Human Capital Accumulation, the Family, and Economic Development

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Family issues—particularly the notion that there has been a decline in “family values” as signaled, for example, by a lack of respect for elders and family instability—have become an important theme of political debates in the United States in recent times. Another important theme has been the relationship between economic development and human capital investment. This essay is concerned with the relationships between human capital, the family, and economic development. In particular, it examines two related questions: First, do family arrangements and family stability, as characterized by the structure of households and their dissolution and marital patterns, reflect the rapidity of economic development, such that enhanced growth and development can cause a “breakdown” of the family? Second, how does economic development affect the returns to and investments in different types of human capital? I will attempt to show that these two questions are linked, that the technological transformation of an economy, by altering the value of different kinds of human capital and increasing incomes, also affects the nature and stability of family relationships.

To understand the complex relationships among growth, human capital, and the family would be quite difficult in the context of an economy such as that of the United States. Distinguishing the effects of development on the returns to human capital investments from the effects of human capital investments on development, for example, is a formidable task. Moreover, the measurement of economic growth and the technical change that underlies it is fraught with difficulties when the economy is as technologically differentiated as in the United States. As a consequence, I look for some answers to the questions
about the family-human capital-growth nexus in a simpler economy, that of rural India.

There are three key reasons for studying the Indian rural economy to understand better the relationships between family, human capital, and development. First, that economy is relatively homogenous with respect to production compared to the United States. The most important economic activity by far is agricultural production, and as a consequence it is easier to characterize the economic constraints facing individuals and households.

Second, an important and recent source of economic development in India is clear—the "green revolution." There is no question that a major source of rural development and growth was technical change that was essentially exogenous to the Indian economy. In particular, the widespread availability of substantially more productive varieties of wheat and rice, which began in the early and mid-1960s, was not due to increases in human capital investments or to changes in family arrangements in rural areas. Moreover, because the technological change was crop-specific, not all of the Indian economy could benefit directly from the new grain varieties. The geographically selective nature of the green revolution and its relatively clear timing means that we have a natural experiment in which we can compare, before and after the technical change began, areas now experiencing growth propelled by agricultural technical change with those areas without such growth.

The third and essential reason for examining the Indian economy is that there are excellent data describing that economy. We can thus exploit the green revolution experiment. In particular, there are two sets of data that (1) characterize the behavior of Indian farmers over time in an environment relatively untouched by the green revolution, and (2) describe farmers across all of India, both within and outside of green revolution areas. Thus there is information that describes family arrangements, schooling, and agricultural production prior to and after the onset of technical change in the same areas, as well as in areas without significant agricultural productivity growth.

I use results from prior studies undertaken by me and others over the last decade based on these data describing Indian farm families to examine hypotheses about families and the role of human capital as affected by economic growth. First, I will briefly discuss the key fea-
Hypotheses About Family Arrangements and Human Capital Returns in Agricultural Settings

The Agricultural Environment Prior to Technical Change

The four most important features of the environment experienced by agricultural households in a setting without technical advances are: (1) intertemporal variability in rainfall, a critical productive input; (2) spatial covariability in rainfall—families living close-by experience similar weather at the same time; (3) stationarity in weather, making it possible to assess weather risk and the consequences of weather, once realized, for production and income; and (4) the absence of insurance for adverse rainfall conditions or shortfalls in incomes. As a consequence of fluctuating rainfall, and other weather conditions, households experience fluctuating incomes and have a need for mechanisms, alternative to formal insurance, to smooth their consumption.

There are two principal means of consumption-smoothing. Farmers can attempt to reduce the impact of weather variation on incomes by altering their productive practices or inputs prior to the realization of rainfall, by installing irrigation facilities, for example. These \textit{ex ante} adjustments to the riskiness of rainfall can be supplemented by
attempts to transfer income from good-weather periods to bad-weather periods by *ex post* adjustment to realized weather outcomes. Saving, by storing output, or borrowing from the more fortunate are examples. Note, however, that neighbors are of limited help in bad-weather times, as they are likely to experience shortfalls at the same time as the “distressed” household because of the covariant nature of rainfall.

In this economy, experience is the most valuable form of human capital. Given the stationarity of weather, farmers learn over time the best ways of coping *ex ante* and *ex post* with the varieties of rainfall based on their experience. Moreover, if land plots are differentiated, the returns to such experience are specific to plots of land or the local economy. As a consequence, schooling, which enables farmers to acquire knowledge outside their immediate environment, provides little return. Because of stationarity, traditional practices based on years of experience (learning by doing) are optimal, with book knowledge about other environments of little value.

Where experience is valuable, the elderly have the highest levels of human capital; it would be expected in such stationary environments that elders would be “respected.” In particular, where the returns to plot-specific experience are high, there are incentives for children and parents to farm together on the family land. By working on the family land, the children acquire specific knowledge about that land, and that land then becomes more valuable to them than any other land in the economy and is worth more to them than to any anonymous agent. The children will thus want to remain on the family land that they will inherit. The gains from keeping the land within the family, arising from plot-specific experience, are shared intergenerationally, with the adult children perhaps working at lower rates of pay than hired laborers or working harder in exchange for future returns they will earn on the family land from their experience on it. Thus, the existence of experiential returns leads to intergenerational co-production and to little land divestment. Family stability with highly valued elders should be characteristic of the stationary but risky traditional economy.²

Note that this plot-specific experience hypothesis turns the “old-age security” hypothesis on its head—the vertical extension of farm households is not due to the need by the elders for support from their more productive children, but rather reflects the enhanced value of the elders’ human capital, relative to their children, which is tied to the
family land. The value of accumulated experience as a factor in binding together two generations of family members also implies that there is no reason for adult siblings to co-produce after their father dies. Each sibling essentially brings no additional embodied knowledge to the farming enterprise.

Specific experience, given the natural immobility of land, is a centripetal force tying family members together and contributing to exante consumption-smoothing. However, the scope for mitigating the effects of adverse weather is limited. What can be done if such actions fail to sustain incomes? Some means by which income shortfalls are made up ex post is required. However, by concentrating in one location, the family gives up the gains from spatial diversification, which makes ex post consumption-smoothing more difficult. The covariant nature of weather risk and the need to smooth consumption would create an incentive for the family to diversify income sources spatially. Thus there is also a centrifugal force tending to spread family members over space, given risk prospects.

While risk considerations increase the returns to the spatial spread of income sources, the costs of coordinating and monitoring a geographically diverse income-pooling scheme also rise with the separation of partners in the scheme. Indeed, it is the positive association between risk-spreading from locational diversity and information and monitoring costs entailed in limiting the scope for cheating that is in part responsible for the absence of crop or income insurance. Can the family sustain an efficient income-pooling scheme across space while minimizing moral hazard and maintaining the gains from experience that are tied to specific plots of land?

Consider first the possibility that the family simply splits, with some members migrating to settle apart from the origin household. The productivity of the new, split-off household would be lower than that of the origin household, as the specific experience returns would be lower on the newly acquired land. Indeed, ex post income-pooling considerations would lead to the minimization of the similarity of both land and weather across the two households and thus minimization of the relevance of experience on the family land. An alternative scheme, however, would have one family member transferred into an existing, established household with experience on its own land and income covaring minimally with that of the origin household. In this case, the
origin household has an incentive to support the destination household to the extent that the household cares about its former member. Moreover, to the extent that the family member cares about the origin family, the family member will see to it that the destination household does not cheat—the departed family member is like a resident agent of the origin household. Thus, altruism, an important characteristic of families, contributes to the efficiency of spatial income pooling by creating a verification and monitoring capacity.

This latter scheme describes the typical pattern of marriages in rural India, as will be described below. Daughters typically leave the village in which they are born to live with their new husband in his household of birth. Why are daughters and not sons mobile? Given the division of labor in which women contribute less time to agricultural production, there is smaller loss from the reduction in experiential capital upon the migration of a woman compared to a man. Thus, an arrangement in which men are immobile and inherit the family land, and in which there are maritally mobile women establishing ties with spatially spread families, facilitates risk-sharing in the face of covariant risks while maximizing the returns from experience capital (Rosenzweig and Stark 1989).

**Effects of Technical Change**

One of the most important potential effects of the introduction of technical change is on the returns to human capital. First, under a new technology, past experience becomes less relevant to production decisions. The new regime of best production practices that characterize the new technology obsolesces experience. As a result, it may be expected that one of the ties holding families together, the value of experience specific to the family's land, would erode, with a consequent increase in family breakups and an increase in land sales. In addition, as the value of elders' experience is reduced, such groups may become more vulnerable.

A one-shot change in technology immediately reduces the value of past experience, but if there are no further changes in technology, experiential returns eventually will increase, as farmers become more familiar with the new technology under different varieties of weather and on their own plots of land. Under a regime of constant changes in
technology, however, long-term experience never has substantial value and, as hypothesized by T. W. Schultz (1975), the returns to formal schooling rise. This is because under constant change, farmers better able to cope with that change and adapt to new practices earn higher returns. And it is this skill that formal schooling may help to foster. Farmers experiencing a flow of new technologies may need to decode the new information better, for which literacy may be quite useful.

In an environment of persistent technical change there is an increase in the rate of return to formal schooling and literacy and a decline in the value of experience. These changes may lead to new family relationships, not only because of the reduced value of specific experience but also because the increase in incomes reduces the need for alternative mechanisms for coping with the vagaries of weather. Farmers are better able to self-insure, and perhaps are less averse to risk, when average incomes are higher. However, informal insurance arrangements involving transfers across households would appear to be inherently fragile. One reason is that beliefs about each farmer's future willingness to participate in the income-pooling arrangement are critical for arrangements undertaken by households that transfer resources to those experiencing negative earnings shocks from those with positive shocks (Foster 1988; Coate and Ravallion 1993). Each participant must believe that other participants will not renege from commitments in the future. These considerations suggest that economic development may have an important effect on the ability and willingness of households to engage in these arrangements.

There are three ways in which economic development, in particular increases in farm earnings brought about by agricultural technological change, may reduce the role of insurance-like transfers and thus the insurance premium attached to marriage. First, technological change may increase mobility; established households will be less likely to remain on the same land due to the erosion of plot-specific experiential returns. As shown by Coate and Ravallion, the prospects of increased mobility of any household participating in the income-pooling scheme increase the divergence between first-best and optimal-constrained transfer arrangements, as the likelihood increases that the future benefits from such a scheme will not be forthcoming to all participants.

A second reason that technical change may reduce the insurance value of marital ties is that increases in earnings, given declining risk
aversion and/or improved abilities to accumulate assets, reduce the demand for such insurance. Note that with forward-looking households, it is only necessary that one of the partners believe that future earnings growth will reduce the likelihood of participation for the arrangements to be broken off in the current period. Thus, even farmers who experience earnings growth but who wish to continue such arrangements may not be able to if their partners are less motivated to do so.

Finally, all of the parameters in the risk-sharing decision rules reflect the bargaining parties' mutual assessment of risk and their knowledge of the technology of production. Changes in technology necessitate new arrangements, at least initially, by changing risks and making risk assessment more difficult. This may decrease the ability to risk pool and thus make farmers more reliant on alternative mechanisms to smooth consumption.

In the new environment of technical change and growth, then, the incentives for larger, and vertically extended families with little schooling are reduced. The reduction in returns to experience attenuates the costs of mobility by loosening the ties of generations of kin to the family land, and the decline in the value of family arrangements involving spatial diversification lowers the demand for larger families. Moreover, if the returns to schooling also rise, then in order to mitigate the costs of such schooling, families will reduce the number of children they will have, as elaborated in Becker and Lewis (1973).

The Data and Empirical Features of the Rural Indian Economy

In order to ascertain if the relationships between family arrangements, human capital, and growth elaborated above are useful depictions of reality, it is important to have data that describe household structures in settings with and without technical change. There are two data sets describing rural India that are quite useful for this purpose. One of these, the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT) Village Studies survey data, provides information on income, expenditures, production resources, assets, and family membership for thirty farmers in ten villages in the semi-arid
tropics of India, many of whom were surveyed for as many as ten years. This survey was begun in 1975 in six villages in three agroclimatic regions. In three of those villages, the farmers (and ten households not owning land in each village) were surveyed for ten years, in three others for seven years. In addition, a retrospective questionnaire administered in 1984 elicited retrospective information on marriages, farming experience, and land ownership, which is particularly relevant to the study of the family.

There are two other important features of this data set for an inquiry into the determinants of family-human capital interactions. First, although the data were collected after the green revolution was well under way in India, the semi-arid tropical areas were not directly affected, as the low levels and erratic nature of the rainfall in such areas preclude the use of the new seed varieties of wheat or rice. Thus, the data describe a setting in which there is little technical progress. A second important feature of the data is that there is time-series information on daily rainfall, making it possible to measure an important source of risk and thus study how risk differentially shapes family relationships and the returns to human capital under a technologically stagnant regime.

The longitudinal nature of the ICRISAT data makes it useful for depicting the consumption-smoothing problem confronting farmers. Figure 1 displays the aggregate fluctuations in farm profits from crop production in the original villages for the period 1975–83. As can be seen, the fluctuations are large, and with the exception of two of the villages depicted by the solid lines where there were some improvements in seed varieties (sorghum and cotton) in 1981, trendless. A computation of the intertemporal coefficient of variation (the intertemporal standard deviation divided by the mean) for each of the farmers in these villages indicates that for the average farmer the standard deviation in profits is 25 percent higher than mean profits. To benchmark this figure, I calculated the same statistic based on seven years of annual earnings using U.S. data on white males 25–29 years of age in 1971. For this group, the average coefficient of variation was only 39; earnings variability was thus more than three times higher among farmers in the ICRISAT region than among white males in the United States.
Another important feature indicated by figure 1 is the covariability in incomes. As noted, the villages are grouped into sets of two in three regions. This is depicted in the figure by the use of common line patterns for the groups, and as can be seen the intertemporal movements in aggregate profits are quite closely correlated, particularly in the two solid-line villages, whose distance apart is only 20 kilometers. The data thus suggest that earnings fluctuations and the covariability in earnings are important characteristics of the agricultural environment.

**Figure 1. Profits from Crop Production**

The ICRISAT data cannot be used to assess directly the consequences of technical change. As noted, and as indicated by the ICRISAT data, an important feature of the Indian experience with respect to the introduction of the newer higher-yielding grain varieties in the early 1960s is the spatial variability in the degree to which the green revolution took hold, chiefly because of location-specific heterogeneity in soil and weather conditions. In recognition of the selective potential for the success of the new technologies, the government of India in 1961 implemented a program, the Intensive Agricultural District Pro-
gram (IADP), in one district in each state in India (two in the state of Kerala) in which it was expected that the improved grain varieties were likely to be particularly productive. The program’s objective was to facilitate the adoption of the new inputs and the implementation of new agricultural practices associated with the new inputs—an early example of a governmental program attempting to “pick winners”!

To assess the income distribution consequences of the new grain varieties, the National Council of Applied Economic Research (NCAER) undertook a national survey of rural households in 250 villages in 1968, the Additional Rural Income Survey (ARIS), based on a stratified random sample in which one of the sampling strata was defined by the presence of the IADP program in the district. One-third of the sample thus included households from each of the IADP districts (National Council of Applied Economic Research 1975). Households were interviewed three times annually from the crop year 1968–69 through the crop year 1970–71 resulting in three years of information on a sample of 4,118 households, approximately two-thirds of which were farming households. The sampling scheme of the ARIS survey enables both a more generalizable view of Indian households and behavior and an assessment of the effects of technical change. With the information provided on production, household demography, and income sources taken in the early stages of the green revolution for a national probability sample of rural households, we can assess how typical the six to ten villages in the ICRISAT sample are as well as the consequences, at least initially, of the introduction of continuing agricultural technical progress.

Both data sets reveal a consistent picture of household structure and stability. The NCAER-ARIS data indicate that 62 percent of farm families are characterized by vertical extension (two adult generations of co-resident kin), with only 7.5 percent characterized by horizontal extension (adult siblings co-residing without their parents). The ICRISAT data are similar; they show 70 percent of the farm households vertically extended and only 3 percent horizontally extended. The ICRISAT retrospective data also indicate that households are stable and immobile, with less than 7 percent of household heads born outside of the village in which they were currently living. This stability is also reflected in the rarity of land sales indicated in the NCAER data, with less than 2 percent of farm households having sold any land in the
last year of the survey (when this information was elicited). In contrast to the immobility of households and household heads, the women are mobile, as indicated by the ICRISAT retrospective data: 94 percent of the adult married women in the sample were born outside of the village in which they were currently residing. These figures on the immobility of men and the mobility of married women in rural areas in the ICRISAT data are echoed in the 1981 Population Census of India, which indicates that 80 percent of all lifetime migrants, persons not residing in the village where they were born, are women.

**Returns to Experience in a Stationary Environment**

The patterns of household structure and mobility (and immobility) are broadly consistent with the hypothesis that returns to experience are sufficiently important in stationary but risky agricultural settings to bind the household to the family land, particularly those members who specialize in production. But is the basic assumption correct, that experience has a high return related to coping with the consequences of adverse weather in a stationary economy? To have some confidence in the experience-household structure association, which has important implications for the consequences to families of economic growth, it would be desirable to estimate the returns to experience.

Both the NCAER-ARIS and ICRISAT data sets permit estimation of the returns to farming experience. The NCAER data identify for each of the three years of the survey whether or not there was adverse weather in the village in which the household resides. It is thus possible to estimate the effects of bad weather on farm profits and the way these effects are mitigated, if at all, by farmer experience. Based on regression estimates, figure 2 shows how profits earned under adverse weather conditions are related to the age structure and other characteristics of households, given their average profitability in the years in which weather conditions were normal. Each bar represents the percentage fall in profits from normal or good weather profits resulting from bad weather for households with different characteristics. The first bar on the left represents the percentage shortfall from normal profits (39.7 percent) for households in which the eldest person is less
than forty years old and in which there is no extension aid. The next bar represents the profit shortfall in an otherwise identical household in which the eldest person is as old as fifty-nine—the effect of adding a person in the forty to fifty-nine age range to a household in which the eldest is less than forty. The effect is to decrease the shortfall by 10 percentage points. When the eldest is sixty or over, the shortfall declines by an additional 15 percentage points to 15.3 percent (third bar). Thus the presence of an elder over fifty-nine years of age halves the adverse effect of bad weather compared to a household in which the eldest person is less than sixty.

Figure 2. Percentage Fall in Profits Due to Bad Weather by Family Type

As a benchmark with which to compare the age structure effects, the next bars in the figure represent the profit shortfalls in households like the first, with no elders over forty, but with extension aid and electrification, respectively. These figures indicate that the provision of extension services has a comparable effect on the mitigation of adverse weather to adding an elder between the ages of forty and fifty-nine to
the "young" household (the percentage shortfall declines from 39.7 to 31.5 as compared to 30.4), but is only half as effective as adding an elder who is sixty or more years of age. The effect of electrification, which permits irrigation and thus better water control, is similar to the extension service (a fall of 31.0 percent compared to 31.5), and evidently less valuable for limiting the consequences of bad weather than having an individual in the family with forty or more years of farming experience.

The results in figure 2 suggest the importance of farming experience in a stationary environment characterized by erratic rainfall. However, they are not fully satisfactory because (1) age and experience on the family's land are not necessarily the same, although the dearth of land sales suggests that they are highly correlated; and (2) the association between age structure and profits is not necessarily indicative of the effects of age structure, but may instead mean that higher profits in bad weather affect household age structure. Specifically, vertical extension may be a "normal" good—households with higher profits in bad weather may simply prefer to have elders co-reside compared to less fortunate households. Or, for households in which bad weather somehow does not strongly affect profits, the elderly are more likely to survive.

The ICRISAT data permit, in contrast to the NCAER data, a more exact reconstruction of each farmer's experience on the family's land, based on the retrospective questionnaire providing a complete plot-specific history for all owned plots of land for all heads of households. Moreover, the extended number of years over which the farmers are observed permits better controls for unobserved factors that may affect profits and thus the family age structure. Based on the retrospective questionnaire on plot ownership and cultivation administered to all sample households, the total experience of each household head on all owned plots of land, differentiated by whether the land was irrigated or not, was computed for each of the ten years of the sample survey. For each household in each year, cumulative experience on owned plots for each type of land (dry or irrigated) was computed as the weighted average, by plot size, of the total years that each plot (whether owned or not) had been cultivated by the household head. One can then examine how the change in the real value of net profits from cultivation is
related to the changes in (1) total experience on each type of land, (2) total holdings of each land type, (3) rainfall in the year (rain per day in three of the most critical months during the rainy season, July, August, and September), and (4) rainfall interacted with both land owned and experience. By looking at the association between the change in profits and the changes in the determinants of profits, the influence on profits of permanent but unmeasured characteristics of the farm households, such as ability or healthiness, which may also affect the number of accumulated years of cultivation, are eliminated.

Figure 3 reports in graphical form the relationships between farm profits and rainfall for the farmers surveyed by ICRISAT classified into three experience groups: those with ten, twenty, and thirty years of farmer experience on their own plots of land. The figures show that, among farmers with the same schooling, with the same irrigated and dry landholdings, and who are the same age, increases in specific experience contribute significantly to increased agricultural profits. At the sample mean rainfall (5 mm per day), it can be seen that farmers with thirty years of specific experience (3,963 rupees) have significantly higher profits than those with twenty years of experience (2,596 rupees) and ten years (1,459 rupees). Moreover, and consistent with the results from the NCAER-ARIS sample, the sensitivity of profits to rainfall is also less for the more experienced farmers—the relationship between profits and rainfall is less steep for the more experienced farmers compared to those farmers with less experience. Indeed, at the lowest level of rainfall, 2 mm, the ratio of profits for the most experienced farmers to those with the least experience is 4.5 to 1, while at the highest levels of rainfall the ratio is only 1.8 to 1 as a consequence of the differential sensitivities of profitability to rainfall across the experience groups.

The results reported in figure 3 thus indicate that there are significant gains from the experience accumulated by farmers from the continuous cultivation of land in the environment of the ICRISAT villages where technical change is not a significant factor. The magnitudes of the effects are such as to make it profitable for families to try to hold on to their landholdings, and for cultivating members of the household to stay on the family land. Moreover, the data also indicate, although these results are not shown, that the schooling level of the farmers played no role in either altering the effects of rainfall on profits or in
determining the level of profits. Where there are few or no innovations to learn about, the skills provided by formal schooling are evidently not profitable.

**Figure 3. Relationship of Farm Profits to Rainfall, by Farmer Experience**

![Figure 3](image)

**Risk-Diversification Gains from Marital Mobility**

While figures 2 and 3 suggest that specific experience in farming can alleviate some of the adverse consequences for earnings due to shortfalls in rainfall, they also indicate that farm profits are sensitive to rainfall variability even among the most experienced farmers. Farm households thus still need mechanisms to smooth their consumption in the face of *ex post* earnings fluctuations. As discussed earlier, having family members who reside some distance from the household can potentially contribute to consumption-smoothing by pooling earnings from spatially diversified income sources. If there is such pooling, then
transfers of income should be observed to originate from outside the villages of the households and not from nearby neighbors and in particular from the destination households of married daughters and the origin households of the wives of the men in the household. The ICRISAT data provide information on the approximate location of transaction partners for many of the transactions undertaken by the surveyed households, which can be used to ascertain if transfers are locally based.

Table 1 compares the origin, by location, for three types of income for the three ICRISAT villages with the longest time-series of information on transactions (ten years). These numbers indicate that the likelihood of a transaction originating outside of the village is three times higher for a transfer than for crop sale and a transfer is four times more likely to originate outside the village than is the sale of labor services. Moreover, among transactions with partners residing outside the village, income transfers originate the farthest from the village—three times farther than the external purchasers of crops and almost four times farther than the employers of labor.

Table 1. Location of Origin of Income, by Type, in Three ICRISAT Villages

<table>
<thead>
<tr>
<th>Income type</th>
<th>Total number of transactions</th>
<th>Value share from outside of village</th>
<th>Mean distance to source (kilometers)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transfers</td>
<td>3,000</td>
<td>58.7</td>
<td>24.9</td>
</tr>
<tr>
<td>Daily labor</td>
<td>10,940</td>
<td>24.8</td>
<td>6.5</td>
</tr>
<tr>
<td>Sale of crops</td>
<td>13,083</td>
<td>19.0</td>
<td>8.3</td>
</tr>
</tbody>
</table>

SOURCE: Rosenzweig (1988b)

Although there is no information in the ICRISAT data on the identity of transaction partners, the issue can be addressed indirectly. One way to do this is to ask whether households who are more successful in smoothing consumption are those with a greater number of marital “connections,” as indicated by the number of married women in the household. If such marriage-based income-pooling schemes are important, then one should observe that adding married women to the household reduces consumption variability. Information on annual consumption is available for each household and can be used to com-
pute, over a ten-year period, the variability in consumption for each household. Similarly, based on annual profit information, a measure of household-specific profit variability can also be constructed.

If households can perfectly smooth their consumption, then there should be no relationship between the variability in earnings or profits that they experience and the variability in their consumption. On the other hand, if households cannot smooth at all, consumption variability will be identical to earnings variability. Figure 4 charts the extent to which actual consumption variability deviates from perfect consumption-smoothing (no variability) for households classified by the number of married women in them and by their inherited wealth. The figure shows that households least successful in smoothing consumption ex post have the highest deviations and the tallest bars.

Figure 4. Percent Deviation from Perfect Consumption-Smoothing

The first bar on the left depicts the shortfall from perfect ex post consumption-smoothing for a household with no married women and no inherited wealth; for this household, approximately 68 percent of profit variability is carried over into consumption variability so that the household’s consumption variance deviates from perfect consumption-
smoothing by 32 percent. The next two bars represent the extent of consumption-smoothing for otherwise identical households, in terms of landholdings, total number of adult males and females, and levels of schooling, but with one and two (resident) married women who came from a household located in the village, respectively. These households, as can be seen, experience less consumption variability than the first household with no married women, by about 7 percentage points for the household with two married women.

The next two bars show what would happen in a household with two married women if the average distance of the origin household from the village of the respondent household was to increase to 30 and 60 kilometers, respectively. As can be seen, increasing the distance between households does also reduce consumption variability, although the effects are smaller than the creation of household ties via marriage as represented by the presence of married women.

Finally, the last bar shows the extent to which the addition of capital to a household with no married women also reduces the impact of earnings variability on consumption variability. In this case, it is the effect of providing the sample mean inheritance of 79,000 (1984) rupees, or about $4,000, to the household with neither wealth nor married women. The height of this bar indicates that this amount of wealth, coincidentally, has almost the exact same impact of the degree of ex post consumption-smoothing as does having two married women in the household with origin families located 60 kilometers away. In terms of improving a household's ability to smooth consumption in the face of earnings variability, these married women are equivalent in value to having an inheritance of 79,00 rupees! This last “experiment” also demonstrates that increased wealth, which is one consequence of economic growth, is a substitute for the informal risk-pooling scheme associated with marriage.

Consequences of Agricultural Technical Change for Schooling Investments and Household Stability

I turn now to the evidence on how technical change affects the returns to schooling and family stability exploiting the geographically
selective nature of the green revolution in India and, in particular, the identification by the Indian government of specific districts in which such technology would yield the greatest productivity gains, the IADP districts. How successful was the Indian government in identifying where growth would be most rapid? In this case, the areas selected do appear to have grown more rapidly than did other areas as a whole. Figure 5 plots the ratios of indices of aggregate output to 1960 levels in IADP and non–IADP areas from 1960 up to the survey date. As can be seen prior to 1967, output movements in both IADP and non–IADP districts were similarly affected by weather variation and did not exhibit growth. After 1966, however, output grew at a higher rate in the IADP areas and the similarity in movements is attenuated, reflecting in part the different agricultural technologies being used. Moreover, adoption rates of the new high-yielding grain varieties in IADP areas were significantly higher than elsewhere as of 1970–71 and real agricultural wage rates in the decade between 1961 and 1971 rose by 24 percent in IADP areas compared to 6.4 percent in non–IADP areas (Rosenzweig 1990). Thus, the IADP areas were, at least up to the time of the survey, experiencing higher rates of growth in earnings after the onset of the green revolution.

Figure 5. Ratio of Aggregate Output to 1960 Output in IADP and Non-IADP Districts
It is, of course, not possible to know on the basis of the 1968–71 NCAER-ARIS data, collected approximately eight years after the introduction of higher-yielding seeds, whether the returns to schooling rose more in districts where farmers directly benefited from the new technologies, because we only have cross-sectional evidence. The evidence does suggest that rates of return to primary schooling in 1970–71 were higher in the IADP areas, but they may also have been higher in 1950 or 1960 as well (Rosenzweig 1990).

On the basis of school enrollment data for children and schooling attainment information for adults in the 1970–71 survey, however, a retrospective history of schooling investments can be reconstructed. It is thus possible to ascertain if schooling investments rose more in the IADP districts since the onset of the green revolution compared to non–IADP districts. By comparing the pre- and post-green revolution schooling investment rates in the IADP and non–IADP districts, aggregate trends in schooling over the 1961–71 period are effectively “controlled for.” This intertemporal comparison from the cross-sectional survey data can be accomplished based on the fact that members of households aged twenty-five and above in 1971 who attended primary school would have completed their primary schooling prior to the introduction of the new high-yielding grain varieties, while those persons aged ten to fourteen in 1971 who attended primary school would have completed their primary school education after the green revolution began.

Figure 6 shows the changes in the percentage of male illiteracy in farm households in the non–IADP areas and in the IADP districts before and after the beginning of the green revolution. The figure shows that male illiteracy was lower in the IADP districts before the new technologies were introduced. This pre-1961 difference in literacy could not therefore have been caused by the growth induced by the subsequent availability of the new grain varieties. However, the figure also reveals that the proportion of men who were illiterate fell more after the new technologies were first introduced in the IADP areas compared to the non–IADP areas, which experienced considerably less growth: the proportion of men who were illiterate in farm households decreased by 14.5 percentage points, a 56 percent drop, in IADP districts, and by 12.1 percentage points, a 30 percent drop, in non–IADP districts. The cohort data thus indicate that increases in the pace of
development, fueled by exogenous technical change, lead to increases in human capital investment, consistent with the hypothesis that technology growth raises the returns to schooling.

Figure 6. Male Illiteracy in Non–IADP and IADP Districts: 1961 and 1971

Non–IADP Districts

<table>
<thead>
<tr>
<th>Percent illiterate in 1961</th>
<th>Percent illiterate in 1971</th>
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<td>50</td>
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IADP Districts

<table>
<thead>
<tr>
<th>Percent illiterate in 1961</th>
<th>Percent illiterate in 1971</th>
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<td>50</td>
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It is also possible to compare the pre- and post-green revolution cumulative fertility experiences of comparably aged women in the
IADP and non–IADP districts using a similar cohort analysis based on the retrospective fertility rosters of the married women in 1970–71 to see if families were getting smaller as a consequence of technical change. The children born to women aged twenty-five to thirty-four in 1971 in IADP districts should almost wholly reflect the green revolution experience, while the cumulative fertility of women aged twenty-five to thirty-four residing in IADP districts in 1961 and that of women aged twenty-five to thirty-four residing in non–IADP districts in either 1961 or 1971 should not have been directly influenced by the new technologies. Figure 7 plots the cumulative fertility (children ever born) of women aged twenty-five to thirty-four in the IADP and non–IADP districts for the years 1961 and 1971. The figure suggests that there were substantial effects on fertility associated with the introduction of technical change. While cumulative fertility was higher by almost one-third of a child in the IADP districts compared to the non–IADP areas in 1961, the cumulative fertility rates fell by much more over the subsequent decade in the IADP districts—from 3.44 children to 3.04 children in the IADP districts compared to a fall from 3.11 to 3.03 children in the rest of India. By the end of the 1960s, fertility in the IADP and non–IADP areas was virtually the same.

Figure 7. 1961–71 Change in Fertility: Women 25–34 in IADP and Non–IADP Areas
Do the declines in fertility reflect the reduced return to larger families from risk-spreading and the reduced stability of households? The evidence based on the 1968–71 NCAER-ARIS data suggests that households in the IADP districts were significantly less likely to receive a financial transfer than households in non–IADP districts experiencing the same shortfalls in income and with the same household structure. However, again, the lower efficacy of income-pooling in the IADP districts observed in 1968–71 may have existed before the onset of the green revolution; before and after evidence is needed.

Two new findings on the change in the stability of landholdings and in family structure are associated with the introduction of new grain varieties. First, as noted, new varieties of two principal crops, sorghum and cotton, were introduced in two of the ICRISAT villages in 1981. Prior to that year, over the 1975–1980 period, 4.8 percent of households sold land in a typical year. After 1981, based on information in the years 1982–84, 6.3 percent of households sold their holdings. This increase in land divestment is consistent with the erosion of the returns from specific experience associated with new technologies.

Figure 8. Proportion of Households Splitting in Non–IADP and IADP Districts, 1971–1982
A second and more important piece of evidence is from a preliminary look at newly available data from a 1982 follow-up survey undertaken by NCAER, which reinterviewed a subset of the original 1970–71 NCAER–ARIS households. By matching the two surveys for households in which the head was still alive in 1982, it is possible to discern which households split over the 1971–82 period, where a “split” household is defined as one in which an adult male has left permanently. The results of this preliminary matching, performed jointly with Prem Vashishtha of NCAER, are shown in figure 8. It indicates that in the non–IADP districts, the proportion of households that split was 29 percent less than the proportion who split in the IADP districts subsequent to the initial survey in 1970–71—16.8 percent of households split by 1982 in the non–IADP districts compared to 21.6 in the IADP districts. These differences in the probability of break-up were not due to either differences in initial wealth across the two areas, as indicated by landholdings in 1970–71, or to differences in the schooling attainment of heads in 1970–71, as the results are unaffected by controlling for these household characteristics.

Conclusion

In this essay I have briefly discussed some of the connections between economic development, the family, and the returns to human capital. The evidence from the Indian experience, in which economic growth in the rural sector was propelled by exogenous technical change starting in the mid-1960s, appears to suggest that a fuller understanding of changing family arrangements and family values cannot be achieved without attention to the economic problem of security facing households and to the effects of economic growth on the relative rates of return to formal schooling and experience. An examination of Indian data soon after the beginning of the revolutionary transformation of agriculture, from a relatively stable, tradition-based regime to one which is dynamic, suggests that technical change can have important destabilizing effects on basic institutions such as the family by reducing the returns to experience and by making
risk-spreading arrangements among family members more difficult in an environment of increased uncertainty.

There are some general implications for policy from these findings. First, it is notable that the significant decline in fertility in the growth areas relative to the rest of India occurred without direct governmental intervention. Public family planning efforts were not targeted to those areas. When lower fertility is a public goal, such efforts are not always necessary if economic growth is significant. On the other hand, the demand for services that a family planning program would provide was evidently higher in the high-growth areas. Moreover, the less substantial relative increase in schooling may in part reflect a lack of response in terms of school facilities. Given the Indian government’s prescience in selecting areas of potential growth, it would appear that an anticipatory reallocation of public resources aimed at facilitating schooling, fertility reduction, and, perhaps, increasing income security would have been desirable. Indeed, it is hoped that the further study of the consequences of economic growth for family relationships and for human capital investments will provide a more effective basis for formulating policies that will mitigate some of the problems associated with adapting to the new, and less stable, circumstances a high-growth regime entails.

NOTES

1. See Rosenzweig and Binswanger (1993) and Rosenzweig and Wolpin (1993) for studies of how weather risk alters the allocation of productive durables in Indian farming and the consequences of different production portfolios.

2. The intergenerational gains from specific experience are more formally modeled in Rosenzweig and Wolpin (1985).

3. The relationships between the distance between the ICRISAT villages and the intervillage correlations in rainfall and farm profits are positive and statistically significant (Rosenzweig 1988b).

4. Only households experiencing at least one good-weather year were selected for this analysis. In the crop year 1968–69, 59 percent of households were in a village that experienced adverse weather; the percentages for the subsequent two crop years were 27 and 14 percent, respectively. For details, see Rosenzweig and Wolpin (1985).

5. For details on the estimates underlying the figure, see Rosenzweig (1988a).

6. The figures are computed for farmers at age fifty, with otherwise average schooling and landholdings in the sample.

7. The estimation procedures used to obtain the results in the figure are described in Rosenzweig and Stark (1989).

8. The construction of the output series for the districts included in the NCAER-ARIS survey is described in Binswanger, Khandker, and Rosenzweig (1993).
References


