RISK SHARING IN VILLAGE INDIA: THE ROLE OF DECREASING RELATIVE RISK AVERSION[1]

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Abstract

The testable implication of the complete risk-sharing hypothesis depends on what is assumed on households' relative risk aversion (RRA) coefficient. We therefore use a hyperbolic absolute risk aversion (HARA) utility function, which includes increasing, constant, and decreasing RRA as special cases, to test this hypothesis. Using household level total non-durable consumption data from Indian villages, we find evidence supporting the decreasing RRA (DRRA) hypothesis, along with evidence favoring full risk-sharing hypothesis at the village level, and rejecting it at the inter-village level. When RRA is restricted to be constant, we replicate the previous findings in the literature: reject the full risk-sharing hypothesis at both levels. Our tests, however, reject this restriction and favor DRRA. These results suggest that it is important to allow for DRRA in testing the complete risk-sharing hypothesis, especially when data containing low-income households are investigated.

Key Words: Decreasing Relative Risk Aversion, Risk Sharing, Consumption Smoothing, Generalized Method of Moments

JEL Code: E21, D12, O12, G10, C12

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1. Introduction

The constant relative risk aversion (CRRA) preferences have been widely used in economic analysis, despite the fact that there has not been much empirical evidence for this specification. Indeed the major support to it seems to come from Blume and Friend (1974) and Arrow (1965). Blume and Friend (1974) use the consumer finance data on American households to pin down the relative risk aversion (RRA) coefficient. They find that CRRA seems to be supported by the data. Arrow (1965), based on the boundedness of utility function, proves that RRA should be increasing with wealth. However, he thinks that fluctuations of RRA are likely, and CRRA does not seem to be a bad approximation.

Existing evidence based on the asset data is, on the contrary, consistent with the idea that the RRA is decreasing. For example, using household level data collected in Italy, Guiso, Jappelli, and Terlizzese (1996) find that the share of risky assets in household portfolio is positively correlated with income and wealth level. Kessler and Wolff (1991) find that for French and American households the share of wealth invested in risky assets increases with wealth. Rosenzweig and Binswanger (1993) report that the wealthier Indian farmers are, the less their investment portfolio shares are affected by increasing weather risk. However, it is important to note that these studies do not conduct direct tests of different hypotheses of RRA. Instead, they provide somewhat indirect evidence that can be rationalized using decreasing RRA (DRRA).

Will *consumption* data also support DRRA? Is it possible to test which hypothesis of RRA is supported by the data? Will DRRA matter in terms of understanding the behavior of household consumption? This paper aims at answering these questions in the context of testing consumption risk sharing hypothesis. We use total non-durable consumption data from Indian rural households in the International Crops Research Institute of the Semi-Arid Tropics (ICRISAT) data set to test the full risk-sharing hypothesis in a framework that allows DRRA, CRRA, and increasing RRA (IRRA) as special cases. We will demonstrate that strong evidence of DRRA can be found in consumption data, and CRRA is decisively rejected. We will also show that DRRA plays a crucial role in understanding the cross-sectional smoothing of consumption. The conclusions that one draws in testing the full risk-sharing hypothesis depend in a most important way on what is assumed about RRA. Specifically, allowing DRRA in the test leads to the non-rejection of the full risk-sharing hypothesis at the village level, whereas forcing CRRA leads to the rejection. However, the CRRA restriction imposed in the test is strongly rejected by the data. The finding of DRRA is consistent with a simple intuition: lower-income households may not be willing to bear as much proportional risk as the wealthier because they can not afford it. The possibility of hitting the subsistence level deters a household from undertaking the same risks in proportion to its wealth that a rich household does.

Our test results contrast sharply with the existing empirical literature on risk sharing (see, e.g. Altug and Miller (1990), Deaton (1990), Morduch (1990), Cochrane (1991), Mace (1991), Townsend (1994), Udry (1994), and Hayashi, Altonji, and Kotlikoff (1996)). These tests are derived using preferences that exhibit either increasing or constant RRA, even when they are applied to data containing low-income households. For example, the power utility implies CRRA, whereas the exponential utility implies IRRA.

Ogaki and Zhang (2000) also show that misleading results may be obtained when DRRA is ignored in testing the full risk-sharing hypothesis. They use household-level food consumption data from India and Pakistan, which requires the assumption that food and nonfood consumption are separable in the utility function. However, there has been overwhelming evidence from the studies of demand system against this assumption. Indeed, Attanasio and Weber (1995) demonstrate that food consumption cannot replace total non-durable consumption in studying intertemporal consumption behavior. In addition, an earlier paper based on the ICRISAT data set, Atkeson and Ogaki (1996), reveals that the separability of food and nonfood consumption can be rejected at 8 percent significance level. Therefore, it is important to examine if the conclusions reached in Ogaki and Zhang (2000) will still hold for total consumption.

We present our model and derive its testable implication in Section 2. In Section 3, we explain our tests for full risk sharing. We explain the empirical results in Section 4, and conclude the paper in Section 5. The ICRISAT data are described in the Appendix.

2. THE MODEL

Consider an economy with potentially H households that will ever exist. These households participate in a risk-sharing pool, in which a Pareto efficient sharing rule is carried out by a social planner. The sharing rule is established at period $t = 0$ and there is a "doomsday" T. Let $s(t) \in \{ 1,2,...,S \}$ denote the state of the world in period t. The history of the economy can then be denoted by the vector $e(t) = [s(0),s(1),...,s(t)]$. Let household h, $h=1,..., H$, have time and state separable utility $u(C_h(t,e(t)))$, where $C_h(t,e(t))$ is per male-adult equivalent consumption. Let β denote the common discount factor in the economy, and $prob(e(t) \mid e(0))$ denote the common conditional probability of $e(t)$ given $e(0)$. The objective of the risk-sharing pool is to maximize the weighted lifetime discounted utility of the participating members. Therefore the optimal allocation of consumption among the members can be characterized by a social planner problem:

$$\text{(1)} \qquad \text{Max} \quad \sum_{h}^{H} \lambda_h \left[\sum_{t=0}^{T} \sum_{e(t)} prob(e(t) \mid e(0))\, u(C_h(t, e(t))) \right],$$

subject to the resource constraint, for every t and every e(t),

$$\text{(2)} \qquad \sum_{h} C_h(t, e(t)) \leq C_a(t, e(t)),$$

where λ_h denotes the welfare weight assigned to household h and is positive, the expression inside the square brackets in (1) is the lifetime utility function of household h, and $C_a(t,e(t))$ is the aggregate consumption good available to the pool at t in the history $e(t)$. Here, we assume that the utility function is common across all households. Given the welfare weights and the probability distribution of possible histories, the solution to this problem, i.e. the consumption sharing rule, depends only on $C_a(t)$.[3] This is known as the Mutuality Principle. In addition, it can be shown that household h's consumption depends on t and $e(t)$ only through C_a. Therefore we denote $C_h^*(C_a(t, e(t)))$ as the sharing rule.

Using Wilson (1968)'s Theorem 5, Ogaki and Zhang (2000) show that the static consumption growth of rich households fluctuates more than that of the poor if RRA decreases with wealth. In other words, due to DRRA the value of $(dC_h^* / dC_a)/C_h^*$ for a rich household is higher (lower) than that of a poor household, when aggregate

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[3] $e(t)$ is suppressed below for the ease of exposition.

consumption C_a increases (decreases) in comparative static sense. This static implication of DRRA can be extended as follows to dynamic settings where $C_a(t)$ varies with time. Suppose $C_a(t+1)$ is higher than $C_a(t)$. Then by the proposition in Ogaki and Zhang (2000), under DRRA $\left(dC_h^* / dC_a\right) / C_h^*$ is higher for rich households for any value of C_a between $C_a(t)$ and $C_a(t+1)$. Since the consumption growth rate is a monotone function of $\ln C_h^*(t+1) - \ln C_h^*(t)$, and

$$\ln C_h^*(t+1) - \ln C_h^*(t) = \int_{C_a(t)}^{C_a(t+1)} \frac{dC_h^*}{dC_a} \frac{1}{C_h^*} dC_a ,$$

it will be higher for a rich household if DRRA holds. Therefore the consumption growth rate for a rich household is higher. On the other hand, if $C_a(t+1)$ is lower than $C_a(t)$, since under DRRA $\left(dC_h^* / dC_a\right) / C_h^*$ is lower for a richer household for any value of C_a between $C_a(t+1)$ and $C_a(t)$, the consumption growth rate decreases with wealth. If instead IRRA holds, we just need to reverse the results above. These results are in contrast with the result under CRRA that the consumption growth rate is identical for all households in the pool. It clearly demonstrates that the testable implication of the full risk-sharing hypothesis depends on what is assumed about RRA. Therefore, it is very important to test which hypothesis of risk aversion is supported by the data in testing the full risk sharing hypothesis. To the extent that our theoretical discussion so far is rather general (in the sense that it does not depend on the functional form of the expected utility), current tests of the complete risk-sharing hypothesis share a potential problem: by ignoring the possibility of DRRA, their test results may not be valid if CRRA or IRRA does not correctly characterize households' risk preferences.

To parameterize the alternative hypotheses of RRA in a parsimonious way, we now assume that

$$u(C_h(t)) = \frac{(C_h(t) - \gamma)^{1-\alpha} - 1}{1-\alpha}, \tag{3}$$

where γ is the preference parameter that governs whether the RRA coefficient increases or decreases with the level of wealth. The RRA coefficient for household *h* implied by (3) is

$$\theta_h = \frac{\alpha}{1 - \gamma / C_h}. \tag{4}$$

If γ is zero, (3) reduces to the CRRA case, and the RRA coefficient is α. If γ is negative, RRA coefficient rises with consumption. If γ is positive, RRA decreases with consumption, and approaches α asymptotically. A positive γ is usually called subsistence consumption in the literature. Townsend (1994) reports that his results remain unchanged when a variety of values of subsistence consumption are tried for the ICRISAT data. His method, however, ignores the effect of estimating the unknown subsistence level on the test statistics for testing the full risk-sharing hypothesis.[4]

With this utility function, the consumption growth for household *h* is

$$\frac{\Delta C_h(t+1)}{C_h(t)} = \frac{1}{\theta_h} \frac{\Delta C_a(t+1)}{C_a(t) - H\gamma},$$

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[4] See Chatterjee and Ravikumar (1999) and references therein for implications of a positive subsistence parameter on growth and distribution. Sethi and Presman (1997) study the behavior of RRA implied by the HARA utility in consumption/investment problems that allow the possibility of bankruptcy. Zimmerman and Carter (1996) simulate an economic model in which poor consumers decide to hold less risky assets than rich ones because of a positive subsistence constraint.

where Δ denotes the first difference. Mechanically, if γ is a positive constant so that θ_h decreases with consumption, then consumption growth across households will increase with consumption when C_a increases, and it will decrease with consumption when C_a decreases. But this is just the implication of DRRA on consumption growth *based on a general utility function* discussed earlier in this section. Therefore in our model with (3) as the utility function, a statistical test of positive γ is also a test of DRRA, not just a test of the positiveness of γ. It is easy to find a utility function in which a positive subsistence parameter does not imply DRRA. However, that is not the case in our model.

The intertemporal first order conditions for the social planner problem imply that for any state of the world

$$\frac{C_h(t+1)-\gamma}{C_h(t)-\gamma}=\phi(t+1), \tag{5}$$

where $\phi(t+1)=\left[\beta\ prob(e(t+1)\mid e(t))\mu(t,e(t))/\mu(t+1,e(t+1))\right]^{1/\alpha}$, and $\mu(t,e(t))$ is the Lagrange multiplier associated with the constraint (2).

Equation (5) should hold for each household *h* in the risk-sharing pool. Since $\phi(t+1)$ is independent of *h*, the consumption in excess of subsistence level, $C_h-\gamma$, should grow at the same rate for all households in any state of the world. This is because idiosyncratic risk is insured away through the optimal risk sharing arrangements. Our econometric method below tests this implication of the full risk-sharing hypothesis.

To summarize, the testable implication of the full risk-sharing hypothesis usually depends on what is assumed on households' RRA. The CRRA assumption implies that consumption growth should be equalized across households with complete markets. The DRRA (IRRA) assumption, in contrast, implies that consumption growth will be positively (negatively) correlated with the wealth level even there is full risk sharing. These implications are still valid if we generalize our model to include non-traded goods such as leisure, as long as they enter the utility function additively separably.

3. Econometric Method

This section outlines our econometric method. As discussed in the previous section, complete risk sharing implies that the growth rate of $C_h - \gamma$ is identical for all households in each state of each period. We now assume that consumption is measured with additive error. Ogaki and Atkeson (1997) discuss the choice between additive and multiplicative measurement errors. They suggest that an additive specification would be better for the purpose of testing risk sharing. Hence we have

(6) $$C_h^m(t) = C_h(t) + \xi_h(t),$$

where $C_h^m(t)$ is measured consumption in per male-adult equivalent terms, and $\xi_h(t)$ is the measurement error. Combining (5) and (6), we obtain

(7) $$C_h^m(t+1) - \phi(t+1)C_h^m(t) - \gamma + \gamma\phi(t+1) = v_h(t+1),$$

where $v_h(t+1) = \xi_h(t+1) - \phi(t+1)\xi_h(t)$.

Now assume that $\xi_h(t)$ is uncorrelated with household *h*'s average and current incomes and their measurement errors at time *t*. Let $\bar{y}_h$ be its average income, and $y_h(t)$ be its current income. Let $Z_h(t) = (1, \bar{y}_h, \Delta y_h(t+1))'$ be a vector of instrumental variables. The number of time periods of the sample is denoted by *T*. Let $\psi = (\phi(2),\ldots,\phi(T),\gamma)$ be the *T*-dimensional vector of unknown parameters, and ψ_0 be the corresponding vector of their true values. In addition, let $f(C_h^m(t+1),\psi)$ be the 3-dimensional vector

(8) $$f(C_h^m(t+1),\psi) = Z_h(t+1)[C_h^m(t+1) - \phi(t+1)C_h^m(t) - \gamma + \gamma\phi(t+1)]$$

$$\equiv f_{h,t+1}$$

and

$$f_h(\psi) = (f_{h,2}(\psi), f_{h,3}(\psi), \ldots, f_{h,T}(\psi))'.$$

Then we have 3×(T–1) orthogonality conditions

(9) $$E_H\left(f_h(\psi_0)\right) = p\lim_{N\to\infty} \frac{1}{N}\sum_{h=1}^{N} f_h(\psi_0) = 0,$$

where E_H is the expectation operator over households. We assume that a central limit theorem applies to $f_h(\psi_0)$ so that $N^{-1/2}\sum_{h=1}^{N} f_h(\psi_0)$ converges to a normal random vector with mean zero and covariance

$$\Omega = p\lim_{N\to\infty} \frac{1}{N}\sum_{h=1}^{N} f_h(\psi_0) f_h(\psi_0)'.$$

The parameter vector ψ can be estimated using Hansen (1982)'s Generalized Method of Moments (GMM).[5] The nonlinear restriction between the parameters in the model (please refer to eq. (7)) justifies the use of GMM. We pool the households of different villages together, and allow the covariance matrix Ω to be different across villages in the estimation. Compared with the usual panel data regression method, our approach has the advantage that it allows for a general form of serial correlation between different elements of the vector $f_h(\psi_0)$ for each village. Altug and Miller (1990) and Hayashi,

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[5] We use the Hansen/Heaton/Ogaki Gauss GMM package for estimation and testing (see Ogaki (1998)).

Altonji, and Kotlikoff (1996) also use GMM in their tests of the complete risk-sharing hypothesis, but in quite different ways from our method.

We consider two types of tests. The first type is the χ^2 test of the over-identifying restrictions (also known as Hansen's ***J*** test). Under the null hypothesis of full risk sharing, the disturbance term in (7) is uncorrelated with the income variables in the set of the instrumental variables. Therefore, the ***J*** test statistic has an asymptotic χ^2 distribution. Under the alternative hypothesis of incomplete risk sharing, the disturbance in (7) will be correlated with income variables. Hence the ***J*** test statistic will tend to be large.

As we have mentioned above, our econometric method requires the assumption that the measurement errors in consumption are not correlated with income variables and their measurement errors. If this assumption does not hold, then Hansen’s ***J*** test will tend to *reject* the null hypothesis of complete risk sharing, and favor the alternative of incomplete risk sharing.

The other type of test is based on variable addition. We add the income difference term to (7) to obtain:

$$C_h^m(t+1)-\phi(t+1)C_h^m(t)-\gamma+\gamma\phi(t+1)-\eta\Delta y_h(t+1)=v_h(t+1). \tag{10}$$

Under the null hypothesis of full risk sharing, $\eta=0$, because the intertemporal first order condition of our model implies that the change in household income should play no role in explaining household consumption when the effects of γ and of the aggregate shock (represented by $\phi(t)$) are accounted for. However, under the alternative hypothesis of incomplete risk sharing, income variables will affect household consumption growth even after controlling for the effects of γ and the aggregate shock. For example, let us take the alternative hypothesis of a Keynesian consumption function, $C_h = a + by_h$, where $0 < b < 1$. Under this hypothesis, GMM estimation of (10) would result in $\phi(t) = 1$ and $\eta = b$ if income is measured without error. Therefore η would be positive, and we can test the hypothesis of full risk sharing by testing the null hypothesis of $\eta = 0$. Even if income is measured with error, the probability limit of our estimator for η will still be positive, although it will be smaller than *b*. So the variable addition test will still have power against this alternative hypothesis. This test is very similar to the regression-based test in the empirical risk sharing literature.

In our empirical work since we pool data from all the villages, the variable addition testing is conducted at two levels. At village level we test whether or not the η estimate is significantly different from zero for each village using the *t*-statistic for each estimate. At the pooled cross-village level, we test whether or not the η estimates of all the villages in the data set are jointly significant. This is done by computing the likelihood-ratio type test statistic, which is the difference between the constrained Hansen's ***J*** statistic and the unconstrained ***J*** statistic.

The variable addition test is very likely to be more powerful than Hansen's ***J*** test against the alternative hypothesis of incomplete risk sharing. The ***J*** test tests against any correlation of the instrumental variables and the disturbance term, whereas the variable addition test is specifically directed toward the positive correlation between consumption and income which incomplete risk sharing implies. In addition, the variable addition test based on the income coefficient in each village has the advantage that it can be used to test against incomplete risk sharing for each village, even when data for many villages are pooled. Indeed, our empirical results below are consistent with this argument.

Another experiment that we will do is to examine the consequence of forcing $\gamma = 0$ in the estimation and testing. As we pointed out in the Introduction, the current literature generally ignores the role of the subsistence parameter γ. Forcing $\gamma = 0$ is equivalent to what other researchers have done in their tests. If we can replicate the result of rejecting the null hypothesis of full risk sharing at the village level when we impose this restriction, but cannot reject it when allowing γ to be estimated, then we can be confident that it is the restriction $\gamma = 0$ that is driving the rejection of the model. In turn, we can test if this restriction itself is reasonable. If it is decisively rejected, then we can conclude that it should not have been imposed in the estimation and testing, i.e. γ should have been allowed to be different from zero. Then, if after taking into account the effect of estimating γ, we do not reject the null hypothesis, we can conclude that the theory presented in Section 2 is not rejected by the data.

4. Empirical Results

We present the empirical results based on the household level ICRISAT data in this section. This data set has been used to study consumption smoothing and risk sharing models by many authors, including Townsend (1994).[6] For data description, please refer to the data appendix.

Table 1 presents the average real consumption data that include real total consumption, real food consumption, and real nonfood consumption for three villages

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[6] See, e.g., Bhargava and Ravallion (1993), Jacoby and Skoufias (1997), Lim (1993), Rosenzweig (1988), Rosenzweig and Stark (1989), and Rosenzweig and Wolpin (1993).

Aurepalle, Shirapur, and Kanzara for the period of 1976-1981. These data are useful for the purpose of interpreting the subsistence estimates in the following two tables.

Table 2 reports the empirical results for the real total consumption expenditure. The first row presents the baseline result on testing the null hypothesis of village-level full risk sharing. This is done by restricting $\phi(t)$ to be identical across all the households in the same village. The subsistence parameter γ is restricted to be equal across villages in the estimation and testing. The *p*-value for Hansen's ***J*** test of the overidentifying restrictions is 16.8%, indicating that the null hypothesis of full risk sharing within villages is not rejected at the conventional significance levels. The estimate of γ is positive and significantly different from zero at very low significance level. Therefore, it supports the hypothesis of DRRA as we point out in Section 2. Additionally, the size of the γ estimate is economically sensible. As a percentage of the average total non-durable consumption for the period of 1976-1981, the estimate of γ is 79% of Aurepalle's, 57% of Shirapur's and 56% of Kanzara's.

The remaining rows report results on five additional tests. First, note that the hypothesis of full risk-sharing across villages can be tested by restricting $\phi(t)$'s to be equal in all the three villages. The ***C*** test in the second row does just that, and tests if this restriction is rejected by the data. The ***C*** statistic here is calculated as the difference between the ***J*** statistic of this row and that of the first row, and is a likelihood-ratio type test statistic. There is overwhelming evidence against the hypothesis of full risk sharing across villages — the *p*-value for the ***C*** test is virtually zero. Given that these villages are far away from each other, private information is very likely to be a serious problem. This in turn causes moral hazard and adverse selection problems, which work against full insurance. Our test result is consistent with this intuition.

The third row reports the variable addition test results. This test is likely to be more powerful than the ***J*** test against the alternative hypothesis of incomplete risk sharing, as discussed in Section 3. The ***C*** statistic tests the joint restriction of $\eta_A = \eta_S = \eta_K = 0$ implied in the baseline case. It is the difference between the ***J*** statistic of the first row and that of this row. The ***C*** test does not reject this restriction, and hence the joint hypothesis of full risk sharing within each village. However, the *t*-statistic for Aurepalle rejects the null hypothesis of $\eta_A = 0$ at 5% significance level, indicating that the full risk-sharing hypothesis is rejected for this village. Therefore the results from the variable addition test and Hansen's ***J*** test are consistent except for Aurepalle.

In order to test if the test result in the baseline case is sensitive to the restriction of equal γ across villages, we now experiment with relaxing it. The fourth row reports the results when γ is allowed to be different in each village. The ***J*** test does not reject the null hypothesis of full risk sharing. The ***C*** test, which is again based on the difference between the two ***J*** values in the first and this row, does not reject the restriction that the subsistence level is the same across villages. It should also be interesting to test if the baseline result is sensitive to the restriction that γ is constant across wealth classes. However, the sample size of each village is not large enough to accommodate the split of sample. For example, if we divide the sample by landholding classes, then the number of landless households in each village is 8, 9, and 6, respectively, for Aurepalle, Shirapur and Kanzara. The same problem exists even if we form wealth groups in other ways.

The fifth row reports the results when γ is restricted to be zero. This corresponds with the case of CRRA. The *p*-value of almost zero for the ***J*** statistic indicates a decisive rejection of the null hypothesis of full risk sharing. On the other hand, the ***C*** statistic tests the restriction of $\gamma_A = \gamma_S = \gamma_K = 0$. It is the difference between the ***J*** statistic of this row and that of the first row. A ***C*** statistic of 35.3 with one degree of freedom implies a *p*-value of virtually zero, so the restriction of $\gamma_A = \gamma_S = \gamma_K = 0$ is strongly rejected. It further strengthens our confidence that DRRA is supported by the data, and demonstrates that tests based on assuming a CRRA or IRRA utility function may have to be interpreted with caution.

The sixth row reports the variable addition test for the case of $\gamma = 0$. Given the result reported in the fifth row — rejecting full risk sharing when imposing the restriction of $\gamma = 0$, one would expect that the income difference to be significant in explaining the variation of consumption. The ***C*** statistic here, *unlike* the previous ones, is the difference of the ***J*** statistic of the fifth row and this row. It tests the joint restriction of $\eta_A = \eta_S = \eta_K = 0$ implied by the full risk-sharing hypothesis. Somewhat to our surprise, it fails to reject this restriction at conventional significance levels, since its *p*-value is about 15%. This is inconsistent with the ***J*** test result in the last row. However, this restriction is indeed strongly rejected, separately for the nonfood and food consumption.

The results for nonfood consumption are reported in Tables 3, and those for food consumption are reported in Ogaki and Zhang (2000), along with results based on food consumption from a Pakistani data set. The tests based on nonfood consumption yield very similar results to those described above for total consumption. We do not reject the hypothesis of complete risk sharing in each village, but we find strong evidence against full risk sharing across villages. We do not find evidence against the restriction that γ is equal across three villages. We, again, are able to replicate the rejection of the full risk sharing hypothesis when imposing $\gamma = 0$. However, as in the case of total consumption, this restriction itself is again strongly rejected by the data. The variable addition test result when imposing $\gamma = 0$ is consistent with that of the fifth row in this table. Finally, we point out that the results presented here are consistent with the test results based on food consumption data reported in Ogaki and Zhang (2000).

5. Conclusions

Based on a general utility function within the expected utility framework, we have demonstrated that how the RRA coefficient varies with wealth plays an important role in determining the consumption growth of households of different economic status in a complete markets model. Therefore it is very important to test how RRA varies with wealth (or consumption) in testing full risk sharing hypothesis. Using a HARA specification of preferences, we have shown that the hypotheses of CRRA and IRRA are both rejected by consumption data. Built upon these results, we have demonstrated that misleading results could be obtained in testing the full risk-sharing hypothesis when ignoring DRRA. For two of the three Indian villages that Townsend (1994) and others studied, we have found evidence supporting DRRA, along with evidence supporting the full risk-sharing hypothesis within villages. Our results for within-village risk sharing contrast with those reported by Townsend and other authors.

Since our empirical results are obtained by using a data set that consists mainly of low-income households, it should be safe to say that DRRA is at least important for understanding the consumption behavior of poor households. Many researchers have rejected complete risk sharing for other data sets. However, most of these data sets contain low-income households. Moreover, based on the available evidence built upon asset data and cited in the Introduction of the present paper, the possibility that DRRA also holds for higher-income households cannot be ruled out. Therefore it will be of great interest to see if allowing for DRRA may change their test results. Without these efforts, our understanding on this issue will remain incomplete. We conjecture that complete risk sharing could be violated in economies where private information is more pervasive, such as a developed economy. Our results that we accept the complete risk-sharing hypothesis within two of the three villages but reject it across villages is consistent with this view. In addition, in these villages, as in many other low-income economies, although formal market mechanisms may fail to provide ample risk sharing opportunities, non-market institutions can still function effectively to fill the gap because of its comparative advantage in monitoring and enforcement capacity. Besley (1995) provides an excellent survey on this issue.

Lastly, the test result that it is DRRA that is supported by the data should be of interest to many economists. Risk preferences play a prominent role in many models of economics and finance. Our result sheds new light on how the preferences should be treated in these models.

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Data Appendix

ICRISAT conducted intensive interviews in southern rural India between 1975 and 1984. This paper uses data from three villages for which the complete consumption data are available: Aurepalle, Shirapur, and Kanzara. Three measures of consumption, food, nonfood, and total consumption, were constructed. Since the construction of food consumption was changed in 1976 and the data for nonfood consumption are missing for most categories after 1982, 1976-1981 is chosen as the relevant sample period for total consumption. On the other hand, nonfood consumption data between 1975 and 1982 are used in our empirical analysis in this paper. The income data that we use is already net of remittance, and includes crop profit, labor income, profit from trade and handicrafts, and profit from animal husbandry.

We use food including grain, milk, vegetables, meat, sweets, and spices as the measure of food consumption. To obtain nonfood consumption, food and ceremonial expenses are subtracted from total consumption expenditure. Ceremonial expenses are removed because they often jump from zero to large amounts. Nonfood consumption consists of narcotics, tea, coffee, tobacco, pan, and alcoholic beverages; clothing, sewing of cloth, other tailoring expenses, thread, needles, chap pals and other footwear and so on; travel and entertainment; medicines, cosmetics soap, barber service; electricity, water charges and cooling fuels for household use; labor expenses for domestic work; edible oils and fats (other than gee); and others, including complete meals in hotels, school and educational materials, stamps, stationery, grinding and milling charges, and so on. The ICRISAT consumption data do not include housing and transportation, because the market values of these categories of consumption are hard to measure in these villages. Total consumption expenditure is the sum of food and nonfood consumption.

To construct real consumption and real income per male-adult equivalent, nominal consumption and income at some year *t* is divided by the family size measure used in Townsend (1994) and the corresponding price index at *t* for each village. The price index for total consumption expenditure, food, and nonfood are the consumer price index, the price index for food, and the price index for nonfood, respectively. These real variables are valued at 1983 prices.

There are about forty households for each year in each of the three villages in the data. Some households drop out of the sample and others are added to the sample over years. These households were excluded from the sample. The number of households in our sample for the village of Aurepalle is 35; that for Shirapur, 33; and that for Kanzara, 36.

Table 1 Real Consumption Per Male-Adult Equivalent: ICRISAT Data

	1976	1977	1978	1979	1980	1981	1976-81
Average Household Total Consumption							
Aurepalle	502	490	544	750	738	660	614
Shirapur	1,063	980	749	869	787	664	852
Kanzara	852	847	758	993	937	815	867
Average Food Consumption							
Aurepalle	313	381	408	538	502	423	408
Shirapur	604	555	644	543	623	521	582
Kanzara	490	489	418	578	571	479	504
Average Nonfood Consumption							
Aurepalle	190	101	156	214	240	236	158
Shirapur	337	313	345	352	329	364	235
Kanzara	369	359	353	426	364	345	267

Notes:

The data reported here are in 1983 Indian Rupee.

Table 2 GMM Results for Total Consumption

Risk Sharing	γ_A *	γ_S	γ_K	η_A *	η_S	η_K	**J** †	**C** †
Within Village	485.1‡ (13.5)	485.1	485.1	…	…	…	36.2 (.168, 29)	…
Across Village	595.9 (34.1)	595.9	595.9	…	…	…	174.2 (.000, 39)	138.0 (.000, 10)
Within Village	466.4 (18.9)	466.4	466.4	.076 (.036)	.072 (.051)	–.003 (.048)	30.3 (.255, 26)	5.1 (.165, 3)
Within Village	481.7 (14.2)	513.5 (30.3)	548.9 (30.6)	…	…	…	35.3 (.132, 27)	.9 (.638, 2)
Within Village	0	0	0	…	…	…	71.5 (.000, 30)	35.3 (.000, 1)
Within Village	0	0	0	.008 (.031)	.026 (.043)	–.084 (.038)	66.2 (.000, 27)	5.3 (.151, 3)

Notes:

*: The subscript *A* is Aurepalle, *S* for Shirapur, and *K* for Kanzara.

†: **J** is a χ^2 statistic, and **C** is a likelihood-ratio type statistic. The numbers in parenthesis are the *p*-value and the degree of freedom, respectively. The degree of freedom for the **J** test is the difference between the number of orthogonality conditions (which, e.g. for the baseline case, is 3×3×(6 –1) = 45) and the number of parameters estimated (which is 16 for the baseline case, because there are 3×5 = 15 $\phi(t)$'s and one γ to be estimated). The value of the **C** statistic in Row *i*, *i* = 2, …, 5, is the difference between the **J** statistic in Row 1 and that for Row *i*. For Row 6, the **C** statistic is the difference between the **J** statistic of Row 5 and that of Row 6. The degree of freedom for the **C** statistic in Row *i, i* =2, …, 5, is the difference between the degree of freedom for the **J** statistic in Row 1 and that for the **J** statistic in Row *i*. For Row 6, the degree of freedom for the **C** statistic is the difference between the degree of freedom for the **J** statistic in Row 5 and that for the **J** statistic in Row 6.

‡: Standard errors are in parenthesis under the estimates, except for the two columns for the **J** and **C** statistics.

Table 3 GMM Results for Nonfood Consumption

Risk Sharing	γ_A	γ_S	γ_K	η_A	η_S	η_K	***J*** †	***C***
Within Village	96.4 (3.5)	96.4	96.4	…	…	…	41.7 (.437, 41)	…
Across Village	35.1 (2.6)	35.1	35.1	…	…	…	1184.4 (.000, 55)	1142.7 (.000, 14)
Within Village	97.0 (3.6)	97.0	97.0	–0.016 (0.020)	0.010 (0.014)	–0.005 (0.008)	40.2 (.373, 38)	1.5 (.682, 3)
Within Village	97.3 (3.6)	37.6 (57.7)	82.2 (12.0)	…	…	…	38.5 (.492, 39)	3.2 (.202, 2)
Within Village	0	0	0	…	…	…	251.7 (.000, 42)	210.0 (.000, 1)
Within Village	0	0	0	0.035 (0.016)	0.008 (0.013)	–0.026 (0.007)	234.1 (.000, 39)	17.6 (.001, 3)

Notes:

†: The degree of freedom for the baseline case is different from that of Table 2 because we use nonfood consumption data from 1975 to 1982, as explained in the Data Appendix. Please refer to the notes under Table 2 for the explanation on the degree of freedom for the ***J*** and ***C*** statistics.