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Jonathan Morduch

Two observations are essential to understanding the market structure of most low-income economies. First, many markets do not exist and, of those that do, many work imperfectly. Second and more optimistically, a wealth of behavioral and institutional responses often emerge to fill in the holes left by market failures. These responses can be so varied and plentiful that it is natural to ask whether real holes remain in the effective market structure. Nowhere has this question figured more prominently than in recent work on risk and credit, and the answers have surprised many observers. The emerging consensus of the empirical literature is that holes in effective insurance and credit markets exist, especially for the poorest households. But, in general, the holes are a good deal smaller than many had assumed, and many better-off households seem to face few holes at all.

The results have clear policy implications. If, when taken together, markets and alternative mechanisms do indeed provide reasonably good insurance and credit, publicly provided financial services and social security could crowd out private efforts with limited net gain to society (for example, Cox and Jimenez, 1992), just as has sometimes been argued in the United States (Feldstein, 1974). The argument of course hinges on the empirical strength of the claim and on the efficiency of private versus public action.

I focus here on one set of issues that both leads to reconsiderations of the empirical claims and suggests that available means of coping with risk can be very costly for households in low-income economies. The concern is with one

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particular set of risk-coping strategies, those involving risk mitigation through production and employment decisions. Coping with risk can occur at two stages. First, households can smooth income; this is most often achieved by making conservative production or employment choices and diversifying economic activities. In this way, households take steps to protect themselves from adverse income shocks before they occur. Second, households can smooth consumption by borrowing and saving, depleting and accumulating nonfinancial assets, adjusting labor supply, and employing formal and informal insurance arrangements. These mechanisms take force after shocks occur and help insulate consumption patterns from income variability.

One cannot simply look at the smoothness of consumption and know which type of smoothing mechanism is at work. Indeed, the two types can act as substitutes for each other.[1] While much recent attention has focused on credit and insurance, a great deal of risk is already averted in the course of income generation. One aim here is to highlight the empirical importance of income smoothing in its own right.

A second aim is to illustrate the importance of considering income smoothing in any full evaluation of the functioning of credit and insurance mechanisms. The results of standard tests of the effectiveness of consumption smoothing mechanisms—in which income smoothing is ignored—may be quite far off the mark. Income smoothing is more likely to occur when households anticipate being unable to borrow or insure. Because households choose safer production techniques, they may be able to limit exposure only to income shocks that can be handled with the means available. Those mechanisms could then appear to perform without constraint, but we cannot say that if households undertook new, riskier opportunities, they would be as well protected. Holes may remain in the effective market structure, but because households go out of their way to sidestep them, we are much less likely to see households in trouble.

A third aim is to illustrate some of the costs associated with income smoothing. Mitigating risk through production choices can be costly, since typically expected profits must be sacrificed for lower risk. Moreover, the costs can intensify over time as risk averse households show reluctance in adopting new technologies and taking advantage of new economic opportunities. The

[1]Both types of smoothing are employed extensively in low-income economies, and research has concentrated on both. In contrast, nearly all empirical work on coping with risk in high-income economies considers just consumption smoothing after shocks—although a good deal of income smoothing goes on as well, mainly through choice of occupation. All else the same, we take jobs that provide a comfortable balance of expected earnings and risk. Issues surrounding income smoothing in high-income economies are more difficult to investigate than in low-income economies, however. In the United States, for example, most people choose occupations early in life (and after that income fluctuations are largely determined by forces out of their control). This lack of variation makes the relationship of occupational sorting and consumption smoothing harder to quantify in high-income economies. In contrast, in low-income economies, and particularly in rural areas, the riskiness of income must instead be determined every year—for example, in season-to-season choices about cropping strategies or the intensity of input use.

issues of risk and how it is handled can then be central to understanding broader patterns of income growth and distribution.

Quantifying the Importance of Risk

The potential demand for insurance and credit is high in most low-income economies. Not only are average incomes low, but also they tend to be volatile, largely due to the important role played by agriculture. Fluctuations in weather patterns and commodity prices translate into income shocks faced by farm households, and households are also vulnerable to risk from sources like business failures, recessions, and illness. For example, taking these factors together, the average coefficient of variation of household income faced by farmers is on the order of 40 percent in the set of South Indian villages intensively surveyed over 10 years by ICRISAT, the International Crops Research Institute for the Semi-Arid Tropics (Walker and Ryan, 1990). When considering just farm profits, the average coefficient of variation in the ICRISAT sample has been found to be over 125 percent (Binswanger and Rosenzweig, 1993).

One way to gauge the welfare costs of such risk is to calculate how much money households would be willing to pay to completely eliminate income variability—that is, to have the same average income but with zero variance. Approximately, the fraction of average income that a household would be willing to give up can be calculated as half of the coefficient of relative risk aversion multiplied by the square of the coefficient of variation of income.[2] So, if the coefficient of relative risk aversion is two, indicating moderate risk aversion, and the coefficient of variation is 40 percent, households would be willing to give up 16 percent of their income to achieve perfect smoothing. This can be a large absolute amount for a farm household living close to subsistence levels.

While the calculation overstates the willingness to pay when some consumption smoothing mechanisms already exist, it will understate benefits when there is income smoothing. On the latter score, if the availability of insurance allows households to allocate resources to more profitable ends (which were previously precluded for being too risky), the willingness to pay for risk-sharing

[2]To see this, assume for now that there are no consumption smoothing possibilities at all. Households receive an uncertain income stream $\{y\}$, which has an expected value equal to Y. We want to know the amount of money m that households would be willing to pay so that the utility from receiving $Y - m$ with certainty is equal to the expected utility flowing from the random stream of income. That is, we want to know the m, which solves $U(Y - m) = E[U(y)]$. A second-degree Taylor expansion around Y yields $-mU'(Y) \approx U''(Y)\sigma^2/2$, where risk aversion implies that $U'' < 0$ and σ^2 is the variance of $\{y\}$. Rearranging the terms gives an expression for the fraction of income that households would be willing to give up in order to face no risk (the relative risk premium): $m/Y \approx R[\sigma/Y]^2/2$. Here R is the coefficient of relative risk aversion $(-YU''(Y)/U'(Y))$, and σ/Y is the coefficient of variation.

mechanisms will be increased by the expected gain in income. So, roughly, if 10 percent of expected income is sacrificed presently in undertaking less-risky production activities, the household would instead be willing to pay up to 26 percent of their income for the provision of insurance.

These simple calculations provide a sense of the economic value of closing holes in the effective market structure, but inevitably they miss concerns beyond the direct welfare costs associated with income losses. For example, in investigating child health in rural households in South India, Behrman (1988) finds that because households are not able to smooth consumption, the health of children suffers during seasons before the major harvest, and girls are especially hard hit. Similarly, Rose (1994b) uses nationally representative data from India to show that the survival rate of girls relative to boys increases if income shocks are favorable in the early years of life, a result explained by discrimination coupled with the inability to smooth consumption (consistent with this, the result is stronger for households without land). Similarly, in investigating changes in the body size of children before and after major flooding in Bangladesh, Foster (1995) finds that body size suffers notably for households unable to borrow or insure against the associated income fluctuations. Along a different dimension, Jacoby and Skoufias (1992) find that, again in rural South India, children are often taken out of school in response to adverse income shocks, and this may explain low accumulations of human capital.

These few examples suggest that the costs of imperfect insurance and credit markets may spill widely. They also suggest that thinking only in terms of foregone utils or current consumption may miss much about the importance of the issues at hand. Providing better mechanisms to cope with risk may not only lead to greater efficiency in production, it may also play a role in improving health and education conditions.

Consumption Smoothing and Risk

Given the high potential demand for insurance and credit, how vulnerable do households remain? Taking all coping strategies together, do available mechanisms allow households to smooth consumption in ways predicted by fully functioning markets for credit and insurance? A starting point in answering the question is the economic theory of fully functioning markets. In this "perfect case," households will not be vulnerable to income shocks: all risk should be diversified away so that idiosyncratic or transitory shocks should have no impact on consumption levels.[3]

[3]By focusing on the smoothness of consumption over time, the tests take into account the net contributions of all risk-mitigating mechanisms employed by households, no matter how subtle and difficult they may be to observe in isolation. While the data requirements are steep (the tests require information on consumption and income data for the same households over time), several new data sets have been collected in low-income economies, some of which cover five or more years.

An empirical test of the extent to which this theory of financial efficiency holds is clear enough. If there are complete markets for credit, then transitory income shocks—roughly, shocks that differ from the average over time—should be smoothed away by borrowing and saving, and they should not affect consumption patterns. Thus, run a regression with household consumption as the dependent variable and a household's transitory income as one of the independent variables. The more complete are credit markets, the closer the coefficient on transitory income will be to zero. Alternatively, run a regression with savings on the right-hand side, as Paxson (1992) does in her study of Thai rice farmers, and the coefficient on transitory income should be close to one. (Her point estimates are between 0.73 and 0.83 and not significantly different from one.) A third approach is to run a regression with a measure of the change in consumption between two time periods as the dependent variable. With perfect credit markets, households will borrow and save so that consumption changes reflect the interest rate between the two periods and the rate at which future consumption is discounted (as well as an error term that reflects adjustments made in the second period based on new information about long-term earnings—that is, permanent income).[4] When credit markets are complete, these variables should sufficiently characterize consumption changes, and any other independent variables should take coefficients of zero. When households are constrained in their ability to obtain credit, however, income on hand will also help to explain consumption changes.[5]

The general finding of these sorts of approaches is that consumption smoothing is real and significant—that is, for many households consumption does not track household income particularly well—but consumption smoothing is not complete. For example, in my study of three of the villages surveyed by ICRISAT in rural South India, I find substantial evidence of consumption smoothing among better-off (but still absolutely poor) farmers. Landless laborers and small farmers appear to face substantial constraints in borrowing, however. As Townsend describes in his paper in this symposium, he also finds evidence consistent with extensive, but not perfect, risk sharing in these villages.

[4]Economic theory indicates the relationship for changes in the marginal utility of consumption, but under common utility functions (like the constant absolute risk aversion and constant absolute risk aversion classes), the relationship holds for changes in consumption itself. The functional form of the regression will of course be determined by the assumed form of the utility function. Note that "precautionary motives" for saving can also yield results that are similar to those obtained when there are borrowing constraints. See Deaton (1992) for a critical review of this "Euler equation" approach. Alderman and Paxson (1992) provide a useful synthesis of the recent literature on insurance and credit in low-income economies.

[5]Similarly, if there are complete markets for risk, then idiosyncratic income shocks—that is, shocks that differ from households in the surrounding village or region—should be smoothed through risk sharing among a given population and should not affect consumption patterns (Townsend, 1994; Morduch, 1991). In this case, again run a regression with household consumption as the dependent variable, but this time use idiosyncratic income as one of the independent variables. Again, the more complete are markets for risk sharing, the less impact idiosyncratic variation should have on consumption.

This vein of research has been productive. But notice that the very framework of complete markets assumes away the idea of income smoothing. After all, with full markets for consumption smoothing, households ought to make income-earning choices that produce the highest expected value, and then use mechanisms after shocks occur (credit and insurance) to achieve consumption smoothing as desired. Thus, when we see perfect consumption smoothing, we should also find that production and consumption decisions are separable—production choices should be made to maximize profits without concern for risk. For example, Binswanger and Rosenzweig (1993) find that for the top wealth quartile of households in the ICRISAT villages, where there are no evident constraints on insuring or borrowing, households do not alter production choices or contractual arrangements in a way that would smooth income. In sum, when the assumptions of the benchmark theory are correct, income smoothing can be safely ignored.

But when the assumptions are violated, income smoothing can and should play an important role in dealing with risk. As I find for less well off households in the ICRISAT villages, production choices will be made with an eye to reducing the likelihood that the shocks will happen in the first place (Morduch, 1990).[6] The degree of exposure to income variability should then be thought of as a variable chosen by households, picked with knowledge of which potential income shocks can be handled with available means. As a consequence, when income smoothing matters, the standard tests of consumption smoothing provide an overly optimistic measure of the effective market structure in risky environments. A full picture is only possible with information on the extent of income smoothing.

Income Smoothing

When full markets for consumption smoothing do not exist, risk aversion can affect how households decide both the composition and nature of income-generating activities. Not surprisingly, many studies point to risk aversion as the culprit when results indicate that households are not maximizing profits. All the same, there are relatively few studies that take the issues head on. The evidence is slowly accumulating, however, that the effect of risk on production (and consequent efficiency losses) can be large, especially with respect to choices made by most poor (and most vulnerable) households. The examples below provide a sense of the variety of ways that households can smooth income.

[6] In addition to being constrained in the extent of insurance and credit available, households might be constrained by high costs. For example, monopolist moneylenders in rural India typically charge rates on the order of 25 percent for three months. Households may then find it worthwhile to smooth income in order to limit outlays for borrowing. Fetzer (1994), however, finds that the evidence for the ICRISAT villages is most consistent with quantity rationing rather than price rationing.

Indeed, many of the studies employ the ICRISAT panel data set from rural South India and thus provide insights into dimensions of behavior of the same group of households.

One method of income smoothing is to favor variability-reducing inputs and production techniques. For example, rice farmers in the ICRISAT study area in South India have been shown to use more labor than would be called for on the grounds of profit maximization alone. On average, their labor use implies a relative risk premium of 14 percent of expected net returns, a figure close to the hypothetical calculation in the example above (Antle, 1987, p. 518). Alternatively, inputs may be used *less* intensively as a way of reducing the level of investment tied up in risky activities. Bliss and Stern (1982, ch. 8) take up this issue in investigating production choices in the closely studied village of Palanpur, in the north Indian state of Uttar Pradesh. They find that fertilizer is a highly productive input in wheat cultivation, but the marginal product of fertilizer remains 3.5 times its price. Farmers could substantially raise expected profits by increasing applications of fertilizer, but by using less fertilizer, investment losses are reduced in bad times. The authors' calculations suggest that the foregone expected profits are most plausibly explained by high levels of risk and risk aversion.[7]

In considering farm profits as a whole, Binswanger and Rosenzweig (1993) consider the impact of risk aversion on a broad set of inputs (again with the ICRISAT data set). They estimate a production function that provides a measure of the impact of riskiness (as dictated largely by the timing of rainfall) on input choice. As the environment becomes riskier, vulnerable households would be expected to shift production into more conservative, but less profitable, modes. Binswanger and Rosenzweig quantify this effect by considering the impact on profits of increasing the coefficient of variation of rainfall timing by one standard deviation. They find that for a household with median wealth levels, farm profits would be reduced by 15 percent, but for the bottom wealth quartile, income smoothing would reduce farm profits by 35 percent. On the other hand, they find that households in the top wealth quartile have adequate ways to cope with risk; as a result, increasing riskiness would have a negligible impact on the profitability of the richest farmers. The inability to cope with adverse shocks can thus exacerbate inequalities that are already wide; in their sample, 54 percent of wealth is held by the top 20 percent of households.

The importance of rainfall timing suggests that it can be wise for households to postpone making investments until they have better information on expected weather conditions. Once it is known that weather will be poor, households may choose to limit production to cut potential losses; as a result, the variability of area cultivated has been found to be higher than yield variability in the ICRISAT study area (Walker and Ryan, 1990, p. 256). While

[7]Moscardi and de Janvry (1977) also point to high risk premia in explaining low fertilizer use in corn cultivation in Puebla, Mexico.

it may help smooth income, waiting to obtain better information can be costly. Bliss and Stern (1982, p. 271), for example, provide an estimate that in Palanpur, delaying the onset of production by two weeks can reduce yields by 20 percent. Similar types of tradeoffs are described by Fafchamps (1993) in his investigation of sequential aspects of uncertainty and labor supply in Burkina Faso.

By considering farm profits broadly, Binswanger and Rosenzweig (1993) take into account multiple aspects of household choice that help smooth income. One of the most important choices entails diversification. Engaging in multiple activities need not be risk reducing in itself, of course, since risk can be increased by moving from specialization in a single, conservative activity to undertaking a mix of riskier activities. Thus, the sharpest insights have come from studies that consider instances in which choices clearly entail balancing risk against expected profits. For example, in my study of the ICRISAT villages in South India, I find evidence that households whose consumption levels are most vulnerable to income shocks devote a greater share of land to safer, traditional varieties of rice and castor than to riskier, high-yielding varieties (Morduch, 1990). I also find that the most vulnerable households are more likely to diversify plots, a common means of reducing the impact of weather shocks that vary with location. Insurance motives for plot diversification have also been explored in McCloskey's (1976) research on medieval England, in which he estimates that 10 percent of average income was given up through working a variety of small fields rather than a single, consolidated plot.[8]

Another form of income diversification involves off-farm activity. Rosenzweig and Stark (1989), again using a survey collected by ICRISAT, find that households facing greater volatility in farm profits are also more likely to have a household member employed in steady wage employment. Similar relationships between income shocks and labor supply behavior have been investigated by Kochar (1992) and Rose (1994a) in national samples from India. In an interesting study of migration in Thailand, Paulson (1995) finds that of migrants who remit income back to family members in their home province, there is a greater tendency to move to Bangkok if income patterns in Bangkok and the province of origin are less correlated—a pattern consistent with insurance motives for migration.

Perhaps the most extreme case of income smoothing through labor market activity is given by Bardhan's (1983) analysis of "tied labor." His study takes on the notion that permanent labor contracts are inefficient relics of an age when slavery was condoned. Such contracts involve long-term relationships between employers and employees at steady but low wages (in contrast to the standard seasonal or daily wage contracts). Tied labor contracts account for roughly

[8]Townsend (1993) provides a broad theoretical framework in which to place the role of risk and plot diversification in the medieval economy. Heston and Kumar (1983) describe alternative explanations for plot diversification. In the ICRISAT surveys, the average number of plots per acre is 0.30, which indicates only moderate diversification (Walker and Ryan, 1990, Table 6.11).

one-third of agricultural labor relationships in surveys of rural India and have been employed in a diverse set of agricultural economies. More than a century after the emancipation of the serfs, for example, tied laborers remained the bulk of the agricultural labor force in Denmark (Bardhan, 1984, ch. 5, p. 78). Bardhan argues that this is because tied labor contracts can be to the mutual advantage of both employers and employees. The permanent labor contracts mitigate the risk for workers of facing low consumption in slack seasons when employment can be hard to find. At the same time, permanent contracts allow employers to minimize the risk of having to pay excessive wages at times of peak labor demand. In this way, workers may be able to achieve near perfect income smoothing for the duration of the contract. As a consequence, even workers facing sharp constraints in obtaining credit and insurance can maintain smooth consumption levels.

Risk Attitudes and the Heterogeneity of Constraints

One problem in testing the effective market structure is that income smoothing and consumption smoothing are difficult to disentangle. The degree of income smoothing will depend on the amount of risk, the degree of risk aversion, and the extent to which other consumption smoothing mechanisms are available. But, as above, measuring the ability to smooth consumption depends on knowing about the degree of income smoothing.

Many studies of income smoothing have taken the extreme position that there are no insurance or credit mechanisms at all (for example, Moscardi and de Janvry, 1977; Antle, 1987). In that case, income translates directly to consumption, and production choice will fully reflect the tradeoff between risk aversion and expected profit maximization. Since profit maximization implies that the marginal products of inputs will equal their prices, measures of risk aversion can be quantified by estimating the degree to which marginal products and prices depart.

But of course, the strong assumption of no consumption smoothing is not often tenable. Even without well-developed financial markets, households will be able to achieve some level of consumption smoothing by accumulating and depleting assets or using nonmarket mechanisms. Given some consumption smoothing, measures of risk aversion taken from these studies will be understated. Findings of risk neutrality in production data may then indicate that the households in question have good consumption smoothing possibilities rather than indicating that the households have no fundamental concern about risk. This provides an alternative explanation for Antle's (1989) surprising finding that farmers in one relatively well-off village in the Indian ICRISAT sample are risk neutral.

Most often, credit and insurance mechanisms will be neither completely lacking nor completely functioning. Transactions costs, information problems

(like moral hazard), and difficulties in enforcing contracts, however, can limit their effectiveness. Future work that aims to understand observed income and consumption patterns better will need to begin with a better understanding of how these constraints determine which households will be best served by available institutions and markets. If there are fixed transactions costs per loan, poorer households (which desire smaller-scale loans) are then likely to have a more difficult time borrowing than richer households. Similarly, moral hazard and enforcement problems may be more likely to hurt poorer households than richer households. For now, sorting out how and why heterogeneity matters remains an item on the research agenda.

Simplicity and Complexity in Low-Income Economies

Many varied mechanisms exist for dealing with risk. Individuals and households in low-income countries have been innovative in finding ways to protect themselves, given that they are often in situations where formal financial markets are deeply limited or missing altogether. And, as our understanding of the role of risk has improved, institutions and practices that had once seemed illogical and inefficient, like permanent labor contracts, have been shown to offer valuable ways of coping in uncertain environments.

The examples here illustrate how understanding economic mechanisms in low-income economies, especially rural sectors, can be both more simple and more complex than understanding those in large, fluid, well-integrated economies. The simplicity is obvious. Many markets are missing, spatial integration is limited, and income is often generated by a straightforward, readily specifiable production process—often traditional farming where the distribution of weather shocks is well known and varies little over time. Thus, economic choices faced by households are frequently discrete and describable: Which crops to plant? How much fertilizer to use? How much money to borrow in a drought year? Many real low-income economies in fact look reasonably close to the abstract, theoretical worlds constructed as rhetorical devices to explain the design of institutions and contracts under uncertainty and imperfect information. The simplicity can provide an opportunity to study the behavior of households and the functioning of institutions in something close to a controlled environment; this has even led some to speak of villages as "economic laboratories."

The simplicity obscures an important dimension of complexity, however. With so many missing and incomplete markets, the nonseparability of choices in different spheres is the rule rather than the exception. Here, we have seen how risk aversion and market imperfections create a fundamental nonseparability between consumption and production choices. While it is in examining these nonseparabilities that hidden rationalities of behavior and the economic sophistication of institutions emerge, they can also make analytical work more

difficult than that on high-income economies. Sectors can less plausibly be left out of analyses and, most important here, fewer household choices can be taken as exogenous to a particular decision.

Ironically, the applied nature of development economics and the element of simplicity noted above has led some to eschew using sophisticated formal tools in analyzing low-income economies. Mounting evidence shows that, to the contrary, the appropriate tools for understanding the nature of contracts and behavior in the face of missing markets must often be more sophisticated than those for studying economies with rich, fully integrated markets where separability can be plausibly assumed. Only by continuing to try to better appreciate the complex weave of income smoothing, insurance, and credit mechanisms will we be most able to understand the limits to and possibilities for economic progress in low-income economies.

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