Dynamics of Livelihood Structure and Assets in Village India, 1975-2004: Literature Survey and Research Agendas

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Introduction

Many developing countries today are liberalizing their markets. Only some of them, however, seem to be able to catch the benefit of globalization through enhanced growth rates. While the case of Chinese growth and poverty reduction impresses everyone, a moderately successful case of India presents an interesting example for further investigation. Since the “Economic Reforms” began in 1991, the pace of liberalization has been accelerated in India and the growth rate has also increased. Although there is a sign that the growth indeed trickled down to the poor in India during the 1990s, the achievement in nation-level poverty reduction shown by the national sample surveys (NSS) data was not as impressive as in China (Deaton [2003], Sen and Himanshu [2004a, 2004b]). Furthermore, it has been an active debate in India whether macroeconomic pictures depicted by NSS datasets correctly capture actual changes in well-being (Bardhan [1989]). For instance, if a rural household now faces larger fluctuations of its income or

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consumption than before, the welfare gain from an increase of expected income following the macroeconomic growth may be cancelled out by the welfare loss due to the risk, resulting in higher vulnerability and lower welfare (Dercon [2005], Kurosaki [2004], Fafchamps [2003]).

Therefore, this paper addresses the question how the quality of life has been changed at the micro level in India, with due consideration paid to the impact of risk. Then what we need is information on the dynamics of well-being at the individual/household level. Such information is available from a number of village studies conducted in India (Jayaraman and Lanjouw [1999]), among which the village-level studies (VLS) conducted by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) during the 1970s and the 1980s are known as the most reliable source of panel information (Walker and Ryan [1990]). For this reason, the empirical focus of this paper is on semi-arid villages in Peninsular India (Andhra Pradesh and Maharashtra) where the VLS was conducted. The theoretical focus of this paper is on the impact of risk since the risk factor is of vital importance in many developing countries including India (Dercon [2005], Kurosaki [2004], Fafchamps [2003]).

Due to wide fluctuations together with a sustained growth of household income observed in the study area, the observed changes in income reflect both long-run mobility and short-run shocks. To distinguish the two, a careful investigation of the dynamics of assets and consumption is required, in addition to the investigation of the income dynamics. Fortunately, a new round of the VLS is now under implementation by the ICRISAT beginning from year 2001/02 (Rao [2004]). The new VLS gives us a rare opportunity to investigate a very long-term panel dataset spanning twenty years or more (Dercon [2004]). Unfortunately, the individual-level linkage between the old and the new VLS datasets is yet to be established, the information linking sample households in the old VLS with those in the new VLS households is not complete, and some of the concepts of the household economy may not be comparable due to changes in the survey design (Dercon [2004]). Therefore, we cannot at this stage quantify the changes of the quality of life in the VLS villages, distinguishing long-run mobility and short-run fluctuations. Instead, this paper describes how we can approach this question once the full set of information, i.e., a cleaned and well-documented panel dataset combining the new and the old VLS, is available. For this aim, this paper presents a literature survey on methodologies as well as on empirical studies on these dynamics using the old VLS dataset.

The paper is organized as follows. Section I presents a theoretical framework to analyze the dynamics of household behavior under risk. Section II then describes the ICRISAT household dataset and reviews the past literature that used the dataset. In addition, long-run changes in the study villages elicited from the new VLS are discussed in this section. The final section summarizes the paper with research agendas.

I A Theoretical Model of Household's Dynamic Optimization under Uncertainty

Let y_{it} be the welfare level of individual i in period t, approximated by real consumption per capita. The period t is measured in years since the dataset used in this paper estimates income and consumption on the annual basis.[*1] One of the most important determinants of y_{it} is real income per capita in period t (denoted by x_{it}). Due to unexpected shocks, such as weather variation, illness and injuries of household members, and commodity price changes and recession, the realized level of x_{it} is stochastic. As income x_{it} fluctuates, consumption y_{it} may also fluctuate.

However, y_{it} may not be exactly equal to x_{it} because households can smooth consumption over time by changing the amount of assets carried over to the next

[*1] In agriculture-based, low-income economy, cropping season could be a better unit for the period when seasonality is severe. For example, Dercon and Krishnan [2000] showed that poor households had difficulty in smoothing consumption between the two seasons of Ethiopian agricultural year.

period or by sharing risk with neighbors (Townsend [1994]). For example, a farmer with a bumper harvest is expected to increase the grain carryover to the next period so that his consumption may increase but not to the extent of the increase of income due to the bumper harvest.

Fluctuations in income are not completely exogenous to household behavior, either. Sources of income fluctuations such as a weather shock may be exogenous, but how much household income is affected by the weather shock depends on resource allocation of the household to generate income. For example, the level and the variance of wage income depends on the labor force allocation of the household across sectors and across spaces. The crop income may or may not fluctuate much depending on crop and input choices by the farmer. These measures are called “income smoothing” and become more important when consumption smoothing measures are limited (Dercon [2005], Morduch [1995], Deaton [1992a]). Furthermore, when the returns to assets and the variability of asset prices vary substantially from asset to asset, households choose the asset portfolio that is associated with smaller risk. Zimmerman and Carter [2003] called such strategy “asset smoothing.”

I.1 General Model

In investigating the dynamic behavior of households in developed countries, focusing on consumption smoothing, ignoring income smoothing, could be a good proxy since the majority of workers are employed by firms and have access to formal financial institutions. Considering the development of credit and financial markets, an assumption of linear returns to financial assets could also be justifiable. With these simplifications, the household decision making process can be analyzed rigorously using a tractable version of dynamic optimization models (Deaton [1992b]).

In sharp contrast, in developing countries, a significant portion of workers are self-employed and have difficulty in access to formal financial institutions. In such cases, income smoothing measures could be cheaper than consumption smoothing measures to achieve a certain level of stability in consumption. Various kinds of assets are used in developing countries, such as agricultural land, livestock, grains, and human capital (Fafchamps [2003], Kurosaki and Fafchamps [2002]). The use of monetary assets may be of minor importance. Therefore, it is important to combine income smoothing and consumption smoothing simultaneously and to allow for non-linear asset returns when the focus is on the dynamic behavior of households in developing countries. As one of the simplest cases that satisfy these requirements, a model by Kurosaki and Fafchamps [2002] is extended in this paper as follows.

For simplicity, the subscript for household or individual i is dropped. In other words, we implicitly assume a unitary household model where a single utility function can characterize the household utility. In year t, the household allocates "the cash in hand" k_t (state variable) between consumption y_t and saving/investment into various types of assets $s_t^a, a = 1, ..., A$. The household obtains the instantaneous utility of $v(y_t) = v(k_t - \sum_{a=1}^{A} s_t^a)$ from consuming y_t. It is assumed that $v' > 0$ and $v'' < 0$ (risk averse preferences). After a period, s_t^a yields a gross return of $g_{t+1}^a(s_t^a)$, which is stochastic. For example, if a riskless saving/borrowing opportunity with interest rate r is available without a ceiling, $g_{t+1}^a(s_t^a) = (1 + r)s_t^a$. Consumption smoothing opportunities may be limited by constraints that characterize technology and market conditions surrounding the household. These constraints are expressed by the shape of function $g_{t+1}^a(s_t^a)s$, which is basically a reduced-form solution of the constraints. For instance, when there exists a borrowing ceiling from a formal financial institution (Deaton [1992b]), the value of function $g_{t+1}^a(s_t^a)$ approaches negative infinity at the ceiling.

On the production size, the household allocates semi-fixed production factors such as land or family labor, denoted as $l_t^b, b = 1, ..., B$ into various production activities in year t, which yields gross returns of $f^b_{t+1}(l^b_t)$ in year $t+1$. We assume these returns are also stochastic. Crop choices by farmers are typical example (Kurosaki and Fafchamps [2002]). The income smoothing allocation is subject to the endowment constraint (the sum of the semi-fixed factors is pre-determined) and may be subject to other technological constraints. For example, the availability of canal irrigation water puts restriction on crop choices (Kurosaki and Fafchamps [2002]). Such constraints are expressed by a vector of inequalities $F(l_t) \leq 0$.

In period $t+1$, income is determined, depending on the choices of l_t made in t, as $x_{t+1} = x^0_{t+1} + \sum_{b=1}^{B} f^b_{t+1}(l^b_t)$, where x^0_{t+1} is a flow of unearned income that is exogenous to household decisions. At the same time, asset income is determined, depending on the choices of s_t made in t, as $\sum_{a=1}^{A} g^a_{t+1}(s^a_t)$. The cash in hand in period $t+1$, k_{t+1}, is the sum of these and the programming problem completes one circle. The household is assumed to continue this process forever. Then the optimization problem of the household in period t is equivalent to finding the value function V defined by the following Bellman equation:

$$V(k_t) = \max_{s_t, l_t} \quad v(k_t - \sum_{a=1}^{A} s^a_t) + \frac{1}{1+\delta} E[V(k_{t+1})], \tag{1}$$

s.t. $F(l_t) \leq 0$, and

$$k_{t+1} = x^0_{t+1} + \sum_{b=1}^{B} f^b_{t+1}(l^b_t) + \sum_{a=1}^{A} g^a_{t+1}(s^a_t), \tag{2}$$

where δ is the subjective discount rate of the household and $E[.]$ is expectation operator. Assuming that function V exists and are differentiable,[*2] first order conditions for the optimization become

$$-v_y + \frac{1}{1+\delta} E[V_k \frac{\partial g^a_{t+1}(s^a_t)}{\partial s^a_t}] = 0, \qquad \forall a, \tag{3}$$

$$\frac{1}{1+\delta} E[V_k \frac{\partial f^b_{t+1}(l^b_t)}{\partial l^b_t}] - \phi_t \frac{\partial F(l_t)}{\partial l^b_t} = 0, \qquad \forall b, \tag{4}$$

where V_k is a partial derivative of the value function V with respect to k_t, v_y is marginal utility in each period, and ϕ_t is Lagrange multiplier on the production factor constraints. Equation (3) shows that the ratio of marginal utilities in different periods is equalized to the opportunity cost of the future consumption (marginal return of an asset) normalized by the subjective discount rate. Equation (4) shows that the production behavior maximizes expected profit only when V_k and $\partial f^b_{t+1}(l^b_t)/\partial l^b_t$ are not correlated. Otherwise, risk preferences should affect the production behavior of the farmer (Kurosaki and Fafchamps [2002: 423]).

[*2] See Stokey and Lucas [1989: Chap.9] for the mathematical conditions for this assumption to hold.

I.2 Dynamics of Livelihood Structure and Assets

When the entire structure of the microeconomic model above is known, $V(k_t)$ can be calculated for each household. Thus the short-run impacts of environmental and market risk on the household welfare and the long-term impacts of macroeconomic growth can be quantified. However, function $V(k_t)$ is not observable directly. Instead, if we have a detailed panel dataset, we can observe income and consumption (x_t, y_t) on the one hand, and assets, semi-fixed production factors, and their returns $(k_t, s_t, l_t$, etc.) on the other hand.

Given such panel information, one approach is to specify the entire structure of the stochastic dynamic programming model that is consistent with the observed data and then to simulate the dynamics of household economy numerically (Ligon and Schechter [2003], Elbers and Gunning [2003], Zimmerman and Carter [2003]). This approach has a strong advantage that the exact route can be clarified in which an exogenous change in environment or policy affects the household behavior. On the other hand, the biggest difficulty for this approach lies data requirement. Even with very high quality data, such as the old VLS dataset from India (see Section II), a significant portion of the model needs to be calibrated, rather than estimated econometrically. Another difficulty is that when the dynamic model has a moderate number of state variables (say, more than two), the underlying mechanism becomes so complicated that intuitive interpretation may not be obtained in several simulations.

Faced with these difficulties, another approach is to characterize the structural relation among (x_t, y_t), $(k_t, s_t, l_t$, etc.), and $V(k_t)$ based on a purely calibrated structural model and then to use the relation as a benchmark to interpret the observed relationship between (x_t, y_t) and $(k_t, s_t, l_t$, etc.) in the dataset. This is basically a reduced-form approach. For example, if observed data show that the relation $x_t = y_t$ holds approximately and both x_t and y_t fluctuate every period, it indicates the absence of consumption smoothing opportunities. Then the welfare level of the household can be measured by consumption or income (equivalent). However, such an extreme case is rarely observed in real situations in developing countries (Dercon [2005], Fafchamps [2003]) so that certain amount of consumption smoothing is possible. Therefore, measuring the household welfare by the level and the variance of consumption through some concave utility function is better than measuring the welfare by those of income. The trade-off between mean and variance of consumption depends on risk preferences, which can be elicited from experiments (Binswanger [1980], [1981]) or can be estimated econometrically using information on production or investment choices (Kurosaki and Fafchamps [2002]).

One note is that the variance of consumption that matters in this context is the variance after controlling for life-cycle factors. The optimal consumption path in the simplified model shown above is a smooth one because such factors are assumed away for simplicity. In empirical examination of actual households who are subject to life-cycle factors, these factors cannot be assumed away. To control for the life-cycle factors, detailed information on household demographics and assets is required definitely.

Assets can be used for another, possibly more important, purpose as well. The observed consumption path of a household in the past contains sufficient information on the welfare level of the household during that period. Therefore, if two households have the same demographic characteristics and the same consumption path, we may be able to regard their welfare levels in the past to be similar. However, if we move to investigating welfare in a forward-looking way, this may not be relevant. If the same two households are different in their asset positions in the last period (possibly due to the contrast that one household was hit by an adverse shock and sold its land and livestock while the other enjoyed a bumper harvest and purchased livestock, for example), then the welfare level expected in the near future should be much higher for the household with larger wealth. Therefore, detailed information on household assets is critically important in implementing forward-looking analysis. A study by Carter and May [2001] is interesting from this perspective. They first searched for an asset item that is very closely related with the long-term welfare level of the household and then analyzed the dynamics of that asset in order to investigate who were more vulnerable to downside risk.

Considering measurement errors (Deaton [1997]), the argument in favor of using information on the allocation of assets and semi-fixed factors as the main information for a welfare analysis is strengthened. In low income countries with higher dependence on self-employment, such as peasant farming, the imputed part of income and consumption becomes larger. The information on livelihood structure (such as major sources of cash income and major sources of food consumption) and asset holding are less subject to the imputation-based measurement errors. In addition, in a village economy, such as in India's VLS, the information flow among villagers could be smooth (Townsend [1994]), so that the information on livelihood structure and assets of a household can be cross-checked easily by collecting the same information from neighbors of that household.

II Studies Using ICRISAT-VLS Data

II.1 VLS 1975-84

The richest panel information on the household economy, such as income, consumption, demographics, assets, and the livelihood structure, can be found from the ICRISAT-VLS database. To introduce the dataset, a general background is provided first. Semi-arid tropics, defined as those tropical regions where annual rainfall ranges from 400 to 1,200mm, occupy the majority of India's area (Walker and Ryan [1990]). Without perennial irrigation, semi-arid agriculture is inherently dependent on monsoon and frequently suffers from drought. The lack of dependable irrigation inhibits the introduction of green revolution technology for rice and wheat. The improvement of well-being of the people living in the semi-arid tropics, therefore, is critically important from economic development perspective.

With this background, the ICRISAT implemented both intensive and extensive household surveys to collect socio-economic information at the micro level. These surveys conducted in the ten-year period from 1975 (cropping year 1975/76) to 1984 (cropping year 1984/85) are famous for its detailed information on agricultural production as well as rural economy (Walker and Ryan [1990]).

Table 1: VLS Villages in India's Semi-Arid Tropics (SAT)

State	Andhra Pradesh		Maharashtra			
District	Mahbubnagar		Sholapur		Akola	
Study village	Aurepalle	Dokur	Shirapur	Kalman	Kanzara	Kinkheda
Soils	Red soils, low water retention capacity		Deep black heavy clay soils, high water retention capacity		Medium deep black clay soils, medium water retention capacity	
Rainfall 1975-84	Un-assured, 630mm, 31% CV1		Un-assured, 630mm, 35% CV1		Assured, 890mm, 22% CV1	
Major crops in 1975	Sorghum, castor, pearl millet paddy, pigeon pea, groundnut		Sorghum, pigeon pea, minor pulses		Cotton, sorghum, mung bean, pigeon pea, wheat	
Number of sample households in the old VLS (1975/76-84/85)						
Laborers	10	10	10	10	10	10
Cultivators, small	10	10	10	10	10	10
Cultivators, medium	10	10	10	10	10	10
Cultivators, large	10	10	10	10	10	10
Total	40	40	40	40	40	40
Number of complete panel households in the old VLS analyzed by Kurosaki (2001)						
Laborers	8		9		6	
Cultivators, small	9		8		10	
Cultivators, medium	8		8		10	
Cultivators, large	10		8		10	
Total	35		33		36	
Number of sample households in the new VLS (2001/02-03/04)						
Laborers	25	20	22	24	13	8
Cultivators, small	21	31	43	53	20	14
Cultivators, medium	37	15	17	14	14	6
Cultivators, large	17	14	6	3	5	4
Total	100	80	88	94	52	32

Source: Walker and Ryan (1990), Rao (2004), and the old VLS database.

Notes: 1. "CV" stands for the coefficient of variation.

2. The classifications is according to the size of operational holding in year 1975/76.

This dataset is called "old VLS" in this paper (it is also called "first generation VLS" among several ICRISAT economists).

Considering the diversity in soils, rainfall, and cropping patterns, three districts were chosen to capture various aspects of the diversity (Table 1). Study villages in Mahbubnagar District (Andhra Pradesh) and Sholapur District (Maharashtra) are drier than those in Akola District (Maharashtra). Not only the rainfall in the former is low on average, but also its annual fluctuation is very high. Although both regions were basically rain-fed when the old VLS was implemented, cropping patterns were very different due to differences in soil quality. In Mahbubnagar, where red soil (low moisture retention capacity) dominates, the main cropping season is *kharif* (monsoon season) when bajra (pearl millet), jowar (sorghum), and castor are cultivated on rain-fed lands and paddy is cropped on irrigated lands. In Sholapur, where black soil (high moisture retention capacity) dominates, the main cropping season in the VLS period was *rabi* (post-monsoon season) with jowar as the dominant crop. In Akola, where rainfall is more assured on black soil, major crops are cotton, pulses, and jowar in *kharif*.

In the old VLS, within each of six survey villages, forty households (ten each from farming categories of landless laborers, small farms, medium farms, and large farms) were surveyed each year (Table 1). Out of the six villages, three (Aurepalle, Shirapur, and Kanzara) are especially famous among development economists, because they were surveyed continuously throughout the ten-year period. Because of its rich information, the old VLS dataset has been used extensively in the literature on microeconometric analysis of development. Among the topics investigated, the question how rural households cope with risk has been analyzed most intensively. Therefore, in the next subsection, the empirical literature using the old VLS dataset is surveyed with focus on this topic.

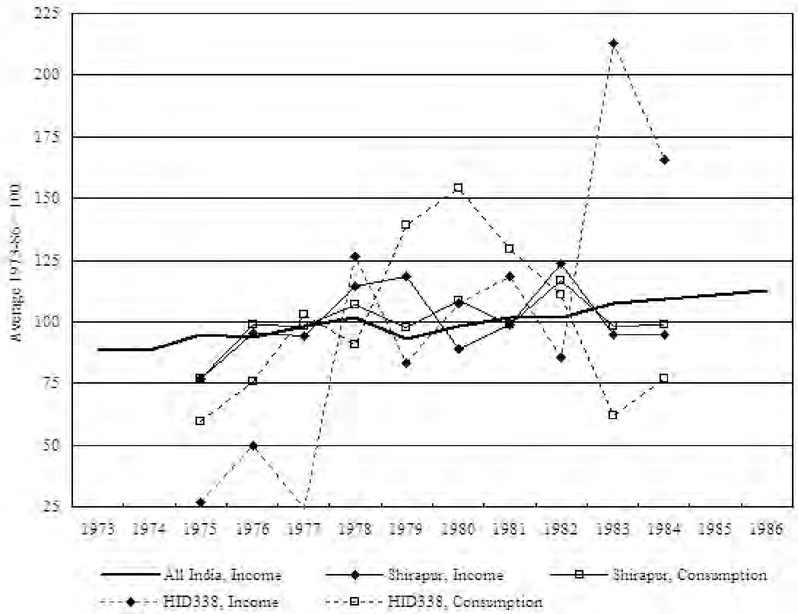
II.2 Risk and Income/Consumption Dynamics in the Old VLS

As reviewed in Section I, one of the most important indicators of welfare is real consumption per capita. To have an idea on how it changed in the VLS villages, a dynamic path of consumption of one household living in Shirapur Village is plotted in Figure 1, together with its income, village average consumption, village average income, and national average income. All variables are expressed as index based on real values and in per capita terms.[*3]

Several interesting features can be found from the graph, regarding the dynamics of income and consumption. First, both real income and real consumption experienced a gradual increase during the period. Second, in sharp contrast to the smooth increase in income at the national level, annual fluctuation is large at the village level. Third, at the village level, income and consumption did not move

[*3] The national figure is based on per population without weighting, whereas village figures are based on per adult-equivalent-unit population. Adult equivalent units used in this paper are: 1.0 for adult male, 0.9 for adult female, and 0.52 for children up to 12 years old.

FIGURE 1: DYNAMICS OF CONSUMPTION AND INCOME AT HOUSEHOLD, VILLAGE, NATIONAL LEVELS



together. Fourth, the plotted curve for the household's income position moves up and down very frequently. Fifth, the plotted curve for the household's consumption position is smoother than income curves.

If we plot OLS-fitted curves on Figure 1 with a linear trend, the household-level income or consumption is found to have positive growth rates that were statistically insignificant, while the annual growth rate of the national income per capita is 1.5% (statistically significant at 5%). In between, the growth rates of the village-average income or consumption are not significant at 5% (but marginally significant at 10 to 15%). This suggests that village level shocks were cancelled each other through aggregation over the diverse country and household level shocks were cancelled each other through aggregation within the village and across neighboring villages. The ICRISAT data show that incomes of individual households in the same village do not move together and they are prone to shocks which are specific to individual households, or "idiosyncratic" shocks, such as plot-specific crop losses and injury/illness of households' working members. Aggregation at the village level conceals such heterogeneity.

Motivated by these observations, Townsend's [1994] seminal paper tested the hypothesis of full risk sharing. If villagers share idiosyncratic income shocks perfectly, which is Pareto superior to partial or no risk sharing, consumption changes at the individual level should not be affected by income changes at the individual level once the village-level income change is controlled for. Townsend's results demonstrated that consumption of the sample households was indeed insulated from fluctuations in income much better than initially expected but the hypothesis of full risk sharing was rejected in many cases.

His paper was followed by various studies that re-investigated the level of consumption smoothing achieved by the households using the same dataset. Ravallion and Chaudhuri [1997] pointed out several sources of econometric bias in Townsend's estimates due to specifications and the way empirical variables were calculated. They proposed an alternative specification in which the observed change in the village-level income is replaced by village-year dummies. Their specification is more robust to endogeneity problems than Townsend's original specification. Instead of using village-year dummies, Jacoby and Skoufias [1998] explicitly used surprise in village rainfall to approximate aggregate shocks. Morduch [2005] explicitly tested whether the unit for risk sharing is better captured by a village or by a caste group. He found that an average of protection levels across caste groups vary quite widely from each other, warning the mechanical approach to assume that the village is the space where risk sharing takes place. Kurosaki [2001] generalized Townsend's [1994] model to allow for heterogeneous time and risk preferences. He found a strong support for the heterogeneity in risk preferences, resulting in larger consumption variability due to village-level income shocks for more landed households. Nevertheless, since these landed households have superior mechanisms to absorb idiosyncratic income shocks, consumption variability due to idiosyncratic income shocks are larger for less landed households than for more landed households. Herein lies the source of vulnerability to shocks due to smaller wealth in village India.

These studies have shown that the existing mechanisms to smooth consumption are not sufficient to warrant Pareto efficient risk sharing. This calls for rigorous research on imperfect risk sharing due to limited information (Ligon [1998]) or limited commitment (Ligon et al. [2002]). Both of these papers theoretically generalized Townsend's model and then applied their models to the ICRISAT data to show that their models explain the data better. Ligon et al. [2002] demonstrated that if a household is hit by an extremely positive income shock, it should be provided with a reasonably large consumption in that time to avoid reneging the contract, leading to excessive consumption response to idiosyncratic income shocks. This is a promising area of further research, both theoretically and empirically, especially to quantify the importance and welfare costs of limited information and commitment.

Using panel information on household consumption in the old VLS dataset, a number of authors attempted to quantify the welfare loss experienced in the past due to excessive consumption variability and the welfare loss expected in the near future due to uninsurable income shocks. Regarding the former, Ravallion [1988] proposed a decomposition of the expected value of a poverty measure into those due to the lowness of average consumption (chronic poverty) and those due to the variability of consumption (transient poverty). Chaudhuri and Ravallion [1994] demonstrated that static poverty measures ignoring individual-level fluctuations may be misleading. Regarding the latter on future welfare loss, Gaiha and Deolalikar [1993] investigated the dynamics of poverty due to asset accumulation process and showed that such dynamics results in persistence of poverty expected in the near future. Gaiha and Imai [2003] extended the analysis into a more forward-looking way and related their estimates for persistence of poverty with the concept of vulnerability. Regarding the measurement of ex ante vulnerability, Ligon [2005] applied to the old VLS dataset a utility-based measure of vulnerability proposed by Ligon and Schechter [2003]. Such poverty persistence may overlap generations but usual panel datasets are not sufficiently long to investigate this issue. Based on the old VLS dataset, Binswanger and Singh [1994] and Deolalikar and Singh [1990] demonstrated that this is indeed the case in semi-arid India.

Although these studies inspired by Townsend [1994] are interesting, they share a common tendency to ignore rich information included in the VLS datasets except for income and consumption. When a certain level of consumption smoothing is observed, a critical question is: By which mechanism? In the terminology of Section I, which assets and which semi-fixed factors are important in smoothing consumption in the VLS households?

Numerous studies investigated this issue using the old VLS dataset. When loan repayment is contingent on the realization of exogenous shocks, *credit* becomes a close substitute for insurance, as is modeled by Udry [1994]. Jodha [1981], Bhende [1986], and Jacoby and Skoufias [1998] found that credit indeed has a role to smooth consumption in semi-arid India. Accumulation and decumulation of own assets is also commonly adopted to stabilize consumption, such as *grain storage* (Renkow [1990], Saha and Stroud [1994]), *livestock* (Rosenzweig and Wolpin [1993]), and *land* (Skoufias [1995], Binswanger and Singh [1994]).[*4] These assets are the main source of household wealth so that the existence of risk and risk-averse behavior results in the structural relationship between risk factors and agricultural investment patterns, as analyzed by Rosenzweig and Binswanger [1993] and Morduch [1993]. Agricultural investment decision under such conditions is based not only on expected rates of returns but also by risk aversion and the necessity for holding liquid assets. Fafchamps and Pender [1997] showed that since *tubewell investment* is highly illiquid, farmers facing difficulty in smoothing consumption requires much more saving to invest than farmers with good access to other consumption smoothing measures. Farmers' adoption of *soil and water preservation technique* can also be analyzed in a similar framework (Pender and Kerr [1998]. Jodha [1986] emphasized the importance of *common property resources* (CPR) as a consumption smoothing measure, since households hit by a

[*4] Regarding the nature of land markets in the VLS villages, see Shaban [1987] who tested alternative theories of sharecropping.

bad shock can extract more from CPR. However, the importance of CPR in the village economy has been declining in semi-arid India.

Households can smooth consumption by adjusting human resources also. First, *wage labor* opportunities[*5] can be used when households are hit by a bad shock. Kochar [1995, 1999] showed that this adjustment is a main mechanism of ex post adjustment to shocks. Studies analyzing labor market supply adjustments incorporating the risk factor include Skoufias [1996], Gaiha [1996], and Kanwar [1998a, 1998b]. When the shock is more aggregate, covering wider regions, *migration* to the outside of the village may be pursued, as is described by Bidinger et al. [1991] for the VLS regions. When a household living in a village expects income fluctuations, it strategically diversifies family members spatially and constructs a network linked with income transfers. Such *remittances* play a substantial role in smoothing consumption in the VLS villages (Rosenzweig [1988], Rosenzweig and Stark [1989], Cain [1981], Jacoby and Skoufias [1998]). A slightly different consumption smoothing strategy is through adjustment of the quality of human capital. Seasonal fluctuations of *nutrition* intake and intra-household disparity of such fluctuations (see Behrman [1988a, 1988b], Behrman and Deolalikar [1987]) suggest that health stock can play some role in

[*5] Regarding the nature of recent changes in labor markets in the VLS villages, see Pereira and Sumner [1990], Pal [1997], and Frisvold [1994].

smoothing consumption. Children's *schooling* can also be adjusted, contingent on the realization of shocks. This is indeed the case in the VLS villages so that the lack of other consumption smoothing measures becomes one reason for the low enrollment ratios and the high drop-out ratios (Jacoby and Skoufias [1997], Behrman et al. [1999]).[*6]

Finally, the old VLS dataset has been widely used in estimating key parameters that characterize dynamic decision making under uncertainty. Binswanger [1980, 1981] attempted to elicit risk preferences by experiments while Antle [1987, 1989] estimated risk preferences econometrically, using data on farmers' production decisions. Time preferences can be estimated similarly: Pender [1996] conducted an experiment to elicit time preferences while Atkeson and Ogaki [1997] econometrically estimated time preferences and intertemporal elasticities of substitution, using household consumption data. Fafchamps and Pender [1997] estimated subjective discount factors and risk aversion coefficients simultaneously through a structural econometric modeling approach, using data on farmers' investment decisions. Properties of utility functions (Bhargava and Ravallion [1993]) and food/calorie demand functions (Behrman and Deolalikar

[*6] However, schooling decisions depend also on wages, family composition (Skoufias [1994]), and learning about future returns to education (Yamauchi [1998]). In evaluating the sensitivity of schooling to unexpected income shocks, these factors need to be controlled for.

[1987]) were successfully investigated through econometrics using the VLS data. Findings by Behrman and Deolalikar [1987] on income/calorie relationship and findings by Deolalikar [1988] on calorie/productivity linkage construct the empirical base for the calorie-based efficiency wage theory.

II.3 Initiation of the New VLS

Rural India has been changing rapidly since the old VLS data were collected, especially since the introduction of the Economic Reforms in 1991. To collect information on these changes, new attempt was initiated in 2001/02 by the ICRISAT to resurvey the six VLS villages. The initial design was to survey continuously for five years. The third round for year 2003/04 has been completed at the time of this writing. In addition to the six villages described in Table 1, several villages were added each year where the same core questionnaire was used — four in 2001/02, one in 2002/03, and four in 2003/04. These additional villages were not for collecting panel information but for investigating specific issues that were relevant for the ICRISAT projects. The dataset collected since 2001/02 from the old VLS villages under this initiative is called "new VLS" in this paper (it is also called "second generation VLS").

The sampling framework was changed in the new VLS. In the old VLS, the same number of sample households were randomly chosen from four categories of laborers, small cultivators, medium cultivators, and large cultivators, regardless of the village size. In the new VLS, the sampling size was enlarged to reflect the difference in the village size and in the distribution of the four household types. The resulting sample size is shown in Table 1. The total number of sample households from the six villages is 446, about twice the sample size in the old VLS.

The new VLS was planned to obtain a panel dataset that can be linked to the old VLS. Therefore, sample households included in the old VLS were surveyed with high priority. The remaining samples were chosen randomly from each category. There are several points that should be mentioned about the linkage of households between the new and old VLS datasets.

First, there were many cases where a household included in the old VLS was split into several households since the last survey in the 1980s or the 1970s. In such cases, each household in the new VLS is treated as "split" households. If a sample household surveyed in the old VLS did not experience such splits and was resurveyed, it is called "maintained" households. Newly added households are called "supplement" households. In the dataset for 2001/02 VLS, there were 140 supplement households. Out of the remaining 306 households, about 100 were split households. However, the exact definition of maintained households, split households, and supplement households was not clearly documented in the dataset. Further, the linkage of individual members in sample households between the old and the new VLS datasets is yet to be established.

Second, the sampling procedure for the supplement households was not clearly documented. Especially problematic was the deleting procedure for the maintained/split households in the case of Kinkheda where the total sample size in the new VLS was smaller than in the old VLS.

Third, the reasons for attrition was not clearly recorded in the survey. It could be due to migration or due to the disappearance of the household because of the death of the household head, but these two should be differentiated. Because the 2001/02 survey was implemented in a relatively short period, there were cases that a household that was surveyed in the old VLS was not included in the group of maintained samples because the household was temporarily out of the village, although it was known at the time of resurvey that the household would come back to the village soon.

Because of these reasons, linking individuals and households between the old and the new VLS is very incomplete at the moment. To fill the information gap, the ICRISAT is now planning to implement a special survey in early 2005 to follow all individuals and households included in the old VLS and to map them into the dataset from the new VLS. We have to wait for the completion of this survey to analyze the long-term dynamics of VLS households over the period from 1975 to 2005.

Even then, statistically rigorous analysis of such long-term panel faces several difficulties. First, the 1975/76 sample was representative of the village population in 1975/76. However, due to attrition, the sample that remained in 1984/85 was representative neither of the 1975/76 population nor of the 1984/85 population. The new VLS attempted to include these samples with priority so that the 2001/02 sample was not representative of the 2001/02 population. Second, how to treat "maintained" and "split" households in the panel analysis is indeed a challenging question from a statistical viewpoint. At the conceptual level, it may not be relevant to treat household as a unit for such a long period. The third is the problem of data comparability and quality. The old VLS data were collected by investigators who lived in the sample villages and information was collected frequently. In contrast, the new VLS data were collected by visiting investigators once a year. Thus the data quality should be higher in the old VLS than in the new VLS. Whether the quality difference led to a particular direction of biases should be examined in the future work. For some key concepts, like consumption and income, it is possible that the way they were asked was slightly different. To compare the old VLS dataset with the new VLS dataset, details of definitions, the way the information was collected, and the way the variable was calculated should be documented in detail, and, when different methodologies were adopted, such as information based on recall or on on-site observation by the resident investigators, safety checks should be carried out to ascertain that there is no systematic bias due to the methodological difference.

II.4 Changes in VLS Villages Over the Long Run

Because of the problems pointed out above, we are not at this stage able to describe the dynamics of livelihood structure and assets over the long run. The descriptive information discussed in this subsection is thus a simple comparison of averages of the old VLS samples and averages of the new VLS samples. Since variables were not strictly comparable and sample households were not the same (but overlapping for the majority in each village), the changes in the following tables may not indicate actual changes that occurred at the old VLS households. For those "maintained" households, aging or life-cycle effects should be considered as well. In interpreting the following tables that compare household income and farming in the old VLS eras and the new VLS eras, these caveats should be kept in mind. In addition to these tables, information obtained from sporadic resurveys conducted before the new VLS (Rao various issues, Bantilan and Anupama

TABLE 2: CHANGES IN INCOME SOURCES AND INCOME LEVELS IN INDIA'S SAT

State	Andhra Pradesh		Maharashtra			
District	Mahbubnagar		Sholapur		Akola	
Study village	Aurepalle	Dokur	Shirapur	Kalman	Kanzara	Kinkheda
Income sources in 1975/76-77/78 (%)						
Crops	29.8	46.1	33.7	46.0	43.9	43.4
Labor	32.8	46.3	42.6	42.1	38.7	40.8
Livestock	25.5	2.0	15.0	0.8	9.0	13.1
Non-farm	11.6	1.2	0.2	4.1	2.4	5.3
Caste occupation	0.0	0.0	0.2	0.0	0.0	0.0
Migration	0.0	0.0	0.0	0.0	0.0	0.0
Others	0.3	4.4	8.5	7.0	6.0	2.6
Total	100.0	100.0	100.0	100.0	100.0	100.0
Income sources in 2001/02 (%)						
Crops	15.0	3.0	22.8	26.4	52.0	40.0
Labor	24.0	14.0	18.8	18.0	21.8	30.0
Livestock	9.0	18.0	15.7	6.5	5.7	2.1
Non-farm	13.0	24.0	31.8	37.5	10.4	20.1
Caste occupation	28.0	6.0	0.3	2.2	1.9	1.8
Migration	8.0	20.0	0.9	0.2	1.6	1.5
Others	4.0	15.0	9.7	9.2	6.6	4.5
Total	100.0	100.0	100.0	100.0	100.0	100.0
Household income in Rs.						
1975-78 (nominal)	2361	2967	2995	1942	3856	2522
1975-78 (2001/02 Rs.)	12938	16259	16413	10642	21131	13821
2001/02 (nominal)	31561	36757	51390	43943	60687	36606
% change	143.9	126.1	213.1	312.9	187.2	164.9

Source: Rao (2004).

[2002]) and observations by the author in Aurepalle, Shirapur, and Kanzara in August 1999 and Dokur in July 2004 are utilized to describe the long-run changes.

First, there occurred a shift from farming to non-farming income sources (Table 2). In the early 1970s (average of the first three years of the old VLS), the contribution of crops and livestock was about 50% in all six villages. In contrast in 2001/02 (the first year of the new VLS), the contribution was 20 to 40% except for village Kanzara where the share increased from 52.9% to 57.7%. In the early 1970s, the contribution of the sum of non-farm and migration income sources was at most 10%. In contrast in 2001/02, the contribution was more than 20% in all six villages. The exceptional movement in Kanzara where the farming share increased and the non-farm/migration share decreased reflects an increase of the cultivation of commercially-oriented cotton crops.[*7] The share of income from migration was higher in the two villages in Andhra Pradesh than in the other six in Maharashtra. This reflects the impacts of drought (see below).

Second, the average household income increased in all six villages by the range of 126-313% (Table 2). According to the national account data in India, per-capita real NNP (net national product) increased by 105% during the same period. Thus, the sample households in Table 2 experienced a faster growth of income than average Indians. Of course, this figure has to be interpreted carefully since the sample households are not representative and the panel households in the new VLS were much older so that the household size was also slightly larger in the

[*7] Another exception was found in Aurepalle where the "caste occupation" share increased dramatically in the new VLS. This reflects an increase of commercial sales of "toddy" (local beer made of palm sap). Since toddy making is restricted to caste "Gowda" known as toddy tappers, this income source is classified as "caste occupation." However, considering its commercial nature, this classification may be misleading.

Table 3: Changes in Farming in India's SAT

State	Andhra Pradesh		Maharashtra			
District	Mahbubnagar		Sholapur		Akola	
Study village	Aurepalle	Dokur	Shirapur	Kalman	Kanzara	Kinkheda
Average size of holding (ha)						
1975/76	4.4	2.6	4.4	8.1	5.8	6.1
2001/02	2.0	1.4	2.1	3.0	3.1	2.6
Ratio of areas under monocropping of foodgrains to the holding size (%)						
1975/76	39.0	85.0	83.0	93.0	59.0	76.0
2001/02	25.6	13.9	68.6	70.5	27.0	18.4
Ratio of areas under mixed crops to the holding size (%)						
1975/76	88.0	40.0	86.0	99.0	21.0	47.0
2001/02	23.6	8.2	0.0	0.0	n.a.	n.a.
Percentage of areas under sorghum in gross cropped areas (%)						
1975/76	44.1	21.2	53.0	35.0	30.0	43.0
2001/02	10.4	9.6	39.4	40.7	4.7	4.0

Source: Rao (2004).

new VLS. In any case, the figures in Table 2 suggest that the average well-being in terms of monetary capability increased substantially in the VLS villages over the long run. The household income in 2001/02 was lower in the two villages in Andhra Pradesh than in the other six in Maharashtra. This seems to reflect the impacts of drought (see below).

Third, average farm size declined by almost half in all six villages (Table 3). This could be one reason for the decline of the share of crop farming in household income in Table 2. The declining farm size reflects the impact of farmland divisions among children of farmers. Regarding cropping patterns, shifting away from traditional dry cropping is evident in all six villages. All three indicators in the table, i.e., foodgrains' importance, the ratio of areas under mixed crops, and the sorghum's share in gross cropped areas, declined substantially. Intercropping various kinds of foodgrain crops with sorghum and pigeon pea at the core is rapidly disappearing from the VLS villages. Instead, the cultivation of paddy and sugarcane increased wherever the irrigation water is available.

However, although irrigation has expanded in all VLS villages, the availability of ground water for irrigation is limited and canal irrigation does not reach the majority of semi-ari villages. In Aurepalle, the number of tubewell owners has increased, resulting in more land now under paddy cultivation. However, here the change is still marginal because paddy cultivation in *kharif* was a part of dominant cropping patterns in the old VLS survey period (see Table 1). The exception in the six villages is Shirapur, where the acreage of land irrigated by canals increased substantially. Since 1993, the village has been provided with water through a perennial canal network built by the government. Cash crop cultivation during *kharif*, such as sugarcane, cotton, and other horticultural crops, is now a rule rather than an exception.

Rainfed agriculture is subject to weather shocks. Various villages in rainfed regions in Andhra Pradesh were severely hit by drought in recent years. Table 4 summarizes drought-related information for the two VLS villages in Andhra

TABLE 4: IMPACT OF DROUGHTS ON VLS VILLAGES IN ANDHRA PRADESH

District	Mahbubnagar	
Village	Aurepalle	Dokur
No. of drought years in the last 10 years	4	6
Average shortfall in income due to drought (% to the expected income)	44.5	55.7
Percentage of farmers adopting coping strategies	74.7	88.3
Percentage of farmers adopting different coping strategies		
Shifted to non-farm labor work	30.4	28.3
Borrowed money	42.9	32.1
Sold draft animals / land	5.4	9.4
Shifted to dairy toddy tapping , etc.	8.9	9.4
Migrated	3.6	11.3
Depended on old savings	3.6	3.8
Reduced consumption expenditure	5.2	5.7
Average no. of out-migrants per household	0.25	0.95
Average no. of days of employment per out-migrant	230	226
Average amount earned per out-migrant (Rs)	12264	8635
Average distance of migration for out-migrants (Km)	85	940

Source: Rao (2004).

Pradesh. In 2001/02, four more villages were surveyed in drought-prone regions of Andhra Pradesh. Situations in these four villages were very similar to those shown in Table 4 (Rao [2004]).

First, farmers replied that they experienced drought four or six out of ten years. The frequency was higher in Dokur than in Aurepalle so that the reported decline in income due to drought was also larger in Dokur. Shifting to non-farm work and borrowing money were the most important measure to cope with drought shocks. However, since drought affects the entire region in which the village is located, these two measures become ineffective when drought occurs in successive years.

Then farmers relied on migration.[*8] The percentage of farmers who migrated to cope with drought shock was much higher in Dokur than in Aurepalle. Therefore, the average number of out-migrants per household was also higher in Dokur than in Aurepalle. Out-migrants worked more than 200 days outside the village. One interesting contrast was the difference in the average distance of migration for out-migrants. The average kilometer for out-migrants from Dokur was more than ten times that for out-migrants from Aurepalle. The contrast reflects a network effect. In Dokur, villagers have strong networks for job opportunities, spanning the whole of India. A number of villagers work in metropolitan cities such as Mumbai and Ahmedabad. Although migration could be an effective tool to cope with drought shocks in the short run, it seriously affects family life and schooling of children.[*9] It may be the case that we should discount the income increases observed in Table 2 in evaluating the welfare gain of the sample households, considering the mal effects of migration.

At the same time, a significant change observed by visitors is that the villagers now have very few problems in food security. This is mainly due to the enhanced

[*8] See also Bidinger et al. [1991] for earlier records of migration from the VLS villages.

[*9] In many cases, small children at the primary school age accompany their out-migrating parents without going to school. These families still belong to their village and stay there for a few months every year during the beginning of a rainy season. When they realize that the rain is going to fail, they again migrate out for work.

level of average income and more connection with surrounding grain markets. As long as households have labor to sell, they are able to purchase staple food from the market. Therefore, the core problem of consumption smoothing has shifted from minimal staple food to other consumption items. In addition, economic and social infrastructure has expanded since the VLS period. Now all villages have banking facilities, cooperative credit institutions, education facilities, and basic health facilities. In that sense, the disparity observed during the VLS period, especially the superiority of Kanzara, has been disappearing.

These developments could be summarized by gradual improvement in the average well-being, which is also supported more or less by other longitudinal village studies in India surveyed by Jayaraman and Lanjouw [1999]. State-level data also show that a steady increase in real rural consumption in Andhra Pradesh and Maharashtra is observed, together with a steady decline in poverty incidence (Deaton [2003], Sen and Himanshu [2004a, 2004b]).

Concluding Remarks: Research Agendas

The discussion in this paper has shown that the long-term panel data, such as those collected by the ICRISAT's VLS, are a source of powerful information to address the question how the quality of life has been changed at the micro level in recent developing countries. The theoretical model in Section I has shown that we now have tools to draw quantitative inferences on welfare changes, utilizing panel information on income, consumption, demographics, and assets. For this purpose, both individuals and households have to be identified and linked between the old VLS (1975-84) and the new VLS (2001-), and the statistical implications of the differences in survey designs have to be examined carefully. These are the first priority for the coming research.

Then in the second stage, we may be able to address questions such as: Who were more vulnerable to aggregate and idiosyncratic income shocks in the short run? Who were less able to capture the economic opportunities created by the Economic Reforms and globalization? Was migration or demographic adjustment an effective way to cope with risk and to capture the opportunity for upward mobility? If there existed a disparity among types of households, was it due to market failure or government failure or community failure? How large was the efficiency loss due to the disparity? How persistent will be the disparity in the near future and over generations? These interesting questions cannot be examined without a panel dataset.

The previous research using the old VLS has shown that the existing measures to smooth consumption and to facilitate investment are inadequate. The inadequacy is more serious in intertemporal resource allocation in the long run, which is likely to lead to an increased inequality in asset accumulation, as was modeled by Zimmerman and Carter [2003]. When the rural economy enters into a period of rapid and dynamic transformation, the inadequacy might imply more isolation of the poor from economic growth. Spread of tractors and opulence of a few villagers observed today seem to offer partial evidence for this implication. At the same time, we observe institutional finance institutions and education spreading throughout the VLS villages. This would have increased investment opportunities even for the poor. The net effect should be investigated carefully. Another positive sign is more assured food security at the household level. Townsend [1994], who investigated a consumption dynamics separately for food grains and others, found that grain consumption was smoother than total consumption expenditure but still it was affected by idiosyncratic shocks. The recent developments in food and financial markets may indicate that the vulnerability of grain consumption to crop shocks has been reduced for the poor. Using the integrated VLS panel including very long-run panel information on income, consumption, demographics, assets, and the livelihood structure, it will become possible to investigate these issues rigorously using the framework of a stochastic dynamic optimization model and the methodology of microeconometrics.

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