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Household Decisions under Uncertainty and Rural Development —Concluding Discussion

In this book the incidence of risk and its relationship with household decisions were investigated for the case of Pakistan's agriculture. The central questions are how households' consumption characteristics affect production choices, and, how their individual decisions are interrelated with the incompleteness of the rural market structure. Since most of the previous chapters contained a section that summarized the findings, this concluding chapter does not repeat them. Rather, findings scattered in chapters are reorganized into the two themes of this study. In the first section, theoretical and methodological issues are discussed, with emphasis placed on the evolution of rural markets and its relationship with households' decisions. In the second section, insights into policy issues obtained from this study are discussed, which are relevant to economic development issues not only in Pakistan but also in the north-western part of India. Each section contains discussions on the limits and shortcomings of this study and suggestions for future research directions.

I. Household Decisions under Uncertainty and Incompleteness in Rural Markets

1. Modeling Household Decisions under Uncertainty

In the recent literature of development economics, the effect of risk on household welfare has regained attention. Based on models of optimal intertemporal consumption, the topic on how households allocate resources

under risk and under incomplete insurance markets has been investigated extensively (Chapter 1). Several characteristics of this new line of literature are worth reviewing. First, theoretical models are rigorously based on the microeconomic theory of agent's optimization. Second, empirical models are derived from these theoretical models. And, third, these empirical models are tested using high quality data such as the ICRISAT data from India. These studies so far have yielded ample information about two aspects: the performance of risk-coping mechanisms on the consumption side; and the functions of risk-management strategies on the production side. However, there are only few attempts that explicitly address the interrelationship between risk-coping mechanisms and risk-management strategies (e.g., Morduch 1995, 1990; Rosenzweig and Wolpin 1993; Rosenzweig and Binswanger 1993).

In this study an agricultural household model was constructed that links the intertemporal model of risk-coping with the risk-management strategies on the production side. The household model is able to incorporate in a theoretically consistent way the effects of incomplete insurance markets and the considerations for household food consumption. When deciding on a production plan, a household is modeled in assuming that it takes into account the two risk-management effects of growing a certain crop: its effects on the variability of household income (the smaller the better) and its effects on the covariance between consumption prices and household income (the larger the better).

How strong is each of these considerations, as well as orthodox considerations for relative profitability and technological constraints? This is determined by household consumption characteristics, which are represented by ordinal consumption preferences and households' willingness to bear risk. An important distinction is made in this study between households' innate risk attitudes and their willingness to bear risk. The former refers to the shape of households' instantaneous indirect utility function. The latter reflects the mixture of the former and the extent to which consumption smoothing arrangements are available. For instance, when a perfect risk-coping mechanism is available, households may behave as if they were risk neutral regardless of their innate risk attitudes. On the contrary, when households have no risk-coping mechanisms at all, their willingness to bear risk is equal to their risk attitudes. The model in this study is comprehensive enough to include both situations.

2. Empirical Support for the Model

An empirical version of the household model has been estimated using microeconomic data from the Pakistan Punjab (Chapter 6). The estimation

enables us to test whether these theoretical predictions are supported by observations and to examine how households behave under parametric situations different from the actual, observed situation.

Structural parameters of the household model have been estimated in a reasonable range, with systematic variation depending on household characteristics. Model specification tests have demonstrated the superiority of the model with ordinal preference effects against a model of risk-averse households that maximize expected utility defined on income alone or a model of expected profit maximization under complete insurance markets. In other words, ordinal consumption preferences do affect household crop choices even when markets for foods exist.

An important finding from the estimated household model is that holding wealth in the form of livestock increases households' ability to smooth consumption so that they become more willing to bear risk in production. Livestock animals themselves could work as *ex post* insurance to smooth consumption. The liquid nature of livestock assets helps households to smooth consumption, as has been modeled for semiarid India by Rosenzweig and Wolpin (1993). In addition, estimation results from per-unit profitability in Chapter 5 have shown that holding livestock animals in a farm gives households an opportunity for *ex ante* risk management through the negative correlation between fodder profits and milk income. Risk-mitigating effects of livestock holding via these two routes have been confirmed in Chapter 7 through an income decomposition analysis. The findings in this study have shown that sample households have some risk-coping mechanisms and adopt some risk-management strategies but still cannot stabilize their consumption level completely mostly due to insufficient channels for sharing aggregate risk at the village level with the rest of the world.

3. Household Decisions and Rural Market Evolution

When considering the development process of a rural economy, it is useful to start with autarky in which all households are self-sufficient in goods and services. When a new opportunity for trade opens, it usually implies that there is an opportunity for households to enhance their welfare by participating in the markets. Then to what extent will households participate in the new markets? If very few participate, it implies the presence of thin markets, which are not attractive to households; if most of them participate, the markets become deep and the prices become stable.

One important implication from the findings in Chapter 6 is that households' ability to smooth consumption *ex post* and households' ordinal consumption preferences for goods should affect households' production and

marketing behavior. When markets for some consumption goods are completely missing, farm households have to produce these goods by themselves according to their ordinal preferences. When ex post risk-coping mechanisms are not available at all, households have to decide on their production plan according to their risk attitudes. When only thin and risky crop markets are available and insurance mechanisms are not sufficient, households still find it advantageous to grow consumption goods on their farms as a hedge against price risk and to choose less risky crop portfolios. Households choose to participate in market transactions only marginally, according to their consumption preferences and their willingness to bear risk.

The similarity between thin markets and missing markets has been revealed more clearly for green fodder markets in the Pakistan Punjab. Simulation results in Chapter 8 predict a seemingly reversed supply response—households would reduce the area devoted to fodder crops when their market prices become more stable. This occurs because risk-averse farmers grow fodder crops to avoid input price risk in milk production. Simulation results have shown that, as the market for fodder becomes more elastic, considerations for input price risk become less important and the supply response of market-oriented cereal crops becomes more elastic.

These results have an important implication for the studies on policy reforms that emphasize the market mechanism. For instance, liberalization of produce markets would not enhance the supply capacity of a developing country appreciably, when market incompleteness is prevalent in inputs, factors, or consumption-insurance markets. This study has shown the importance of modeling the whole set of market failures that are relevant to the issues concerned. The set includes the conditions of markets that are purely on the household consumption side, even when the policy interests are on the production side.

4. Directions for Further Research

This volume has shown that rigorous modeling of production decisions under uncertainty helps to understand the behavior of agricultural households in developing countries. Major limits and shortcomings of this volume are that several dimensions of household production decisions under uncertainty were ignored in order to concentrate on the issue of crop choices and to be able to handle the empirical model. Among them, endogenizing the size of livestock herds and introducing inter-seasonal and inter-annual production adjustments are promising extensions, particularly to understand the dynamics of the household economy. Modeling these dimensions in a dynamic framework is left for future research. The household adjustments to various risks

shown in this study would be useful in exploring these directions. It is expected that the volatile nature of fodder markets would affect the value of milk animals and farm land in a completely dynamic framework also.

Extension to the real dynamics of production assets deserves further study because of the linkage of risk and poverty also. To understand the dynamics of poverty, it is necessary to incorporate risk factors in a rigorous way. This study provides the first step to understand theoretically the linkage of risk and poverty in developing countries.

II. Implications for Development Issues in South Asia

A general implication of this study for agricultural policy analysis is the importance of modeling interactions of risk considerations in household decisions. The effect of price or yield risk of a particular crop on production decisions cannot be analyzed separately from other income-generating activities and the preferences of households. If these interactions are ignored, the adoption of a new technology for a particular crop, for example, would be solely determined by comparing the distribution of its profit under old and new technologies. However, the covariance of its profit and consumption prices or the covariance of its profit and other income sources such as livestock income might be more important in determining production choices.

Regarding development issues in South Asia, this book has provided a number of interesting findings. Among them, the most important is that this study has quantified in a theoretically consistent way the incidence of production risk and the importance of livestock animals in a household economy in the Punjab agriculture.

1. Incidence of Production Risk and Its Implications

In Pakistan's agriculture, variability in net profits at the individual farm level has seldom been analyzed. This study has shown that profit variability at the farm level is much higher than the variability implied by the variability of prices or regional aggregate yields (Chapter 5). Net profits from cereal crops are more stable than those from fodder crops mostly due to the effects of government support-price policies for cereals (Chapter 4). Nevertheless, profits from cereal crops do vary significantly. The coefficient of variation has been found to be larger than that estimated for India's semiarid agriculture where yields are very unstable under rain-fed conditions. This study has found that irrigated agriculture in Pakistan is also confronted with profit variability due to high input costs and idiosyncratic yield shocks (Chapter 5).

Net profits from green fodder crops fluctuate in a more volatile way than

those from cereal crops. However, since the correlation between green fodder profit and milk profit at the individual farm level is substantially negative because green fodder is the most important input in milk production and its price is the most volatile, households can internalize this risk by promoting self-sufficiency in green fodder crops. In the past studies, the advantage of combining fodder production and milk production in a farm has been analyzed from the viewpoint of saving transaction costs of green fodder. This study has demonstrated that this advantage exists even when the differential between selling and buying prices is negligible as long as fodder prices are volatile and farmers are risk-averse.

However, this strategy of risk management through crop choices has a limitation in a sense that the production plan that maximizes expected profit cannot be chosen. Here lies the welfare loss due to foregone income. At the same time, risk-management strategies and risk-coping mechanisms used by sample households are not sufficient to enable them to completely stabilize income or consumption (Chapter 7). Here lies the welfare loss due to variability in the consumption level. Using a theoretically consistent, structural household model estimated in Chapter 6, this study has simulated the effects of risk on household welfare (Chapter 8). Simulation results have shown that the welfare cost of risk lies in the range of 7 to 11 per cent of the initial expected income, the largest proportion of which is derived from the green fodder price risk alone.

These findings imply a potential for policy intervention to enhance households' welfare. This study does not attempt to assess the feasibility of a particular policy intervention, however. Investigation of policy costs is beyond the scope of this study. Nevertheless, this study has shown which area of policy interventions would have the largest potential in enhancing the welfare of agricultural households in the region. Simulation results in Chapter 8 have suggested that a crop insurance scheme is not an efficient way to enhance household welfare, a finding similar to those reported for semiarid India. On the other hand, it has been shown that improvement in green fodder technology, whether on the production side or on the demand side, would enhance household welfare substantially, especially that of smallholders. Improvement in fodder technology is especially important when government procurement prices of cereals are raised. The improvement would offset the negative effects of increased cereal prices on fodder acreage through induced increases in expected fodder prices in local green fodder markets. An implication of this finding is that public investment in fodder technology potentially would be effective in complementing the current price policies in Pakistan.

2. Importance of Livestock and Its Implications

The improvement in fodder technology would enhance the welfare of rural households, especially of poorer sections, because rural households in the Punjab keep a sizable livestock herd and the livestock sector is relatively more important for households with a relatively smaller land asset base. The vital importance of livestock in the household economy in the study area has been repeatedly documented in this study. Most of the existing studies with emphasis placed on the importance of livestock in the Punjab agriculture have focused on the role of income generation, employment generation, draft power provision, and manure and fuel provision. In addition to these roles, this study has clarified and quantified the role of livestock in risk-management and risk-coping strategy for households.

Decomposition of per capita income in Chapter 7 has shown that livestock holding contributes to a reduction in income variability through the negative correlation of livestock income with crop income and through ex post decumulation of livestock assets contingent on a realized income in the crop sector. Estimation results in Chapter 6 have shown that households' willingness to bear risk increases with the size of livestock holding.

Based on a sensitivity analysis (Chapter 8), this study has shown that the structural household model is an effective tool to evaluate distributional effects of a change in production environments among various household groups. Preference parameters vary systematically among households and consumption preferences matter in production choices. Therefore, the sensitivity analysis predicts different supply and welfare effects according to household characteristics. Especially, the welfare costs of risk would be higher for poorer households, such as those with a smaller agricultural land area and those with a relatively larger number of livestock animals.

These empirical results suggest that public research investment in the livestock sector would be highly rewarding. Improvement in efficiency in this sector, either through improved animal husbandry or through improved fodder technology, would enhance the welfare position of households with substantial livestock holding. Since smaller farms have a relatively larger livestock herd in the Pakistan Punjab, the improvement would have an equity-improving effect as well. This study has shown that a welfare aspect of on-farm and off-farm diversification with special attention to livestock should be considered in formulating economic policies in Pakistan.

3. Directions for Further Research

Empirical analysis in this study has been applied to a farming system in the

rice-wheat zone of the Pakistan Punjab. How can the findings from this analysis be applied to other zones in the province and neighboring provinces and states? For zones with a similar technology of artificial irrigation and mixed farming, such as those in other irrigated tracts in the Pakistani provinces of Punjab and Sind, and the Indian states of Punjab, Haryana, and the western part of Uttar Pradesh, basic findings in this study regarding crop-livestock interactions can be applied with minor adjustments. What is critical in this study is the importance of dairy livestock activities carried out in the backyard of farms as an important source of household income. For an agricultural zone with rich alternatives of competing food and fiber crops, mathematical programming methods will be useful to investigate the additional dimension of crop choices. Materials in Chapter 8 will serve as a starting point for such studies.

When applied to the Indian side of the Punjab, including Haryana, where, like in Pakistan, the livestock sector in the household economy has become more important in recent years, two additional issues should be considered. First, since market transactions of green fodder have begun earlier in India's Punjab than in Pakistan's Punjab, insights for the near future situation on the Pakistan side would be derived from a careful investigation into the conditions on the Indian side. Second, the existence of active cooperatives for the dairy sector in India would be another factor that should be investigated carefully. Although it is expected that the major conclusions of this study are applicable to the Indian side also, thorough comparative study that explicitly models these aspects is left for further research.

This study has shown that the structurally estimated household model is able to provide useful information with policy implications. Fully integrating the household model into a sector model and investigating the benefits and costs of a specific policy are left for further research. Particularly promising are modeling local fodder markets in a more rigorous way and specifying the mechanisms through which the government policies affect the price distribution of wheat and basmati rice in local markets.

As an empirical study on risk and household decisions in rural Pakistan, this volume covers only one half of the picture. Microeconomic investigation on nonagricultural households in rural Pakistan is critically needed to understand the dynamics of rural transformation. Farm and nonfarm wage labor, livestock income, and remittances are important income sources for these households. Analytically, the household model in this study can be applied to nonagricultural households by setting the size of farm land to zero. But this simplification would deprive most of the usefulness of the model which is focused on the effects of household preferences on crop choices, a decision

that does not exist for these households. For these nonagricultural households, reward for endogenizing the dynamics of livestock and human capital accumulation is expected to be high. This dynamics, together with an additional adjustment for treating the flow of remittances as stochastic, will help to understand the issue of poverty dynamics in South Asia. The extension in this direction will clarify the importance of policies that promote nonfarm activities in enhancing the poor's welfare. These issues highly deserve future research, in which the author also intends to participate.