Introduction

Rural households in developing countries face a substantial risk of income variability. Risk considerations are more important for poor farmers in these regions because their income is low and formal insurance arrangements are seldom available. Once they encounter adversity, they may have no other means but to sell their valuable assets, as a result of which, transient poverty might become permanent.[1]

To avoid the worst scenario, households facing limited insurance arrangements use various mechanisms of consumption smoothing. This topic now comprises a large and expanding literature in development economics. Households can make ex ante arrangements to reduce uncertainty over income realizations, such as through diversification of economic activities, institutional arrangements including interlinked transactions and sharecropping, and use of risk-reducing inputs or investments in production. They can also make ex post adjustments to smooth consumption contingent on realized outcomes, such as through borrowing and lending, drawing down of assets, remittances, and mutual reciprocity.

Why are these mechanisms important as a development issue? Theoretically, this literature raises a key question relating to development economics—whether markets and institutional arrangements are able to achieve optimal allocation of resources, and, if not, how policies can alleviate the deficiencies. Among the resources to be allocated, the literature especially deals with allocation of risk-bearing. Improving insurance is expected to have

favorable dynamic effects, such as improvement in average efficiency and in equity since the welfare cost of incomplete insurance markets is high for the poor.

This study deals with the behavior of agricultural households under uncertainty. The term agricultural households (or farm households interchangeably) in this study refers to those who operate farmland, including tenant households, but not including agricultural laborer households. Unlike rural households without production assets, agricultural households can control their exposure to risk by adjusting farm production. How do households' characteristics affect production choices and how do their individual decisions affect and are affected by the incompleteness of rural market structure? These are the central questions of this study, which are thoroughly investigated for the case of Pakistan's agriculture.

Several issues are derived from these central questions. How variable are income flows from agricultural activities, given production technology and environment in the study area? How variable are the market prices of agricultural commodities, given marketing institutions? How can a decision model of household production under uncertainty be estimated from actual observations? Do observations support theoretical predictions? How substantial is the welfare cost of risk? How do farmers respond to a change in market and technological environments? Each of these issues is covered in the following chapters.

The major contribution of this study to development economics lies in its modeling strategy. In analyzing the production behavior of poor farmers in developing countries, effects of incomplete insurance markets and considerations for household food consumption should not be overlooked. This study incorporates the two issues in a theoretically consistent, estimable household model. Estimation results will show that, when both income and consumption prices are stochastic, households' production choices are affected not only by their willingness to bear risk but also by their ordinal consumption preferences for individual goods. Households' willingness to bear risk reflects their risk attitudes and the extent to which consumption smoothing arrangements are available.

At the same time, this study attempts to derive policy implications that are relevant to rural development issues in Pakistan. As is the case in many countries that experienced rapid economic growth, Pakistan experienced a shift in agricultural composition toward livestock products during the 1980s. Rising demand for livestock products is one of the reasons for this change. Nevertheless, existing studies on Pakistan's agriculture have rarely investigated microeconomic supply mechanisms underlying this change. This study at-

tempts to fill the gap by explicitly examining interactions between crops and livestock within a farm. Empirical investigation will show that the livestock sector is key to Pakistan's rural development, especially in enhancing poor households' welfare, and that the price risk of green fodder (bulky and perishable commodity) severely constrains land-poor farmers' crop choices.

The objective of this study is, therefore, to show how a theoretically consistent household model can be applied for the dual purpose of verifying the theory and of providing insights into policy issues. Whether or not the dual goal results in satisfactory achievements will be left to readers' judgment. Every chapter is made self-explanatory and re-verifiable by interested readers as much as possible. All the data and computational files used in this study are available on request for re-verification. The author believes that the methodology can be applied to other situations in developing countries also and that policy insights in this study are relevant to similar environments as well, especially in the north-western part of India.

Finally, several caveats should be mentioned. Microeconomic investigation in this study covers agricultural households only. Nonagricultural households in rural Pakistan, who depend on farm and nonfarm wage labor, comprise a large proportion of the rural population in Pakistan and the incidence of poverty is higher for them than for agricultural households (Hirashima 1978, chap. 8; Hirashima and Muqtada 1986). It is the author's intention to supplement the current volume by a future study on risk and household decisions by nonagricultural households in Pakistan. Similarly, the issue of interaction between risk and poverty is not explored further in this volume. The concluding chapter reexamines these issues and gives future research directions.

The book proceeds as follows. Chapter 1 provides a brief review of the development economics literature on risk and household decisions. It aligns the theoretical and empirical models in this study in a broader perspective. Empirical environments and sample households are described in Chapter 2. Chapter 3 investigates production technology and estimates the variability of crop yields per acre. In Chapter 4, the variability of market prices of agricultural commodities is examined, with a description of marketing institutions in the study area. In Chapter 5, the estimates in Chapters 3 and 4 are combined to derive parameters that characterize variability in net-profits at the individual farm level. The profit variability at the farm level has seldom been analyzed for Pakistan's agriculture in the existing literature.

In Chapter 6, a dynamic model of household behavior under uncertainty is proposed. Its empirical version for crop choices is then estimated to investigate whether or not observations support the theoretical predictions. A full-information maximum likelihood method is applied to a system of structural

equations, using both household and market environment data. Chapters 7 and 8 raise the questions of how substantial the welfare cost of risk is and how it is related to the market evolution in rural areas. They focus on the role of livestock in a household economy and clarify constraints faced by households due to thin green fodder markets. The last chapter concludes the book with theoretical and policy insights obtained from this study and suggests directions for further studies.

This study originated in the author's doctoral dissertation at the Food Research Institute, Stanford University (Kurosaki 1995b). Texts and materials in this book were, however, completely rewritten after reanalyzing the whole materials. Many theoretical and methodological details were omitted, for which references were made to corresponding chapters in Kurosaki (1995b). Descriptive details were added, especially in Chapters 2 and 3 of this book, which would help to understand the household economy in the study area. Some of the contents in Chapters 3 to 8 have been published elsewhere (Kurosaki 1994, 1995a, 1996a, 1996b, 1996c, 1997). In such cases, the original texts in these publications were revised to fit in with a chapter of this book and relevant references were made to clarify the relationship.

Note

1 See Ravallion (1988); Lipton and Ravallion (1995); Ravallion, van de Walle, and Gautam (1995); and Jalan and Ravallion (1996a) for the distinction between transient and persistent poverty and the effects of risk and poverty eradication policies on these types of poverty.