variation in income based on the annual data of the Indian ICRISAT survey, though Townsend used the annual income and consumption data without correcting the measurement errors.

(Table 1 to be inserted)

Then, an empirical question arises: how well did households smooth consumption across months within a single crop year? Following Paxson (1992) and Fafchamps et al. (1998), we will capture savings as a function of both permanent and transitory component of income.

$$S_{it} = \alpha_0 + Y_{it}^P \alpha_1 + Y_{it}^T \alpha_2 + VAR_{it}\alpha_3 + W_{it}\alpha_4 + \varepsilon_{it} \quad (1)$$

where S_{it} is savings in various forms, Y_{it}^P is permanent income, *i.e.*, the portion of income that is constant over time, and Y_{it}^T is transitory income. *i* and *t* denote household and time (or year-month,

t=1 for July 1976, t=2 for August 1976, … , t=84 for June 1983) respectively.[7] VAR_{it} (variance of income) and W_{it} (household characteristics) are assumed to be factors which affect the level of savings. If household savings behavior can be described appropriately by the life-cycle/ permanent income hypothesis, then α_1 will be 0; that is, permanent income does not affect the level of savings.

A crucial empirical question is how to identify permanent and transitory component of household income. The studies on Indian households, such as those of Bhalla (1979, 1980) and Wolpin (1982), identify permanent income by instrumental variables which are correlated only with the permanent component and compute transitory income as the rest of household income. One problem with this approach is that it is difficult to distinguish transitory component from measurement error. Paxson's (1992) study of rice farmers in Thailand isolates the transitory components of income which are exogenous by directly estimating the effects of transitory rainfall variation on crop income. We will closely follow Paxson's estimation strategy by using the rainfall data to identify the transitory component.

The permanent component is determined by household characteristics and regional dummies, both of which affect long-term income-earning abilities of households. Permanent income is characterized as;

$$Y_{it}^P = \beta_t^P + \beta_v + X_{it}^P \beta_1 + \varepsilon_{it}^P \qquad (2)$$

β_v is a village fixed effect and X_{it}^P is a set of household characteristics. ε_{it}^P is the error component. Transitory income is;

$$Y_{it}^T = \beta_t^T + R_t^T \beta_2 + L_{it} \otimes R_t^T \beta_3 + \varepsilon^T{}_{it} \qquad (3)$$

where β_t^T is seasonal dummy variables, R_{vt}^T are a vector of village specific shocks, namely, rainfall shocks. L_{it} is the household landholding, which is interacted with a set of rainfall variables

[7] A subscript denoting village, *v*, is omitted for simplicity (except for the rainfall variables).

to take account of the fact that the rainfall shock affects differently households according to the size of the land.[8] Combining the equations (2) and (3), we can describe the income equation as:

$$Y_{it} = \beta_t + R_{vt}^T \beta_2 + L_{it} \otimes R_t^T \beta_3 + \beta_v + X_{it}^P \beta_1 + \gamma_i + \varepsilon_{it} \quad (4)$$

Through the estimation of income equation (4) as in Paxson, we can decompose total household income into permanent and transitory components. γ_i is household fixed effects, that is, the unobserved characteristics which may be added to the permanent component. The predicted permanent and transitory incomes are then denoted by:

$$\hat{Y}_{it}^P = \hat{\beta}_v + X_{it}^P \hat{\beta}_1 + \hat{\gamma}_{iv} \quad (2)'$$

$$= \hat{Y}_{it} - \hat{Y}_{it}^T$$

$$\hat{Y}_{it}^T = \hat{\beta}_t^T + R_t^T \hat{\beta}_2 + L_{it} \otimes R_t^T \hat{\beta}_3 \quad (3)'$$

Empirically, we will first draw upon the two-step procedure in which income equation is estimated in the first step and savings equation for the change of each asset in the second.

In the present study, we use deviations from the mean of village-level monthly rainfall in the ICRISAT data following the specification of Paxson (1992) and Fafchamps et al. (1998) based on the rainfall data to identify the transitory component. Monthly dummy variables, which express the deterministic seasonal patterns within a single crop year, are also included in the transitory factors.

The factors which determine permanent income include village dummies, sex/age/education variables, and the dummy variables on caste. To capture the combined effects of sex, age, and education on the permanent component of income, we classify the whole sample into fifteen groups by sex, age group, and educational status. Owned land as well as a share of the irrigated area in owned land is added as permanent factors.

[8] L_{it} is not a part of X_{it}^P.

One of the problems with the above estimation based on the monthly data is that it does not take explicit account of the seasonal nature of agriculture in formulating an income equation. Therefore, we will apply a slightly different specification to estimate the crop-income equation, drawing upon Jacoby and Skoufias (1998) and Carter and Lybbert (2012).

In the estimation of seasonal income, we will estimate crop income in the peak season as a function of 1) the household characteristics (sex/age/education variables, castes) in the agricultural slack season, 2) the variables on production capitals and inputs in the slack season, 3) village dummies, 4) the rainfall in the slack season and its cross term with owned land in the slack season, and 5) the rainfall in the peak season (October to December) and its cross term with owned land in the slack season (June to September). In the first stage, the profit in the peak season is estimated.

$$\pi_{it} = \beta_1 + X'_{it-1}\beta_2 + \beta_3 R^s_{vt-1} + (L_{it-1} \otimes R^s_{vt-1})'\beta_4 + \beta_5 R^P_{vt} + \left(L_{it-1} \otimes R^p_{vt}\right)'\beta_6 + \vartheta_i + e_{it} \quad (5)$$

where X'_{ist} is farm/household characteristics and information sets available at the slack season; R^s_{vt-1} is rainfall before planting (June-Sept) (capturing transitory shocks in the slack season) ; and R^p_{vt} is rainfall after planting prior to harvesting (Oct-Dec) (capturing shocks in the corresponding period). *t* stands for crop year (t=2 for 1977/78; t=3 for 1978/79, … , t=7 for 1982/83). L_{it} stands for the household land holding. Rainfall variables are interacted with the current owned land to take into account the fact that rainfall affects the households differently according to the size of land. Transitory and permanent crop income can be written as:

$$\hat{\pi}^T_{it} = \hat{\beta}_3 R^s_{vt-1} + (L_{it} \otimes R^s_{vt-1})'\hat{\beta}_4 + \hat{\beta}_5 R^P_{vt} + (L_{it} \otimes R^P_{vt})'\hat{\beta}_6$$

$$\hat{\pi}^P_{it} = \hat{\beta}_1 + X'_{it-1}\hat{\beta}_2 + \hat{\vartheta}_i$$

$$= \hat{\pi}_{it} - \hat{\pi}^T_{it}$$

In the second stage, the household savings response to transitory crop-income shocks and permanent incomes is estimated.

$$\boldsymbol{Savings}_{\boldsymbol{it}} = \boldsymbol{\sigma} + \boldsymbol{\gamma^T \hat{\pi}_{it}^T} + \boldsymbol{\gamma^P \hat{\pi}_{it}^P} + \boldsymbol{\mu_i} + \boldsymbol{e_{it}} \qquad (6)$$

Savings in this case are defined as the net increase in a variety of assets during the *peak* period. In order to capture the seasonality in agriculture, we will use the household crop income in the peak season, rather than the total household income. If γ^T is positive and significant, we can conclude that households save when the transitory crop income (both expected and unexpected transitory income) in the peak season is high, and dissave when transitory income is low.

Table 2 shows the GLS estimates of the reduced forms of monthly and seasonal income estimations specified by the above equations. The estimation results associated with rainfall show that 1) rainfall during the period from the eleventh lagged month to the eighth lagged month has a positive impact on monthly income and, 2) the cross terms of owned land and rainfall during the period from the seventh lagged month to the fourth lagged month (or from the third lagged month to the current month) have positive and significant effects on monthly income. The latter implies that the income of households with larger areas of land is more strongly affected by rainfalls. In Case B where crop income in the peak season is applied, we find that 1) the interaction term of owned land and rainfall during the slack season (June to September) has a positive and significant effect on crop income in the peak season and, 2) rainfall during the peak season (October to December) has a positive impact on crop income.

(Table 2 to be inserted)

Panel A of Table 3 indicates summary results of two-step GLS estimates of monthly and seasonal savings in various forms. Each form of savings is estimated separately. Cases (a), (b), (c), (d), and (e), corresponding to the identity (the equation (1)), show the net increase in capital assets

(production capital assets *plus* consumer durables), crop inventory, input inventory, financial assets (including credit), and cash holdings respectively. Saving or dissaving as a form of crop inventory is the most important device for households to buffer consumption. The second important device of consumption smoothing is currency, as Case (d) shows. As expected, currency is not saved from the increase in permanent income. In the case of capital assets (Case (a)) and financial assets (Case (d)), both transitory and permanent incomes have positive and significant coefficients. They are important not only as a device of consumption smoothing but also as a measure to save permanent income. Financial assets in Case (d) include financial savings, credit (in terms of lending *minus* borrowing), and gifts from others, although they consist mainly of credit. Consumption smoothing through village-level risk-sharing mechanism roughly corresponds to 'credit' in Case (d), considering the dominant role of informal borrowing and lending in the rural credit market. The fact that the coefficient of transitory income in Case (d) is not so large (0.10) implies that households smooth consumption through intertemporal savings, rather than through risk sharing among different households within the village.

(Table 3 to be inserted)

Cases (f) and (g) show that consumption is considerably smoothed out by savings, in particular physical savings. These results correspond to those in Table 1. Case (h) suggests that livestock is not used as a buffer stock, contrary to the results shown by Rosenzweig and Wolpin (1993). We decompose the net change of capital assets (Case (a)) into the net change in production capital (Case (i)) and the net change of consumer durables (Case (j)). In the case where monthly data are applied, consumer durables are more important than production capital as a buffer stock.

Panel B of Table 3 shows the case of GLS estimates of a savings equation in which seasonal data are used. Cash holdings (Case (e)) are the most important factor to buffer consumption because transitory income affects positively and significantly the net change in cash holdings. Crop inventory seems to be used as a buffer stock, though the coefficient associated with transitory income is not significant. Financial assets and capital assets do not serve as buffer stock at all. Rather do they increase consumption fluctuations, because transitory income has negative coefficients. Case (f) implies that consumption is significantly smoothed out across different seasons but the physical savings (Case (g)) are less important. The buffer-stock role of consumer durables is not clearly observed.

If the results based on the monthly data are decomposed by the landholding classes, it is found that all the landholding classes smooth consumption well, relying upon physical.[9] For all the landholding classes, crop inventory plays an important part for consumption smoothing, while capital assets are used only for large farmers and the landless. Only for large farmers do cash holdings and savings/dissavings of livestock serve as buffer stock. For the landless, on the other hand, production capital is one of the main devises to smooth consumption.

4. Extensions

The methodology in the last section has the following two limitations. First, as the savings equation in the second step is estimated for each form of household asset separately, the coefficient of transitory income does not reflect the relative importance of different household assets. To see more clearly the household response of portfolio adjustment to income shocks, it is necessary to estimate savings equations simultaneously. Second, some categories of the savings in the second step are likely to affect the income equation in the first step. In particular, the changes in

[9] Details will be provided on request.

production capital, input inventory, and financial assets (credit in particular) might affect the transitory income. In this section, therefore, we will estimate the system equation as an extension of the methodology put forward by Paxson (1992).

The following system equation will be estimated by three-stage least squares estimation.

$$Y_{it} = \beta_t^T + R_{vt}^T\beta_1 + L_{it}\otimes R_{vt}^T\beta_2 + \Delta P_{it}\beta_3 + \Delta I_{it}\beta_4 + \Delta F_{it}\beta_5 + \beta_6 V_v + \gamma_i + \varepsilon_{it} \quad (7)$$

where Y_{it} is monthly income, β_t^T is a set of dummies to capture the seasonal fluctuations, R_{vt}^T is a vector of lagged rainfall shocks. L_{it} is the stock of household landholding at the beginning of the crop year to be interacted with landholding. ΔP_{it}, ΔI_{it}, ΔF_{it} are the net monthly changes in production capital, input inventory, and financial assets respectively. V_v is a village-level dummy variable. γ_i is the household fixed effects. As we are focusing the temporary shocks in Y_{it}, we subsume permanent factors under γ_i.

$$\Delta K_{it} = \alpha_{k0} + Y_{it}\alpha_{k1} + R_{vt}^T\alpha_{k2} + W_{it}\alpha_{k3} + \alpha_{k4}V_v + \alpha_{k5}k_{it-1} + e_{it}^k \quad (8)$$

where ΔK_{it} is the net monthly change in capital asset.

W_{it} is the household characteristics which are assumed to affect savings. Asset changes are assumed to be influenced by an endogenous temporary income shock, Y_{it}, and rainfall shocks. k_{it-1} is the annual stock of production capital at the last crop year which identifies the equation.[10]

The other savings equations are specified similarly.

$$\Delta D_{it} = \alpha_{d0} + Y_{it}\alpha_{d1} + R_{vt}^T\alpha_{d2} + W_{it}\alpha_{d3} + \alpha_{d4}V_v + \alpha_{d5}d_{it-1} + e_{it}^d \quad (9)$$

$$\Delta S_{it} = \alpha_{s0} + Y_{it}\alpha_{s1} + R_{vt}^T\alpha_{s2} + W_{it}\alpha_{s3} + \alpha_{s4}V_v + \alpha_{s5}s_{it-1} + e_{it}^s \quad (10)$$

$$\Delta I_{it} = \alpha_{I0} + Y_{it}\alpha_{I1} + R_{vt}^T\alpha_{I2} + W_{it}\alpha_{I3} + \alpha_{I4}V_v + \alpha_{I5}L_{it-1} + e_{it}^I \quad (11)$$

$$\Delta F_{it} = \alpha_{f0} + Y_{it}\alpha_{f1} + R_{vt}^T\alpha_{f2} + W_{it}\alpha_{f3} + \alpha_{f4}V_v + \alpha_{f5}f_{it-1} + e_{it}^f \quad (12)$$

$$\Delta M_{it} = \alpha_{m0} + Y_{it}\alpha_{m1} + R_{vt}^T\alpha_{m2} + W_{it}\alpha_{m3} + \alpha_{m4}V_v + \alpha_{m5}n_{it-1} + e_{it}^{fn} \quad (13)$$

[10] In the asset equations, household fixed effects are not included (while a number of household characteristics are included) to make the conversion of estimations achievable.

where $\Delta D_{it,}$ $\Delta S_{it,} \Delta I_{it,} \Delta F_{it,}$ and ΔM_{it} are the net increases in consumer durables, crop inventory, input inventory, financial assets, and cash holdings respectively. d_{it-1}, s_{it-1}, L_{it-1}, f_{it-1}, and n_{it-1} are the annual stock of consumer durables, grain stock, owned land, net borrowings, and net worth (*i.e.*, real assets *minus* liabilities) respectively. System equations of (7) - (13) are first estimated for monthly data. The same specification is then applied to seasonal data.

Table 4 shows the results of the income equation for monthly data (Case A) and seasonal data (Case B). The net increase in production capital and input inventory has positive and significant impacts on both the monthly and the seasonal income. Monthly income is positively affected by the net change in financial assets, including credit. The coefficient estimate of financial assets is not significant for seasonal crop income (Case B).

(Table 4 to be inserted)

Table 5 shows the results of asset change estimations for monthly data (Panel A) and seasonal data (Panel B). The overall results are not so different from those in Table 3. In Panel A, crop inventory is the most important device in smoothing consumption. The coefficients associated with financial assets have become larger than those shown in Table 3, while the relative importance of cash holdings has decreased. Consumer durables are still important as buffer stock, while production capital and input inventory are not.

(Table 5 to be inserted)

To summarize the results for seasonal data (Panel B), crop inventory, together with cash holdings, are used as buffer stock for seasonal fluctuation in crop income. In addition, production capital, consumer durables, and financial assets play some role in buffering consumption.

Transitory income has a positive and significant impact on the input inventory, which suggests that farmers adjust the timing of purchasing and selling so that consumption smoothing can be achieved.

Comparisons of Panel A and Panel B are insightful in inferring some features of household portfolio-adjustment behavior. While financial assets (including credit) are one of the important devices for consumption smoothing in the case where monthly data are used, they are not important in the case of seasonal data. Rather does currency play a key role in mitigating the seasonal fluctuation. Whilst consumer durables, rather than production capital, are used as a buffer stock for monthly crop shocks, the latter is more important than the former to mitigate seasonal crop shocks. This implies that the relatively productive assets, which are closely associated with crop production, tend to be used as a buffer stock to mitigate the seasonal crop shocks.

We decompose the estimation results in Table 5 by landholding class and by village in Table 6. For all landholding classes, crop inventory is the most important device for buffering consumption. For large farmers, currency and production capital are mainly used as buffer stock together with crop inventory in both cases. Crop income shocks positively affect financial assets only in the case where monthly data are used. For medium farmers, the role of the crop inventory is prominent, while financial assets are also important in both cases. Small farmers seem to have various forms of smoothing consumption, namely crop inventory, currency, production capitals, and consumer durables. For the landless, production capital, consumer durables, and financial assets supplement the buffer-stock role of the crop inventory. However, the role of currency as a buffer stock is not found in the case of the landless.

(Table 6 to be inserted)

We also disaggregate the results by villages. In Kanzara, where the average household income is high, the importance of the crop inventory as buffer stock is lower than in the other two villages. In addition, currency, capital assets, and credit or financial assets also serve as buffer stock. In Shirapur and Aurepalle, the role of the crop inventory is dominant, while financial assets are important too. Currency plays no role in smoothing consumption in these two villages.

It is difficult to find any pattern common across different landholding classes or villages. However, it is noteworthy that consumption smoothing is achieved through savings or dissavings of several kinds of asset and not by a single asset. Another important implication derived from our results concerns the relative importance of the risk-sharing mechanism among households and the autarky of intertemporal risk-coping mechanism. Among a variety of portfolio choices, it can be reasonably assumed that a majority of 'financial assets' (which include informal borrowing and lending and gifts) are classified into the former and the rest (*i.e.*, sum of production capital, consumer durables, crop inventory, input inventory and cash holdings, and a part of financial assets, such as financial savings) is classified into the latter. As the coefficient of transitory income associated with financial assets is positive but not large, it is safe to conclude that the intertemporal savings (which draw upon crop inventory, capital assets, or currency) are more important as a device of risk coping than risk sharing, though lending or borrowing across different households in the village.

5. Conclusion

One of the most important implications derived from the panel-data estimation is that not only the level but also the diversification of household assets are important for smoothing consumption. The results of our analysis yielded several crucial conclusions.

First, in the case where monthly data are used, savings as changes of major household assets have a role in buffering consumption. In particular, change in crop inventory, currency capital assets (consumer durables in particular), and financial assets (credit in particular) are important for consumption smoothing. We confirm that when permanent income increases, as a household saves crops, production capital and financial assets, rather than currency or livestock. In general, livestock plays little part in smoothing the fluctuation of household consumption within a single year. These results derived from monthly data are not so different in the case where crop income in the peak season is estimated, except that currency plays a more important role as buffer stock in the latter.

Second, the importance of portfolio adjustment and the consumption-smoothing mechanism are also confirmed by the system equation in which portfolio adjustment and production decisions are simultaneously estimated. This result is important, not just because the majority of the past studies on consumption smoothing or savings treat income as exogenous, but because the empirical studies on savings do not normally pay explicit attention to the aspect of portfolio adjustment.

Third, decomposition by the landholding class or village suggests that consumption smoothing is achieved through savings or dissavings of several kinds of assets and not by a single asset. The pattern of portfolio adjustment, however, differs among different landholding classes. While large farmers rely on a number of assets, including crop inventory, currency, financial assets, and capital assets in smoothing consumption, small and medium farmers use the crop inventory as a main device for buffering their consumption. The landless households smooth consumption through an adjustment of multiple assets, such as grain stock, financial assets, production capital and consumer durables.

Fourth, it appears that inter-temporal savings, which draw upon crop inventory, capital assets, or currency, are more important as a measure of risk coping than risk sharing, though lending or borrowing across different households. This is in sharp contrast with Townsend (1994) who shows that consumption is smoothed out by the risk-sharing arrangement within the villages on the basis of the annual ICRISAT data, and is in line with Ravallion and Chaudhuri (1997), a critique against Townsend's seminal paper. Our study suggests that Townsend's result, which supports the 'risk-sharing' arrangement, would be largely affected by the autarkic 'inter-temporal savings' of each household which have a common trend among different households within the villages.

It is often argued that the poor are constrained by lack of access to credit or savings, but the present study suggests that once we track the record of all the household assets, even the landless cope with the temporary shocks quite well using a variety of household assets over time. Any policy interventions to address the vulnerability of the poor in rural areas should consider this aspect. Future studies should investigate whether the pattern of the portfolio adjustment is similar, or whether the portfolio adjustment (e.g. dissaving of production capital) has any implications for poverty dynamics.

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Table 1 The Comparison of CV (Coefficient of Variation) of Monthly Income and CV of Monthly Consumption in rural India, 1976-84

	CV for each year, 1976-84					
	Average CV of Income (a)	Average CV of Consump-tion (b)	Average reduction	No. of Observations	T test t-statistics (a)-(b)	
Landless	100.8	43.8	57.0	205	2.40	**
Small farmer	103.1	49.3	53.9	243	8.16	**
Medium-Sized	169.8	49.4	120.3	240	5.32	**
Large farmer	167.4	58.6	108.8	243	15.22	**
Total	136.6	50.5	86.0	931	10.40	**

**= significant at 1% level. *= significant at 5% level. +=significant at 10% level.

Table 2. Estimations of the Reduced Form Income Equations based on the ICRISAT data from 1976 to 1982 (summary results)

	Case A (Monthly Income)		Case B (Crop Income in Peak Season)	
Variable	Parameter Estimate	*t*-ratio	Parameter Estimate	*t*-ratio
Transitory Factors				
Rainfall variables:[1)]				
(R_1- mean of R_1) :$R_1 = r_0 + r_{-1} + r_{-2} + r_{-3}$	-2.22	(-2.35)*	----------	
where r_{-t} is the *t-th lagged monthly rainfall*				
(R_1- mean of R_1)*(Owned Land)	0.66	(5.56)**	----------	
(R_2- mean of R_2) :$R_2 = r_{-4} + r_{-5} + r_{-6} + r_{-7}$	-3.37	(-3.60)**	----------	
(R_2- mean of R_2)*(Owned Land)	0.81	(6.87)**	----------	
(R_3- mean of R_3) :$R_3 = r_{-8} + r_{-9} + r_{-10} + r_{-11}$	2.35	(2.53)*	----------	
(R_3- mean of R_3)*(Owned Land)	-0.94	(-8.16)**	----------	
(R_4- mean of R_4) :R_4 =Rainfall in June-Sept	----------		-10.76	(-2.11)*
(R_4- mean of R_4)^2	----------		0.04	(1.77)†
(R_4- mean of R_4)*(Owned Land)	----------		0.002	(2.15)*
(R_5- mean of R_5) :R_5 =Rainfall in Oct-Dec	----------		23.80	(1.80)†
(R_5- mean of R_5)^2	----------		-0.21	(-1.32)
(R_5- mean of R_5)*(Owned Land)	----------		0.003	(0.40)
Seasonal Dummies: [3)]				
Whether July or not	85.86	(0.99)	----------	
Whether Aug or not	208.00	(2.38)*	----------	
Whether Sept or not	340.37	(3.84)**	----------	
Whether Oct or not	889.42	(10.06)**	----------	
Whether Nov or not	831.07	(8.98)**	----------	
Whether Dec or not	764.12	(8.30)**	----------	
Whether Jan or not	398.63	(4.38)**	----------	
Whether Feb or not	558.59	(6.37)**	----------	
Whether Mar or not	724.17	(8.23)**	----------	
Whether Apr or not	556.82	(6.42)**	----------	
Whether May or not	204.59	(2.38)*	----------	
Permanent Factors				
Village dummies: [3)]				
Whether Shirapur or not	-144.57	(-1.79)†	-30.2.09	(-3.17)**
Whether Aurepalle or not	-194.36	(-2.42)*	-4010.96	(-4.55)**
Sex/ age/ education variables:				
Number of people aged 0-5	-7.30	(-0.32)	-122.26	(0.48)
Number of males aged 6-11	53.90	(1.65)†	9.26	(0.03)
Number of females aged 6-11	25.48	(0.70)	42.75	(0.11)
Number of males aged 12-17	-59.23	(-1.63)	749.12	(1.94)*
Number of females aged 12-17	47.56	(1.33)	-352.16	(-0.90)
Number of males aged 18-64				
Illiterate	41.08	(1.00)	395.84	(0.84)
Primary school or less	114.36	(2.19)*	72.55	(0.13)
Secondary school	116.68	(2.02)*	84.82	(0.13)
Post secondary school	102.79	(2.00)*	458.13	(0.89)
Number of females aged 18-64				

Illiterate	84.63 (2.08)*	-1010.68 (-2.15)*
Primary school or less	23.61 (0.35)	777.29 (1.04)
Secondary school	116.68 (2.02)*	-303.69 (-0.44)
Post-secondary school	102.79 (2.00)*	-1299.04 (-1.21)
Number of males aged 65 or more	-158.81 (-1.97)*	82.12 (0.10)
Number of females aged 65 or more	-61.47 (-0.60)	465.16 (0.61)
Variable on the caste:[3)]		
whether high caste or not	-59.85 (-0.63)	460.50 (0.42)
whether mid-high caste or not	158.34 (1.80)†	1354.87 (1.51)
whether mid-low caste or not	4.17 (0.04)	1514.69 (1.47)
Owned Land (ha.)	23.93 (2.78)**	362.53 (4.69)**
Share of Owned Land which is Irrigated	773.79 (7.52)**	5465.59 (4.41)**
Stock of Livestock (Rs.)	0.08 (7.07)**	0.65 (5.73)**
Stock of Production Capital (Rs.)	0.02 (6.44)**	0.04 (1.05)
Input Spending in Slack Season (Rs.)	----------	1.98 (1.99)**
Constant	-322.61(-2.54)**	1679.3 (1.49)
Number of Observations	7703	504

Note: [1)] Square takes negative value when the deviation is negative. [2)]Number in parentheses is *t* ratio. **= significant at 1% level. *= significant at 5% level. †= significant at 10% level. [3)] Dummy variable.

Table 3 Two-step Random-effects GLS Estimates of Savings Equations

Panel A: Based on Monthly Data

Dependent Variable:	**Case(a) ΔCapital Assets ($-\Sigma\Delta K_{ijt} P_{ijtt}$)**		**Case(b) ΔCrop Inventory ($-\Sigma\Delta S_{ijt}P_{ijt}$)**		**Case(c) ΔInput Inventory ($-\Sigma\Delta I_{ijt}P_{ijt}$)**		**Case(d) ΔFinancial Assets ($-\Sigma\Delta B_{ijt}P_{jt}$) (including credit)**		**Case(e) ΔCash holdings[2] ($-\Delta M_{jt}$)**	
Explanatory Variable:	Parameter Estimate	t-ratio	Parameter Estimate	t-ratio	Parameter Estimate	t-ratio	Parameter Estimate	t-ratio	Parameter Estimate	t-ratio
Transitory Income	**0.13**	**(4.09)****	**0.54**	**(11.42)****	**-0.02**	**(-4.70)****	**0.10**	**(2.52)****	**0.23**	**(5.78)****
Permanent Income	**0.11**	**(2.73)***	**0.56**	**(9.64)****	**-0.002**	**(-0.42)**	**0.09**	**(1.92)†**	**-0.02**	**(-0.37)**
Number of Observations	**7703**		**7703**		**7703**		**7703**		**7703**	
Dependent Variable:	Case (f) Savings Total (Sum of Case a, b, c, d, & e)		Case (g) ΔPhysical Savings (Sum of a & b)		Case (h) ΔLivestock [4]		Case (i) ΔProduction Capital [4]		Case (j) ΔConsumer Durables [5]	
Explanatory Variable:	Parameter Estimate	t-ratio	Parameter Estimate	t-ratio	Parameter Estimate	t-ratio	Parameter Estimate	t-ratio	Parameter Estimate	t-ratio
Transitory Income	**0.99**	**(19.26)****	**0.67**	**(11.64)****	**0.01**	**(1.38)**	**-0.06**	**(-1.60)**	**0.19**	**(7.20)**
Permanent Income	**0.82**	**(10.94)****	**0.65**	**(8.45)****	**-0.06**	**(-4.95)****	**0.09**	**(1.95)**	**0.04**	**(1.03)**
Number of Observations	**7668**		**7703**		**7703**		**7703**		**7703**	

Panel B: Based on Seasonal Data

Dependent Variable:	**Case(a) ΔCapital Assets** ($-\Sigma\Delta K_{ijt} P_{ijtt}$)		**Case(b) ΔCrop Inventory** ($-\Sigma\Delta S_{ijt}P_{ijt}$)		**Case(c) ΔInput Inventory** ($-\Sigma\Delta I_{ijt}P_{ijt}$)		**Case(d) ΔFinancial Assets** ($-\Sigma\Delta B_{ijt}P_{ijt}$) **(including credit)**		**Case(e) ΔCash holdings[2]** ($-\Delta M_{jt}$)	
Explanatory Variable:	Parameter Estimate	t-ratio	Parameter Estimate	t-ratio	Parameter Estimate	t-ratio	Parameter Estimate	t-ratio	Parameter Estimate	t-ratio
Transitory Income	**-0.06**	**(-0.46)**	**0.42**	**(1.37)**	**0.03**	**(2.01)***	**-0.33**	**(-1.48)**	**0.88**	**(2.62)****
Permanent Income	**0.04**	**(1.02)**	**0.55**	**(7.66)****	**0.02**	**(4.27)****	**-0.03**	**(-0.60)**	**0.28**	**(3.12)****
Number of Observations	**504**		**504**		**504**		**504**		**504**	
Dependent Variable:	**Case (f) Savings Total (Sum of Case a, b, c, d, & e)**		**Case (g) ΔPhysical Savings (Sum of a & b)**		**Case (h) ΔLivestock [4]**		**Case (i) ΔProduction Capital [4]**		**Case (j) ΔConsumer Durables [5]**	
Explanatory Variable:	Parameter Estimate	t-ratio	Parameter Estimate	t-ratio	Parameter Estimate	t-ratio	Parameter Estimate	t-ratio	Parameter Estimate	t-ratio
Transitory Income	**1.02**	**(2.94)****	**0.35**	**(1.01)**	**0.02**	**(0.37)**	**-0.17**	**(-1.13)**	**0.11**	**(1.30)**
Permanent Income	**0.79**	**(7.60)****	**0.57**	**(6.65)****	**-0.04**	**(-2.74)****	**0.02**	**(0.50)**	**0.02**	**(0.98)**
Number of Observations	**504**		**504**		**504**		**504**		**504**	

Note: [1]Number in parentheses is *t* ratio. **= significant at 1% level. *= significant at 5% level. †= significant at 10% level. [2] Both Production capital (Case (h)) and Consumer Durables (Case (i.)) are a part of Capital assets (Case (a)).[3] Livestock (Case (j)) is a part of production capital of financial assets (Case (d)).

Table 4 System Equation Approach (based on 3SLS for Monthly Data and Seasonal Data) Income Equation

	Case A (Monthly Income)		Case BI (Seasonal Crop Income)	
Variable	Parameter Estimate	*t*-ratio	Parameter Estimate	*t*-ratio
Rainfall variables:[1)]				
(R_1- mean of R_1) :$R_1 = r_0 + r_{-1} + r_{-2} + r_{-3}$	2.53	(2.21)*	----------	
where r_{-t} is the *t-th lagged monthly rainfall*				
(R_1- mean of R_1)*(Owned Land)	0.23	(1.77)†	----------	
(R_2- mean of R_2) :$R_2 = r_{-4} + r_{-5} + r_{-6} + r_{-7}$	-1.45	(-1.23)	----------	
(R_2- mean of R_2)*(Owned Land)	0.38	(3.98)**	----------	
(R_3- mean of R_3) :$R_3 = r_{-8} + r_{-9} + r_{-10} + r_{-11}$	-1.75	(-1.49)	----------	
(R_3- mean of R_3)*(Owned Land)	-0.49	(-5.08)**	----------	
(R_4- mean of R_4) :R_4 =Rainfall in June-Sept	----------		9.49	(1.55)
(R_4- mean of R_4)^2	----------		-0.016	(-0.73)
(R_4- mean of R_4)*(Owned Land)	----------		-0.001	(-1.56)
(R_5- mean of R_5) :R_5 =Rainfall in Oct -Dec	----------		9.01	(0.63)
(R_5- mean of R_5)^2	----------		-0.03	(-0.19)
(R_5- mean of R_5)*(Owned Land)	----------		0.006	(1.18)
Seasonal Dummies: [3)]				
Whether July or not	242.75	(2.27)*	----------	
Whether Aug or not	214.87	(2.36)*	----------	
Whether Sep or not	260.10	(3.07)**	----------	
Whether Oct or not	384.10	(4.23)**	----------	
Whether Nov or not	320.72	(3.54)**	----------	
Whether Dec or not	254.76	(2.94)**	----------	
Whether Jan or not	246.22	(2.54)**	----------	
Whether Feb or not	314.29	(3.67)**	----------	
Whether Mar or not	507.11	(5.28)**	----------	
Whether Apr or not	364.00	(3.76)**	----------	
Whether May or not	251.96	(3.27)**	----------	
Δ Production Capital	1.64	(8.41)**	1.80	(3.27)**
Δ Input Inventory	6.82	(7.14)**	54.22	(6.71)**
ΔFinancial Assets (including Credit)	3.08	(20.36)**	-0.52	(-1.49)
Constant	250.40	(2.72)**	3389.43	(6.30)
Number of Observations	7703		504	

Note: [1)] Square takes negative value when the deviation is negative. [2)]Number in parentheses is *t* ratio. **= significant at 1% level. *= significant at 5% level. †= significant at 10% level. [3)] Dummy variable.

Table 5 System Equation Approach (based on 3SLS for Monthly Data and Seasonal Data)
Asset Equations

Panel B: Based on Monthly Data

Dependent Variables:	**ΔProduction Capital**	**ΔConsumer Durables**	**ΔCrop Inventory**	**ΔInput Inventory**	**ΔFinancial Assets**	**ΔCash holdings[2)]**
Explanatory Variable:	Parameter Estimate (t-ratio)	Parameter Estimate (t-ratio)	Parameter Estimate (t-ratio)	Parameter Estimate (t-ratio)	Parameter Estimate (t-ratio)	Parameter Estimate (t-ratio)
Monthly Income (Transitory Income)	0.02 (0.92)	**0.12 (5.79)****	**0.44 (18.84)****	0.003 (0.83)	**0.23 (8.42)****	**0.11 (3.62)****
Net worth: Real assets – liabilities	------	------	------	------	------	0.0003 (3.84)**
Stock of Production Capital	0.04 (4.01)**	------	------	------	------	------
Stock of Consumer Durables	------	-0.002 (-4.75)**	------	------	------	------
Stock of Grain Stock	------	------	-0.07 (-8.58)**	------	------	------
Owned Land	------	------	------	0.63 (2.22)*	------	------
Stock of Net Borrowings	------	------	------	------	-0.0002 (-0.47)	------
	-51.93 (-1.00)	-5.44 (-0.14)	77.26 (1.78)	2.07 (0.31)	-116.75 (-2.33)	-65.67 (-1.19)
Number of Observations	7703	7703	7703	7703	7703	7703

Panel B: Based on Seasonal Data

Dependent Variables:	**ΔProduction Capital**	**ΔConsumer Durables**	**ΔCrop Inventory**	**ΔInput Inventory**	**ΔFinancial Assets**	**ΔCash holdings[2)]**
Explanatory Variable:	Parameter Estimate (t-ratio)	Parameter Estimate (t-ratio)	Parameter Estimate (t-ratio)	Parameter Estimate (t-ratio)	Parameter Estimate (t-ratio)	Parameter Estimate (t-ratio)
Crop Income in peak season (Transitory income)	**0.06 (2.37)***	0.03 (1.58)	**0.36 (7.05)****	**0.02 (8.03)****	0.06 (1.59)	**0.41 (5.14)****
Net worth: Real assets – liabilities	------	------	------	------	------	-0.025 (-2.23)*

Stock of Production Capital	0.04	------	------	------	------	------
	(4.08)**					
Stock of Consumer Durables	------	-0.005	------	------	------	------
		(-0.37)				
Stock of Grain Stock	------	------	0.15	------	------	------
			(0.63)			
Owned Land	------	------	------	-1.48	------	------
				(-1.23)		
Stock of Net Borrowings	------	------	------	------	-0.02	------
					(1.01)	
Constant	-271.22	-10.16	-0.43	-61.21	-514.98	-287.40
	(-0.78)	(-0.05)	(-0.001)	(-2.61)	(-0.96)	(-0.33)
Number of Observations	504	504	504	504	504	504

Note: [1)] Square takes negative value when the deviation is negative. [2)]Number in parentheses is *t* ratio. **= significant at 1% level. *= significant at 5% level. †= significant at 10% level.

Table 6 Household Reaction to Transitory Crop Income Shocks: Decomposition by landholding class and village (based on 3SLS shown in Table 5)

Panel A: Based on Monthly Data

Dependent Variables:	**ΔProduction Capital**	**ΔConsumer Durables**	**ΔCrop Inventory**	**ΔInput Inventory**	**ΔFinancial Assets**	**ΔCash holdings[2)]**
Explanatory Variable: **Transitory Income**	Parameter Estimate (t-ratio)	Parameter Estimate (t-ratio)	Parameter Estimate (t-ratio)	Parameter Estimate (t-ratio)	Parameter Estimate (t-ratio)	Parameter Estimate (t-ratio)
Large Farmers	**0.06**	**0.07**	**0.54**	-0.01	**0.15**	**0.16**
	(2.01)*	**(1.91)†**	**(16.91)****	(-2.04)	**(3.12)****	**(3.11)****
Medium Farmers	0.08	-0.03	**0.81**	-0.07	**0.15**	-0.04
	(1.20)	(-1.05)	**(23.29)****	(-1.29)	**(3.10)****	(-0.92)
Small Farmers	**0.37**	**0.03**	**0.67**	**0.01**	-0.21	**0.37**
	(4.61)**	**(2.73)****	**(15.73)****	**(3.81)****	(-2.99)**	**(7.01)****
The Landless	**0.13**	**0.04**	**0.65**	-----	**0.09**	-0.06
	(5.47)**	**(2.08)***	**(11.93)****	-----	**(1.68)†**	(-1.19)
Aurepalle	**0.11**	-0.009	**0.56**	0.003	**0.38**	-0.10
	(3.67)**	(-0.47)	**(26.52)****	(1.00)	**(7.00)****	(-1.95)†
Shirapur	-0.18	-0.05	**0.82**	0.003	**0.29**	0.04
	(-2.25)*	(-2.96)**	**(26.45)****	(0.86)	**(4.21)****	(1.19)
Kanzara	-0.03	**0.18**	**0.46**	0.009	**0.05**	**0.29**
	(-1.19)	**(5.94)****	**(17.62))****	(1.62)	**(2.77)****	**(9.73)****
Total	0.02	**0.12**	**0.44**	0.003	**0.23**	**0.11**
	(0.92)	**(5.79)****	**(18.84)****	(0.83)	**(8.42)****	**(3.62)****

Panel A: Based on Seasonal Data

Dependent Variables:	**ΔProduction Capital**	**ΔConsumer Durables**	**ΔCrop Inventory**	**ΔInput Inventory**	**ΔFinancial Assets**	**ΔCash holdings**
Explanatory Variable: **Transitory Income**	Parameter Estimate (t-ratio)	Parameter Estimate (t-ratio)	Parameter Estimate (t-ratio)	Parameter Estimate (t-ratio)	Parameter Estimate (t-ratio)	Parameter Estimate (t-ratio)
Large Farmers	**0.11**	0.03	**0.37**	0.02	0.01	**0.38**
	(2.34)*	(0.87)	**(4.41)****	(3.36)**	(0.14)	**(2.97)****
Medium Farmers	-0.12	0.07	**0.75**	**0.01**	**0.17**	-0.11
	(-0.95)	(1.28)	**(11.62)****	**(2.90)****	**(2.63)****	(-1.41)
Small Farmers	0.12	**0.06**	**0.61**	-0.0006	0.03	**0.84**
	(1.34)	**(2.25)***	**(7.31)****	(-0.08)	(0.67)	**(3.80)****

Aurepalle	-0.08	0.02	**0.80**	-0.002	0.11	0.20
	(-0.87)	(0.38)	**(16.11)****	(-0.43)	(0.73)	(1.21)
Shirapur	**0.17**	0.01	**0.81**	-0.002	**0.07**	-0.12
	(3.90)**	(0.58)	**(18.64)****	(-0.31)	**(1.79)†**	(-2.13)*
Kanzara	**0.09**	0.03	**0.28**	**0.02**	**0.05**	**0.46**
	(3.60)**	(1.25)	**(4.94)****	**(4.54)****	**(2.13)***	**(3.54)****
Total	**0.06**	0.03	**0.36**	**0.02**	0.06	**0.41**
	(2.37)*	(1.58)	**(7.05)****	**(8.03)****	(1.59)	**(5.14)****

Appendix: Constructions of Monthly and Seasonal Asset Variables

Based on household transaction and crop-production modules, we have calculated the following monthly variables. All of these are household variables. Seasonal variables are constructed by aggregating the monthly variables during the agricultural slack season from April to September and the peak season from October to March.

Real Monthly Income is the sum of monthly income from agriculture, labour, trade, handicrafts and net transfers

$$Y = Y_{agriculture} + Y_{labour} + Y_{trade} + Y_{handicrafts} + NetTransfers \quad (A)$$

Real Monthly Consumption is sum of monthly expenditures on all the food and non-food expenditures

$$Consumption = \sum Expenditure_{food/non\text{-}food} \quad (B)$$

Financial Savings is the Net Real Monthly Increase of Financial Assets based on the difference between financial assets and the withdrawal

$$FinancialSavings = Savings + Deposits + LifeInsurance + Others - Withdrawal \quad (C)$$

Credit is the Net Real Monthly Decrease in Liabilities

$$Credit = Lending - Borrowings + Repayment \quad (D)$$

Change in Financial Assets – denoted as $-\Sigma \triangle B_{ijt} P_{ijt}$ above – is the sum of (C) , (D) and income from gift and others

The Net Real Monthly Increase of All the Livestock is based on bullocks, cows, young cattle, buffalo, young buffalo, horses, donkeys, goats, sheep, pigs, poultry, and others

$$\Delta Livestock = Purchase - Sale - LossLivestock^{11} \quad (E)$$

The Net Real Monthly Increase of Main Production Capital is based on dry land, wet land, wells, tanks, cattle sheds, cattle yards, storage facilities, oil or electric pumps

$$\Delta MainProdCapital = Purchase - Sales - LossProdCapital + ExpenditureOnProdCap \quad (F)$$

Net Real Monthly Increase of All Consumer Durables which are *not* included in Consumption, e.g. jewellery, cycles, furniture etc.

$$\Delta MainDurables = Purchase - Sales - LossDurables + ExpenditureOnDurables \quad (G)$$

Change in Capital Assets – referred to as $-\Sigma \triangle K_{ijt} P_{ijtt}$ above - is the sume of (F) and (G)

Savings is computed as the difference between Income and Consumption

$$Savings = Income - Consumption \quad (H)$$

Monthly Change in Currency – referred to as $-\triangle M_{jt}$ above – is the difference between the acquisition of cash and the use thereof.

[11] Loss of livestock due to death, theft etc.

Change in Crop Inventory – referred to as as - $\Sigma \triangle S_{ijt}P_{ijt}$ above – is the sume of crop production and purchase less crop sales and the consumption of self-produced crops

$$\Delta CropInventory = CropProduction + CropPurchase - SaleCrops - ConsumptionCrops \quad (I)$$

Change in Input Inventory – referred to as - $\Sigma \triangle I_{ijt}P_{ijt}$ above – is the net change in fertilisers, manure, pesticides, and insecticides .

$$\Delta InputInventory = \Delta Fertilisers + \Delta Manure + \Delta Pesticides + \Delta Insecticides \quad (J)$$

All of (A), (B), (C), (D), (E), (F), (G), (H), (I) and (J) are in monthly terms and deflated by the village-level monthly CPI – referred to as $P_{ct}Y_{it}$ above.