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Author(s): Mark R. Rosenzweig and Oded Stark
Reviewed work(s):
Source: *Journal of Political Economy*, Vol. 97, No. 4 (Aug., 1989), pp. 905-926
Published by: The University of Chicago Press
Stable URL: http://www.jstor.org/stable/1832196
Accessed: 12/04/2012 02:53

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Consumption Smoothing, Migration, and Marriage: Evidence from Rural India

Mark R. Rosenzweig

University of Minnesota

Oded Stark

Harvard University and Bar-Ilan University

A significant proportion of migration in low-income countries, particularly in rural areas, is composed of moves by women for the purpose of marriage. We seek to explain these mobility patterns by examining marital arrangements among Indian households. In particular, we hypothesize that the marriage of daughters to locationally distant, dispersed yet kinship-related households is a manifestation of implicit interhousehold contractual arrangements aimed at mitigating income risks and facilitating consumption smoothing in an environment characterized by information costs and spatially covariant risks. Analysis of longitudinal South Indian village data lends support to the hypothesis. Marriage cum migration contributes significantly to a reduction in the variability of household food consumption. Farm households afflicted with more variable profits tend to engage in longer-distance marriage cum migration. The hypothesized and observed marriage cum migration patterns are in dissonance with standard models of marriage or migration that are concerned primarily with search costs and static income gains.

Studies of migration in low-income countries have been principally concerned with the flows of individuals and families from rural to urban areas. Such studies for the most part have been based on theo-

We are grateful to Sam Peltzman, Zvi Griliches, and a referee for helpful comments and to R. P. Singh for valuable assistance in obtaining and interpreting the data.

[*Journal of Political Economy*, 1989, vol. 97, no. 4]
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ries of migration in which agents seek income gains (or expected income gains), and migration is viewed as a wage (or expected wage) equilibrating mechanism. However, rural to urban migration propelled by earnings incentives is only one component of spatial mobility. Indeed, in one major low-income country, India, rural to urban migration plays a relatively small role in total migration. Analyses of the 1981 Population Census of India (Skeldon 1986; Sundaram 1987), which for the first time provides reasons for migration on the basis of a 5 percent sample, indicate that the net outflow from rural to urban areas between 1971 and 1982 represented only 2.2 percent of the 1971 rural population, with the net outflow of migrants for reasons of employment representing only 1.6 percent of the rural population in 1971 and only a little more than 8 percent of the 1971 urban work force. Net rural to urban migration contributed less than 19 percent to the total growth in the Indian urban population between 1971 and 1981.[1]

Overall geographical mobility and hence rural to rural migration in India, however, are not low. The 5 percent sample from the 1981 Population Census also reveals that almost 30 percent of the Indian population in 1981 (196.3 million people) was composed of individuals who resided in a place other than their place of birth. Most important, approximately 80 percent of these "lifetime migrants" were women who gave marriage as the principal reason for their move. Migration in India is thus predominantly a marital phenomenon, for which conventional employment-based explanations of migration, motivated by the incentives of spatial income differentials, would appear ill suited.

The importance of marital migration, particularly for women, is not confined to India, although it is more prevalent in that context. Our analysis of the Malaysian Family Life Survey (MFLS) data, a probability sample of 1,262 households in Malaysia containing at least one ever-married woman less than 50 years of age (Butz and DaVanzo 1978), indicates, on the basis of the matching of retrospective migration and marriage dates, that 69 percent of all women who had ever moved from one town to another did so at the time of their marriage, with 32 percent of all moves (town to town) by women accounted for by marriage. As in India, marriage migration is significantly less important for Malaysian men: only 13 percent of men changed their town of residence at the time of their marriage.[2]

[1] Urbanization in India appears particularly slow in the context of the productivity gains in the urban sector (Mills and Becker 1986).

[2] Twelve percent of the women in the Malaysian sample were of South Asian Indian ethnic origin. These women exhibited behavior more akin to Malaysians than to Indians residing in India. Although 42.3 percent of this group moved at the time of

On the basis of unique longitudinal data from India, we develop and test in this paper a framework capable of explaining marriage cum migration patterns. Our central hypothesis is that marital arrangements among households, in particular, the "exchange" of individuals among households, characterized by the distance between households and assortative mating patterns, are manifestations of implicit contractual arrangements serving to mitigate income risk and facilitate consumption smoothing under conditions in which there are informational costs and spatially covariant risks.[3] Problems of information asymmetries and returns to risk diversification have previously been fruitfully incorporated in models of such formal rural institutions as banks and sharecropping contracts and of the landholding arrangements of cultivating households (e.g., McCloskey 1976). While only recently have insurance considerations been brought to bear to the study of actual migration phenomena (Lucas and Stark 1985), the pervasiveness of risk and its important spatial character in rural agricultural societies suggest that attention to consumption smoothing arrangements and insurance mechanisms may be useful in understanding marriage migration processes.

Anthropological and econometric studies indicate that interhousehold family transfers are an important source of income insurance in low-income countries. Indeed, there is evidence (Caldwell, Reddy, and Caldwell 1986; Rosenzweig 1988*a*) that nonresident inlaws in India are the principal source of income transfers for households experiencing income shortfalls associated with the exigencies of weather.[4] The MFLS data suggest similar patterns in Malaysia: 39 percent of the value of all goods and cash transfers for purposes of "emergency" help and for "maintaining expenditures" and sent at least 20 miles from the sample Malaysian households went to the in-

marriage, only 27.5 percent of all their moves were for marriage. Among males of Indian ethnic origin, 13.7 percent migrated when married and 5.6 percent of all their moves were for marriage. The "Indian" pattern of marriage migration appears to depend more on the environment than on ethnicity per se.

[3] We do not investigate the role of dowry payments in marital arrangements. Such payments are part of the set of intergenerational relationships, along with inheritances, whose study we are pursuing in other work.

[4] Caldwell et al. (1986) found in their study of nine villages in Karnataka in South India that 56 percent of the relatives providing aid during droughts were either relatives of the head's wife or those of the husbands of the head's daughters. None of these relatives were located within the study villages. Using a subset of the data described below, Rosenzweig (1988*a*) found that almost 60 percent of income transfers (in value terms), representing 10 percent of agricultural profits on average, originated outside the village, that such transfers moved inversely with agricultural profits, and that the inverse association between net transfers (exclusive of marriage-related gifts and dowries) and profits was stronger among households with greater numbers of resident daughters-in-law.

laws of the male head of the household (22 percent to his parents).[5] Eighty-four percent of the value of the longer-distance transfers received by the sample households was sent by the children of the head, but the MFLS does not identify the sex of these donors.

In Section I, we briefly describe our framework for examining the locational and sorting patterns of marriages under a regime of spatially covariant risks and compare the implications of the framework with those derived from models of marriage and migration that ignore payoffs to risk diversification. Section II provides a description of the sample used and its statistics on spatial correlations in rainfall and incomes, mobility, marital arrangements, and the extent of occupational, locational, and marital diversification characterizing Indian farm households. In Section III, an econometric analysis is performed to test directly the proposition that marital arrangements contribute to mitigating the influence of farm income variability on household consumption. Section IV tests the implications for how household wealth holdings and the degree of risk characterizing crop production jointly influence the average quality of marital matches and the mobility—via marriage and via migration—and occupational choices of household members. The results support the hypothesized consumption smoothing role of marital arrangements and indicate, consistent with the insurance-theoretic framework, that the exogenous income riskiness faced by a household and its ability to self-insure via its own wealth holdings jointly and in a similar way influence (i) the distance between it and the households with which it is engaged in marital cum insurance contracts and (ii) the probability that the household has among its members temporary migrants or resident persons with nonvolatile incomes. The wealth-contract-distance relationships estimated appear to be inconsistent, however, with models of marriage (or migration) concerned only with costs of search and static income gains.

I. Spatial Risk Patterns and the Gains from Marriage Migration

A distinguishing feature of the agricultural sector is that income risk has a strong spatial dimension. As a consequence, the pooling of risks entails the transfer of funds or resources across space. The spatial separation (distance) of agents who might benefit from a risk-pooling arrangement, however, makes such arrangements difficult, given the

[5] Seventy-nine (36) percent of the value of household transfer inflows (outflows) of cash and goods for emergency support and consumption maintenance traversed distances of 20 or more miles. Because of small cell sizes, it is not possible to distinguish precisely differences in the patterns of these transfers among Malaysian ethnic groups.

need to monitor performance as a consequence of moral hazard. Thus while the distance between contracting agents provides a risk-pooling benefit, it also increases costs of enforcement. The nonexistence of competitively provided crop insurance and the difficulties of credit provision in most low-income rural areas are in part consequences of the spatial character of agricultural risks. Protection against risks, however, is an important need of households engaged in agricultural production.

One means by which a household may spatially diversify its sources of income, using the bonds of kinship to mitigate the consequences of enforcement costs, is to locate its members in areas characterized by low covariances in income. The transfer of a family member to another established household confers diversification benefits to both households with minimal setup costs, which may be high in settings in which there are important area-specific experiential returns.[6] The presence in household i of a member of household j not only supplies household j with an incentive to contribute to consumption smoothing in i (altruism) but also introduces a verification and monitoring capacity.

Marriage across villages, whereby one of the marital partners "migrates" to the household of the other partner, thus in part fulfills the role of an institution providing income insurance benefits for households in the presence of spatially covariant risks. Note that this form of migration is welfare-improving even in the absence of any (expected) intervillage wage differentials and even if village-specific risk distributions are identical, as long as the timing of states of nature is not perfectly synchronized. Indeed, in that case migration by entire households would never occur.

If households connected by marriage are also related because of some past marriages, an additional layer of enforcement is enjoyed. Moreover, if kinship facilitates information flows, marital matches among partners already related by kinship will be desirable. Thus risk considerations suggest that marriages will take place between partners in different rather than the same villages, but not in order to avoid marriages between close kin. Rather, marriages are likely to be among kin groups because they take place across spatially separated locations.

Considerations of the returns to risk via cross-household sharing arrangements and problems of incentives imply a particular assortative mating pattern: the origin and destination households' "perma-

[6] Rosenzweig and Wolpin (1985) formulate and test a model that explains the immobility of farm household males as a consequence of land-specific returns to experience associated with weather variability. For additional evidence on the returns to experience, see Rosenzweig (1988*b*).

nent" characteristics or endowments influencing the level and variability in incomes will be similar (positive assortative mating with respect to the persistent attributes of agricultural incomes), but the correlation between income outcomes will be as low as possible. Close matching by endowments is desirable because a difference in endowments that determines susceptibility to risk (such as the size of irrigated landholdings) leaves the better-endowed household poorly insured.

Information considerations would appear to suggest that marriages arranged by a household with many daughters, for example, would often take place with multiple sons from another household, particularly given the desirability of matching households. While multiple transactions with the same household do minimize transaction costs, gains from diversification are not fully exploited. The insurance-conscientious village household will best subdivide its risk by sharing it among different villages.

The risk-theoretic approach to marriage migration thus implies that (*a*) households engaged in a marriage exchange will be closely matched by the permanent traits of the members; (*b*) gains in income levels associated with marriage migration moves will be small or nonexistent; (*c*) individuals from the same origin household will tend not to have the same destinations; (*d*) households with more wealth, and thus better able to self-insure, will invest less in marriage migration; the distance between households linked by marriage will be less for the wealthier, to the extent that distance confers a diversification benefit; and (*e*) households facing greater income risk, for given wealth levels, will be more willing to finance moves of longer distance.[7]

Risk-theoretic considerations provide predictions about marital arrangements and migration that diverge in some important respects from those of standard migration and marriage models. Economic models of marriage (Becker 1973, 1974; Keeley 1977) and of migration incorporate income gain and search cost considerations, with

[7] Cooper (1987) demonstrates that in a model in which agricultural income is uncertain, nondecreasing relative risk aversion with a value less than or equal to one or nonincreasing absolute risk aversion is a sufficient condition for a mean-preserving increase in risk to increase a household's demand for insurance via the allocation of additional household time (migration) to riskless activities. In Quizon, Binswanger, and Machina (1984) it is shown that the experimental evidence on risk aversion (Binswanger 1981) based on lottery games played with residents of the Indian villages from which our survey data were obtained (see below) is consistent with increasing relative risk aversion. The experimental evidence suggests a high degree of risk aversion for games involving large payoffs (500 rupees) and is consistent as well with prospect theory risk models. The evidence appears to reject, however, standard economic models of risk behavior incorporating linear probability weights on von Neumann–Morgenstern utilities of final wealth levels.

marriage models, unlike those of migration, concerned as well with the matching of individuals' traits, although this is implicit in migration models in which individuals seek locations most complementary to their skills.

Positive assortative mating is predicted by income gain marriage models on the basis of the notion that individuals' traits are for the most part complementary. While this implication is the same for the risk diversification framework, the existence of income gains from closely matching traits implies that those individuals with relatively rare traits will invest more in search. In a spatial context, therefore, using the income gain framework, we would expect that the wealthier would tend to search over a greater area for a marital match and to be engaged, on average, in longer-distance marital arrangements. In contrast, the risk model implies that the primary payoff to distance is the reduction in risk covariances, which is less valued by the wealthy who are better able to self-insure. The wealth-distance relationship provides a strong test of the two approaches to marriage in the Indian setting.

A well-known finding of migration studies is the high serial correlation in migration flows between specific origins and destinations. This finding is often attributed in the migration literature to the role of information (Greenwood 1971). As noted, such search-theoretic considerations thus suggest that the correlation between the destinations of individuals from the same origin (household) will be positive, while risk diversification suggests the desirability of diversity among destinations. The sign of the correlation between the destinations of marital migrants thus discriminates between the risk and income gain approaches to migration. Risk-diversifying behavior is indicated if households distribute their migrant members across destinations with differing mean incomes rather than concentrating them at the higher mean income destination. Finally, in contrast to the income gain models applied to marriage migration, the risk framework suggests that (origin) income riskiness will increase the distances of marriage-migration linkages.

II. Mobility, Marital Arrangements, and Spatial Risk Diversification among Indian Farm Households

A. *The Sample and Spatial Covariances in Rainfall, Income, and Wages*

To examine marriage and migration patterns in the context of household arrangements facilitating the minimization of consumption risk requires information not only on the characteristics of household

members and on household asset portfolios, but on income flows, their spatial correlations, and consumption behavior over time. We use a unique longitudinal data set from southern India that provides most of the necessary information. In 1975/76 the International Crops Research Institute for the Semi-arid Tropics (ICRISAT) initiated a survey in six villages in three agroclimatic regions of the Indian semiarid tropics. In three villages, information on family membership, incomes, expenditures, and production resources was collected continuously over a 10-year period for 40 (30 cultivating) households in each village. A supplementary retrospective questionnaire was employed in 1984 to elicit additional information on family background, marriages, and inheritances for 400 households, including the households in the original six villages and households in four additional villages that ICRISAT had begun to survey in 1979/80. In addition, more details were obtained in 1985 from households in the three "continuous" villages on the kinship relationships between marital partners and on the distances associated with marital migration.

The availability of a 10-year time series on daily rainfall, agricultural profits, and wages for six villages affords an opportunity to test directly whether increasing the distance between households can potentially reduce their intertemporal covariances in weather conditions and in incomes. As the number of locations provides $N = \Sigma_{i=1}^{n} n - i$ bivariate correlations for each variable, we can construct a cross-sectional sample of 15 correlation-distance pairings from the six ICRISAT villages. The direct regression of the N estimated pairwise correlations on intervillage distances would yield biased coefficient standard errors because the variance of the distribution of each estimated correlation r depends both on the number of time-series observations, which in this case is the same for each village (10 years), and on the magnitudes of the true bivariate correlation, which clearly varies across the N village pairs. However, the variance of the monotonic transform z of r, where

$$z = .5 \ln\left(\frac{1 + r}{1 - r}\right), \tag{1}$$

depends solely on the size of the sample from which the correlation is computed.[8] Regressions of the transform z on distance yield homoscedastic errors, so that valid hypothesis tests are possible, and, from (1), enable computations of the effects of distance on the actual correlations.

[8] The standard error of z is $(t - 3)^{-1/2}$, where t is the number of time-series observations. The attainment of homoscedastic errors by the transformation of the correlations according to (1) also requires that each of the correlated variables be normally distributed (see Hoel 1971).

TABLE 1

REGRESSIONS OF TRANSFORMED PAIRWISE INTERVILLAGE CORRELATIONS FOR RAINFALL, REAL AGRICULTURAL PROFITS, AND WAGES ON DISTANCE FOR SIX ICRISAT VILLAGES, 1975–84

VARIABLE	VILLAGE CORRELATIONS BETWEEN:		
	Daily Rainfall*	Mean Profits†	Wages‡
Distances between villages	−.122	−.0912	−.0998
(km × 10^{-3})	(5.44)	(2.48)	(1.96)
Constant	1.05	.665	1.17
	(8.84)	(3.42)	(4.33)
R^2	.694	.322	.227
F	29.5	6.27	3.82
Number of observations	15	15	15

NOTE.—Dependent variable = .5 $\ln[(1 + r)/(1 - r)]$, where r is the correlation coefficient. t-ratios are in parentheses beneath coefficients.

* Averages for the months of July–October.

† For all sample farm households, in 1975 rupees.

‡ Daily wages for male agricultural workers, in 1975 rupees.

Table 1 provides the regression estimates of the effects of distance on the z-values of the 10-year correlations for daily rainfall (in the critical agricultural months of July–October), real mean profits net of the value of family labor, and real agricultural (male) wage rates based on the six-village ICRISAT sample. The results indicate that distance decreases significantly the correlations in all three variables: the point estimates suggest that for each 100-kilometer increase in the distance between locations, the correlations in rainfall, profits, and wages decline by .073 (18 percent), .083 (49 percent), and .038 (7 percent), respectively.[9]

B. Mobility and Marriage

In the analysis of marriage and migration, we shall use data principally on farm households in the three villages (Aurepalle, Shirapur, and Kanzara) for which there is both continuous information over the 10 years on farm profits and food expenditures and the supplemental marital information. Each village represents a distinct agroclimatic area. Aurepalle is located in a region marked by low levels of erratically distributed rainfall and by soils with limited water storage capac-

[9] The sample of six ICRISAT villages provides estimates that may overstate the extent to which distance generally reduces the covariation in agricultural incomes since sample site selection was based in part on the criterion of minimizing the similarity in agroclimatic conditions across regions. Thus the pairs of villages within each of three regions are likely to experience similar conditions and are proximate (the intraregion mean distance is 22 kilometers), while the mean cross-region distance between villages, for which conditions are dissimilar, is 583 kilometers.

TABLE 2

DESCRIPTIVE STATISTICS: FARM HOUSEHOLDS, 1975–84

	Mean	Standard Deviation
Mean food expenditure	3,101	10.98
Intertemporal food expenditure variance ($\times 10^{-5}$)	15.1	20.5
Mean profits	3,243	4,137
Intertemporal profit variance ($\times 10^{-5}$)	86.6	162
Value of head's inheritance	78,869	135,905
Distance of marital partner households (km)*	30.0	60.5
Number of married women	1.70	.838
Number of male household migrants	.25	1.27
Number of female household migrants	.14	1.38
Number of permanent servants (attached laborers)	.10	.284
Number of male market workers	1.08	1.20
Number of female market workers	.65	.80
Inherited dry land (acres)	12.7	19.1
Inherited wet land (acres)	1.82	3.47

NOTE.—All values are in 1983 rupees.

* Includes marriages between households within the village (7.8 percent); distance is assigned the value of zero for within-village matches.

ity. Shirapur is characterized by soils with somewhat better storage capacities but is in an area with equally irregular and low levels of rainfall and little irrigation. Kanzara is also characterized by low levels of rainfall, but rainfall is somewhat more reliable and soils have storage capacities equal to that of Shirapur. The principal crops grown in the villages are sorghum, pigeon peas, pearl millet, chick-peas, and groundnuts—crops unaffected by the Indian "Green Revolution." Table 2 provides descriptive statistics on the farm (cultivating) households in the sample.[10] Agricultural incomes are quite variable: the 10-year standard deviation in farm profits net of the value of family labor is 25 percent greater than mean profits for the average farm household.

The three villages appear to conform to the general Indian mobility pattern. Only eight of 108 (male) heads of households inclusive of nonfarm households (less than 7 percent) were born outside the village, while almost 94 percent of married women were not residents of the village prior to marriage.[11] "Temporary" migration is more preva-

[10] Included in the sample are all cultivating households in the three villages that remained in the survey over the 10-year period from 1975/76 to 1984/85, when the retrospective questionnaires were applied. Of the 90 original farm households in 1975/76, 70 were present in 1984/85, but seven of these were not able to be interviewed for purposes of obtaining information on the distances of marriages. Unfortunately, households were dropped from the sample when there was a change in the head of the household. In almost all cases this was due to the death of the head.

[11] A supplementary retrospective survey on the kinship relations associated with all marriages in the sample households in one of the villages, Shirapur, indicates that

lent than male "permanent" migration but less pervasive than marital migration in the sample. Only 28 percent of the sample farm households reported having at least one migrant member, a person 18 years of age or over not resident in the village household nor residing in an independent household. While all these household members were located outside of the sample villages and only two of the 57 migrants worked in agriculture, less than half of the migrants represented a potential steady source of income since 40 percent were attending school. Migrants with regular salaries or with incomes not highly covariant with those of the sample households are still more prevalent than *resident* household members holding salaried jobs, who are found in only 10 percent of the farm households.

With respect to spatial diversification via marriage, the mean distance from a sample household to the origin villages of the daughters-in-law is 30 kilometers. Most important, *within* all but two of the 49 percent of households with two or more married women, each married woman came from a different village. The mean of the maximum distances between the origin villages of the married women within these households, inclusive of any women born in the same village, is 47.7 kilometers. The observed within-household diversification of marriage partners by origin location appears to be inconsistent with pure search-theoretic income gain theories of migration or marriage.[12]

To assess the degree to which there is positive assortative mating with respect to the mean income-generating characteristics of the parents of the marital partners, we performed a confirmatory factor analysis (Jöreskog 1969) based on the survey information describing the family backgrounds of the heads and their wives in the 10 ICRISAT villages. We assumed that the permanent income potential or "quality" of each partner's origin household, a latent variable, is

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despite geographical exogamy, or more precisely because of it, almost all marital partners were also related by kinship. Of the 115 marriages, only 14 (12.2 percent) involved partners who were not also relatives. Daughters-in-law of the head, for example, were most typically daughters of a sibling of either the head's father or the father of the head's wife. The ties between spatially separated households thus are typically reinforced by marriages, not just initiated by them.

[12] A farm household may diversify its income sources and thus reduce the intertemporal variability in its income by cultivating plots of land differentiated by their sensitivities to given states of nature in addition to diversifying the geographical location of potential income sources in the face of spatially covariant income risks. However, while almost three-fourths of farm households in the three villages own two or more plots of land, less than half own plots that are distinct from each other in terms of either soil quality (among seven types), irrigation, or location. Moreover, the households do not appear to view plot fragmentation as advantageous: of the plots purchased by the households in the three villages since inheritance, 42 percent were acquired in order to consolidate landholdings or because the plot was close to the household's residence. Diversification was never mentioned as a reason for either buying or selling plots.

TABLE 3

CORRELATIONS BETWEEN INDIVIDUAL MEASURES AND LATENT INDEX OF MARITAL PARTNERS' ORIGIN FAMILIES IN 10 ICRISAT VILLAGES

	Correlation	*t*-Statistic
Father's schooling	.461	10.11
Owned dry acreage	.319	6.55
Owned irrigated acreage	.267	5.40
Latent family quality	.964*	7.03*
Number of pairs	382	

* From maximum likelihood estimates of latent variable model. See text and App. table A1.

measured by the dry and irrigated landholdings (in tenths of acres) in each partner's household when each was 15 years of age and the educational level (in five categories) of the fathers. Table 3 presents the correlations between the three individual background variables of the marital partners, the correlation between the latent indices estimated from the two-factor latent variable model, and the associated *t*-statistics. The coefficient estimates and test statistics of the full factor-analytic analysis are presented in Appendix table A1. The results in table 3 indicate a significant degree of positive association between the origin households of the heads and those of their wives, which is, however, underestimated by the individual correlations between any one of their background characteristics.

III. Household Characteristics and Consumption Smoothing

The close matching of marital partners with respect to origin household variables and the diversity and distance characterizing the ICRISAT households' marriage portfolios are consistent with the hypothesis that marital arrangements influence a household's ability to smooth its consumption when confronted with highly variable income streams. In this section we exploit the longitudinal feature of the ICRISAT data to estimate directly the contribution of marriage migration, as well as of endowed wealth, to consumption smoothing.

Consider a household that in each year t produces a stochastically determined amount of income from own crop production π_t. Consumption c_{ti} for household i in year t is then

$$c_{ti} = \pi_{ti} + \tau_{ti}, \tag{2}$$

where τ_{ti} (other income) represents other sources of the household's net income, from the sale or purchase of assets, from increasing or decreasing debt, and from interhousehold and possibly intrafamily

net transfers. The amount of other income τ_t in period t used for consumption depends on the household's own crop income π_t at t since how much the household would like to borrow (or repay) or how much transfer income is received (or sent out) will depend on π_t and on the household's expectations of future own crop incomes. Moreover, if capital markets are imperfect, the *sensitivity* of other income to the household's current realization of π_t will depend on its owned stock of assets. Consider, for example, two households, one with assets and one without, facing a transitory decrease in own crop income. In the absence of a credit market the second household cannot smooth its income; the first household, however, can sell off its assets and compensate for the loss in own crop income. More generally, since τ in any period cannot exceed the total value of owned assets, given credit constraints, the capacity to respond to a transitory decline in own crop income depends on the value of assets held. Our hypothesis suggests that a household's other income depends as well on the crop incomes of household partners connected via marriage. In particular, we assume that

$$\tau_{ti} = \alpha(w_{ti})(\pi_{ti} - \mu_{it}) + \Sigma\gamma_k(\pi_{ti} - \pi_{tk}), \tag{3}$$

where w_{ti} is household wealth at time t, μ_{it} is household expected future crop income at time t, π_{tk} is the crop income at time t of the kth potential transfer partner, and α and the γ_k measure the extent to which own wealth and transfer households, respectively, contribute to smoothing income, where $\alpha < 0$, $\alpha' \leq 0$, and $\gamma_k \leq 0$. Note that because τ captures what is conventionally defined as "savings," that is, the change in net wealth, as well as net transfer income, both of which contribute to smoothing income, expression (3) is not the standard income-consumption-saving relationship in a regime of imperfect capital markets.

If households have an infinite horizon and the stochastic income process is characterized by stationarity, assumptions not unreasonable for the environment we are studying, we can treat μ_{it} as a constant for a given household i; that is, any current realization of crop income will not affect income expectations. Changes in consumption for a household i, given (2) and (3), are thus related to changes in its crop income, $d\pi_i$, by (4):

$$dc_i = [1 + \alpha(w)]d\pi_i + \Sigma\gamma_k\left(1 - \frac{d\pi_k}{d\pi_i}\right)d\pi_i, \tag{4}$$

where $d\pi_k/d\pi_i$ expresses the intertemporal relationship between the crop income of household i and the incomes of its transfer partners.

Two extreme views of low-income country environments are nested in (4). If there are perfect credit markets or all households are able to self-insure perfectly, then $\alpha = -1$ and $\gamma_k = 0$; for each household,

consumption will be constant (given stationarity and an infinite horizon), independent of stochastic realizations of income. If, on the other hand, no household can "store" income and there are no risk-pooling arrangements via credit markets or via implicit familial contracts, then $\alpha = 0$ and $\gamma_k = 0$; current consumption is then dependent solely on current crop income. We believe that neither of these extreme cases well characterizes the Indian setting; instead we expect that $-1 < \alpha < 0$ and $\gamma_k < 0$, that a household's ability to smooth consumption depends on its owned asset stock, $\alpha' < 0$, and on its ability to engage in risk pooling with partners with low covariant incomes.

We can use the ICRISAT data to estimate a variant of (4). On the basis of the 10-year time series, we computed intertemporal variances for both farm profits (net of the value of family labor) and food expenditures (85 percent of all expenditures) for each farm household, in 1983 rupees.[13] For the household's wealth stock, we used the value of the household head's inheritance, again in 1983 rupees, which we assume to be exogenous to the household's consumption smoothing preferences. The most difficult component to measure in equation (4) is the covariation in incomes between the (potential) transfer partners and the farm household. To obtain such information would require a survey that followed over time all households or individuals *potentially* engaged in risk pooling/income sharing, not just the sampled (representative) households. We know of no such survey. However, the incomes of household migrants, almost none of whom are engaged in agricultural production, are unlikely to be correlated with the sample household's farm profits. With respect to the origin households of the resident married women, we can use the information collected on the distance to these households, based on the findings in table 1 that distance is negatively related to the covariation in agricultural incomes. We thus can test whether there is a payoff to increasing the distance between the households of marital partners in terms of the enhanced ability of the household to smooth consumption via income sharing.

Let $d\pi_i/d\pi_k = \delta d_{ik}$, where d_{ik} is the distance between household i and "partner" household k and $\delta < 0$ (from table 1). Then the basic equation we estimate is

$$\begin{aligned}\sigma_i^2(c) = {} & \beta_0 + \beta_1\sigma_i^2(\pi) + \beta_2 I_i\sigma_i^2(\pi) + \beta_3 W_i\sigma_i^2(\pi) \\ & + \beta_4 M\sigma_i^2(\pi) + \beta_5 D\sigma_i^2(\pi) + \epsilon_i,\end{aligned} \tag{5}$$

[13] We use food expenditures rather than total expenditures because of the well-known difficulties of correcting for the lumpiness of consumer durable expenditures. Food expenditures include the value of consumption from own production and from own food stocks.

TABLE 4

DETERMINANTS OF VARIABILITY IN REAL FOOD EXPENDITURES IN FARM HOUSEHOLDS, 1975–84

Variable	(1)	(2)	(3)
Profit variance	.114	.229	.227
	(14.9)	(7.91)	(7.18)
Inherited wealth × profit variance ($\times 10^{-6}$)	−.147	−.107	−.197
	(4.08)	(4.97)	(4.53)
Number of married women × profit variance	...	−.0346	−.0340
		(2.82)	(1.97)
Marriage distance × profit variance	...	−.000228	−.000231
		(4.31)	(4.33)
Number of migrants × profit variance	...	−.00719	−.00695
		(1.32)	(1.03)
Number of adult male market workers × profit variance	...	...	−.0003
			(1.24)
Number of adult female market workers × profit variance	...	...	−.0708
			(1.34)
Shirapur village ($\times 10^5$)	11.0	11.1	11.4
	(4.29)	(3.75)	(3.50)
Kanzara village ($\times 10^5$)	3.37	6.18	6.89
	(1.39)	(2.10)	(2.14)
Constant ($\times 10^5$)	1.10	−1.64	−1.20
	(.59)	(.64)	(.44)
R^2	.764	.846	.852
F	63.3	43.4	33.9

NOTE.—t-ratios are in parentheses beneath coefficients.

where $\sigma_i^2(c)$ and $\sigma_i^2(\pi)$ are the 10-year food expenditure and profit variances, respectively, I is inherited wealth, W is the number of resident married women, M is the number of household migrants, D is the mean distance between the sample household i and the origin households of the resident married women, ϵ_i is the household-specific error term, and $\beta_5 = -\gamma_k\delta$. Perfect intertemporal markets would imply all $\beta_k = 0$; alternatively, the absence of any mechanisms to transfer income either over time or contemporaneously across households implies that β_1 is close to 0.8, the proportion of food in total expenditures, and $\beta_l = 0$, $l = 2, \ldots, 5$. With self-insurance and with spatial risk pooling associated with migrants and marriages, $\beta_l < 0$, $l = 3, \ldots, 5$.

Table 4 reports estimates obtained from three specifications of equation (5), all of which additionally include village dummy variables.[14] In the first column, we exclude the possibility of spatial income pooling. The results reject the hypotheses that households, independent of their endowed wealth, can perfectly smooth

[14] The village dummy variables pick up all permanent characteristics of villages inclusive of the means and variances of village-level 25 aggregate incomes.

consumption or that households cannot smooth consumption at all via asset transactions. The joint hypotheses (i) that both the profit variance and inherited wealth profit variance interaction coefficients equal zero ($F(2, 57) = 4.7$) and (ii) that the profit variance coefficient equals 0.85 while the wealth interaction coefficient equals zero ($F(2, 47) = 5.3$) are rejected at the .0001 level of significance. Indeed, inherited wealth significantly contributes to consumption smoothing. A one-standard-deviation increase in wealth, at the sample means, reduces the impact of profit variance in food consumption by 12 percent.[15]

In the second column of table 4 we add the migration and marriage profit variance interaction variables. These results indicate that both the number of married women and the distance between the origin households of the marital partners contribute significantly (statistically) to reducing the variability in household food consumption, for given variability in farm profits. The presence of household "temporary" migrants also reduces the impact of profit variability, but only marginally. The point estimates indicate that at the sample means the (positive) effect of profit variability on the variability in food expenditures is reduced by 15 percent when the number of resident married women increases by 1 and by 6 percent for each one-standard-deviation (60 kilometers) increase in the mean distance between the farm household and the origin households of the resident married women. The addition of a household migrant has a weaker effect, reducing the effect of profit variance by 3 percent. In the last column of table 4, we assess the robustness of our results to the addition of variables representing the number of resident adult male and female market (off-farm) workers. The presence of such workers may reduce the effects of profit variability on the variability in household consumption, to the extent that off-farm labor supply responds flexibly to own farm profits and off-farm earnings opportunities in the village are not perfectly correlated with own farm profits. The estimates indicate that the null hypothesis that the number of off-farm workers does not reduce consumption variability among farm households cannot be rejected ($F(2, 53) = 0.91$). Moreover, the influence of marriage migration in reducing the impact of profit variability on consumption variability is essentially unchanged when the family worker variables are included. It is not the presence of adult women (or men) in the household willing or able to work but their marital status, with

[15] We also included in eq. (5) inherited wealth not interacted with the profit variance to assess if the variances in consumption are greater among the wealthier for given variability in incomes. The coefficient on this variable was not statistically significant in any specification (t-ratios were 0.14, 0.13, and 0.06 in the three variants of [5]), and its inclusion altered only trivially the coefficients and t-ratios reported in table 4.

its associated interhousehold bonds, that contributes to income risk mitigation.

IV. The Determinants of Spatial Income Diversification

The preceding results suggest that the distance between the origin locations of marital partners contributes to the mitigation of consumption variability, as does the household's asset holdings and, marginally, household migrants. In this section we test the hypothesis that farm households facing *exogenously* riskier incomes associated with spatially covariant risks will be more likely to invest in spatial risk diversification. We also examine the influence of endowed wealth on such arrangements.

A difficulty in relating variability in incomes to household arrangements is that income volatility can in part be influenced by household resource allocations. Even fluctuations in farm profits, net of family labor costs and thus net of family labor supply decisions, can be modified by households, for example, via crop or plot diversification strategies or investments in water control mechanisms. Both farm profit variability and arrangements facilitating ex post income transfers may thus reflect a household's attitudes toward risk. The covariation between profit variance and ex post insurance arrangements does not necessarily provide, therefore, evidence on the appropriate experiment, which would alter exogenously the riskiness of incomes for a given household, when households are heterogeneous in risk preferences.

As noted, the ICRISAT data provide information on daily rainfall for the 10-year period. We constructed monthly rainfall variances for each of the critical agricultural months (July–October) for each of the villages. We used as instruments these weather variables interacted with each household's *inherited* dry and wet landholdings to predict each household's mean and variance in profits for the 10 years. Under the assumption that village rainfall and inheritances do not reflect household risk preferences, these predicted measures of household income risk should be orthogonal to preferences.[16]

To test the influence of wealth on marriage migration, we used the value of the head's inheritance, again because a household's post-inheritance wealth state will reflect in part its desire for self-insurance and thus its attitudes toward risk, while the head's inheritance is less likely to be correlated with preferences. We expect, as noted, that

[16] The estimates from the first-stage regressions are available from the authors on request.

households with more variable profits, for given mean profits, and households with less endowed wealth, ceteris paribus, will be more likely to invest in temporary migration, to have some of their members participate as regular salaried workers, and to invest in marriages with partners whose origin households are separated by greater distances. Riskiness in incomes raises the return to such investments, while wealth is a substitute for such income insurance mechanisms, as evident in table 4. Moreover, while higher wealth and profits in the head's (parents') household should attract a spouse from a higher-wealth household, greater variability in incomes is a liability and should lower the mean value of the match, ceteris paribus.

Table 5 reports estimates of the effects of profit variability and endowed wealth on the number of migrants, on the presence or absence in the household of a worker with a regular salaried job (assured yearly income), and on the mean distance between the origin village of the resident daughters-in-law and the sample household, on the basis of two-stage tobit, two-stage probit, and two-stage least-squares procedures, respectively.[17] We also assess whether the inheritance of the head's father and profit variability influence the value of the landholdings of the father-in-law of the head. The estimating procedures take into account both the possible endogeneity of the profit variables and the specific properties of the dependent variable; that is, no households had more than one salaried worker or a member who was a farm servant, and 76 percent of the households had no temporary migrant. In all cases, we could reject the hypothesis that the variance in profits is orthogonal to the error terms. Heterogeneity in risk preferences does appear to jointly influence both realized profit variability and ex post income insurance arrangements.

Two specifications are reported for each dependent variable, one with and one without (predicted) mean profits for the household. The results appear to support the view that exogenously imposed income variability induces households to alter the sources of their incomes. In particular, among farm households with equal endowments of wealth, those afflicted with more variable profits from cultivation are more likely to initiate arrangements conducive to income risk pooling that encompass greater distances, via both "temporary" migrants and longer-distance migration associated with marriage. Moreover, greater (predicted) variability in incomes reduces the mean value of the marital match that the household was able to obtain, consistent with risk-avoidance behavior in the marriage market.

The negative wealth coefficients in the distance regression also con-

[17] The two-stage maximum likelihood tobit and probit procedures are described in Smith and Blundell (1986).

TABLE 5

EFFECTS OF AGRICULTURAL PROFIT LEVELS AND PROFIT VARIABILITY ON HOUSEHOLD LABOR FORCE AND MARITAL ARRANGEMENTS

	DEPENDENT VARIABLE (Estimation Procedure)							
	Number of Migrants (Two-Stage Maximum Likelihood Tobit)		Attached Laborer/ Salaried Worker (Two-Stage Maximum Likelihood Probit)		Mean Marriage Distance (Two-Stage Least Squares)		Value of Landholdings of Head's Father-in-Law* (Two-Stage Maximum Likelihood Tobit)	
Profit variance†	1.32	4.67	−.0381	.137	.707	54.8	.00490	−.0580
	(5.26)	(2.60)	(1.85)	(2.05)	(2.98)	(.52)‡	(.51)	(1.37)
Profit mean† ($\times 10^{-5}$)	. . .	−.152	. . .	−7.40	. . .	2.98	. . .	.00126
		(.33)		(2.66)		(.15)‡		(1.58)
Value of inheritance ($\times 10^{-4}$)	−2.57	−.0356	.0286	−.134	−2.21	−2.03	7,261§	8,618
	(2.20)	(.21)	(.59)	(1.41)	(1.85)	(1.32)	(1.16)	(1.72)
Constant	−.280	−6.42	.287	5.94	−10.31	−7.71	88,964	129,574
	(1.51)	(3.23)	(.37)	(2.41)	(.47)	(.30)	(.95)	(1.25)
χ^2, F	37.8	32.9	10.2	21.0	4.45	3.87	8.75	11.2
Hausman-Wu	9.93	7.08	2.46	13.1	19.4	10.6	2.12	2.48

NOTE.—Asymptotic t-ratios are in parentheses beneath coefficients.

* In 1983 rupees.

† Endogenous variable. Instruments include village-level means and variances of rainfall in July–October 1975–84, and interactions between the rainfall statistics and head's dry and irrigated landholdings at inheritance.

‡ Jointly significant: $F(2, 59) = 5.78$.

§ Inheritance of head's father (in 1983 rupees).

form to the risk insurance model of marriage cum migration but are inconsistent with the conventional theory of marriage, in which families with greater wealth are predicted to search for marital partners over a larger area. Although high-wealth households are evidently more likely to contract marriages with other high-wealth households, in conformity to the assortative mating prediction, farm families with greater wealth, among those households facing the same income risk, are less likely to be characterized by marriages extending over long distances, despite their enhanced ability to finance a search over a wider area and their greater difficulty in finding a desirable marital match.[18] As is consistent with the results in table 4, the usefulness of asset holdings for reducing consumption volatility, for given income variability, appears to be reflected in households' decisions about migration and marriage cum migration arrangements. Wealth is thus not merely a matching trait or a source of investment funds, and marriage and migration are not merely mechanisms for increasing income levels.

V. Conclusion

In this paper we have examined from a risk-theoretic perspective a major component of migration in low-income rural areas, that associated with the movement of women for the purpose of marriage. In particular, we have hypothesized that the spatial distribution and characteristics of matches associated with the marriage of daughters are in part manifestations of implicit interhousehold contractual arrangements facilitating consumption smoothing in an environment characterized by information costs and spatially covariant risks. Analysis of longitudinal data from villages in South India provided support for the hypothesis, indicating that marriage cum migration contributes to a reduction in the variability in consumption, for given variability in income from crop production, and that households exposed to higher income risk are more likely to invest in longer-distance migration-marriage arrangements.

The hypothesized and observed patterns of migration and marriage do not appear consistent with standard models of marriage or migration that are concerned solely with search costs and differentials in expected income levels. These patterns thus suggest that spatial differences in the average returns to skills (or wage levels) may not importantly account for population movements within rural India.

[18] The location of the wealthy households is not the reason for this result. While there is a tendency for wealthier households to cluster among themselves *within* villages, the sample villages are not situated in "wealthy" areas, i.e., in closer proximity to villages with higher proportions of wealthy households.

However, our framework also implies that agricultural technical change may significantly alter spatial marriage patterns, if not the stability of the marriage institution, since such change not only alters the spatial covariances and levels of risk but renders more difficult the assessment of risk and, thus, the establishment of implicit risk arrangements. Conversely, improvements in formal institutional arrangements (e.g., credit markets) that facilitate consumption smoothing may reduce the role played by risk considerations in marital arrangements and rural migration, perhaps resulting in diminished rural mobility. Finally, our results suggest that the value to parents of having a girl relative to having a boy in environments characterized by underdeveloped insurance markets and spatially covariant risks may be substantially understated by sex differentials in expected labor market returns. Attention to the returns arising from the specialized role of daughters accruing from their dispersion, moreover, suggests that policies lowering ex ante income risks in such settings may result in diminished resources allocated to young girls if intrahousehold resource allocations are influenced by economic incentives.

Appendix

TABLE A1

MAXIMUM LIKELIHOOD ESTIMATES: LATENT VARIABLE ANALYSIS OF MARITAL PARTNER QUALITY

Indicator	Head	Wife
Father's schooling	1.00*	1.00*
Owned irrigated acreage	22.65	1.07
	(6.73)	(4.75)
Owned dry acreage	3.28	5.75
	(7.26)	(7.27)
$\chi^2(8)$	75.89	
Number of observations	382	

NOTE.—Asymptotic *t*-values are in parentheses beneath coefficients.
* Reference (scaling) variable.

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