RESEARCH REPORT 96

POVERTY, HOUSEHOLD FOOD SECURITY, AND NUTRITION IN RURAL PAKISTAN

Harold Alderman
Marito Garcia

INTERNATIONAL
FOOD
POLICY
RESEARCH
INSTITUTE

IFPRI Research Reports
Publications Review Committee and Procedures

All manuscripts submitted for publication as IFPRI Research Reports undergo extensive review. Prior to submission to the Publications Review Committee, manuscripts are circulated informally among the author's colleagues and presented in a formal seminar. Following submission to the Review Committee, four or five reviewers are selected. At least two reviewers are identified from outside IFPRI and two from inside, including one from the Review Committee. Reviewers are chosen for their expertise in the manuscript's subject matter and methodology and, when applicable, their familiarity with the country setting. The author responds in writing to the reviewers' comments and resubmits the manuscript to the Review Committee after making any necessary revisions. The Review Committee then makes its recommendation on publication of the manuscript to the Director General of IFPRI. With the Director General's approval, the manuscript becomes part of the IFPRI Research Report series.

IFPRI Board of Trustees

POVERTY, HOUSEHOLD FOOD SECURITY, AND NUTRITION IN RURAL PAKISTAN

Harold Alderman
Marito Garcia

Research Report 96
International Food Policy Research Institute
Washington, D.C.

Library of Congress Cataloging-
in-Publication Data

Alderman, Harold, 1948-
Poverty, household food security, and nutrition in rural Pakistan / Harold Alderman and Marito Garcia.
p. cm.— (Research report ; 96)
Includes bibliographical references.
ISBN 0-89629-099-9
1. Nutrition—Pakistan. 2. Rural poor—Pakistan—Nutrition. 3. Health behavior—Pakistan. I. Garcia, Marito, 1951- . II. Title. III. Series: Research report (International Food Policy Research Institute) ; 96.

TX360.P18A434 1993 93-39211
363.8'095491—dc20 CIP

CONTENTS

TABLES

ILLUSTRATIONS

FOREWORD

Designing strategies and policies that will alleviate poverty and improve household food security and nutritional well-being is one of the most important challenges facing government policymakers in developing countries. The choice of strategies and policies depends in large part on understanding the dynamics of poverty, especially the mechanisms by which households acquire and spend incomes and cope with crises such as poor harvests or loss of employment.

This work by Harold Alderman and Marito Garcia represents IFPRI's first comprehensive analysis of the longitudinal data on 800 households collected between 1986 and 1989 in Pakistan. This unique data set enables researchers to examine the temporal dimensions of food security, income and labor dynamics, consumption and savings dynamics, nutrition and health processes, and many other issues that cannot be adequately addressed using cross-sectional data.

The report is part of a wide-ranging series of studies focused on Pakistan. It is the rural component of a Food Security Management Project jointly undertaken by IFPRI, the Government of Pakistan, and the U.S. Agency for International Development (USAID) Mission in Pakistan. An IFPRI field office, based at the Ministry of Agriculture in Islamabad since 1986, indicates IFPRI's long-term commitment to this program. This report represents the microanalysis part of the program, while earlier IFPRI studies, including *Effects of Exchange Rate and Trade Policies on Agriculture in Pakistan*, Research Report 84, and *The Demand for Public Storage of Wheat in Pakistan*, Research Report 77, have tackled macroeconomic issues facing food security. Other major studies in human capital accumulation, agricultural credit, water management, agricultural production, and nonfarm linkages are under way.

The research was carried out in collaboration with the major economic research institutes in Pakistan: the Punjab Economic Research Institute in Lahore, the Applied Economic Research Centre of the University of Karachi, the Centre for Applied Economic Studies at the University of Peshawar, the Department of Social Welfare at the University of Baluchistan, and the Pakistan Institute of Development Economics in Islamabad. The USAID Mission in Pakistan has provided sustained support to this research program.

Per Pinstrup-Andersen
Director General

ACKNOWLEDGMENTS

This research was funded by the U.S. Agency for International Development (USAID) Mission in Pakistan under Contract No. 391-0401-C-00-5073-00. The entire process of this longitudinal study, which included a three-year data collection phase, involved many institutions and individuals. Per Pinstrup-Andersen was instrumental in the initiation and conceptualization of research of the Pakistan Food Security Management Project, under which the present study was undertaken. We wish to thank our main cooperating institutes in Pakistan: Applied Economic Research Centre at the University of Karachi, Punjab Economic Research Institute of Lahore, Centre for Applied Economic Studies of the University of Peshawar, and the Department of Social Welfare of the University of Baluchistan. We are especially grateful to the principal investigators and the survey teams from these institutions who had to bear the brunt of the tedious process of household surveys all year round, as well as to the staff from IFPRI's field office in Islamabad. Special mention needs to be made of the USAID Mission staff who were supportive throughout the various stages of the research: Barry Primm, Zakir Hussain Rana, Richard Goldman, Patrick Peterson, and Thomas Olson. Sohail Malik and Richard Adams of IFPRI provided analytical insights on numerous aspects of the study. We also are indebted to Nadeem Burney, Eileen Kennedy, John Mason, Martin Ravallion, Joachim von Braun, and Richard Sabot for important comments on an earlier draft. We thank the excellent research support staff at IFPRI who assisted in various stages in the data processing of the large panel survey: Devi Katikineni, Helen Garcia, Dipa Nag-Chowdhury, Roberta Almeida, Elizabeth Miller, Holly Hapke, Lisa Smith, Mansoor Gill, and Rita Aggarwal.

Harold Alderman
Marito Garcia

1

SUMMARY

Managing food security in a predominantly rural economy such as Pakistan's requires an understanding not only of how agricultural policies affect food supply and incomes but also of how households acquire food and cope with insecurity. Many economists regard income as the main indicator of welfare, but other planners maintain that food consumption, health, and nutrition of household members are also important in defining a household's standard of living. The main concern of this research is to trace the pathways from economic and social policies to food security and, ultimately, to nutrition. In effect, the report considers how income is best converted into nutritional well-being. Snapshot approaches—those that look at one point in time—have various uses in understanding these processes but are limited in that they do not reveal anything about the actual dynamics of poverty and food security and their consequences for nutrition and health. This report addresses these concerns by looking at longitudinal data for a three-year period, 1986-89, and analyzing the fluctuations in incomes, consumption, savings, nutrition, and health-seeking behavior of 800 households in five districts in rural Pakistan.

Although the sample households are all located in rural areas, their sources of livelihood are not strictly agricultural. Diverse sources of income other than crops and livestock are found, including artisan work, village crafts, operation of public conveyances, and different forms of trading activities. Moreover, many households receive substantial remittances from household members working in large Pakistani cities such as Karachi or abroad (the Middle East, for example). Together, nonfarm income accounts for nearly 45 percent of total income, including transfers such as remittances pensions. Much of the rural nonfarm income is from self-employment, unskilled labor, or business activities such as production of inputs or processing of agricultural output and therefore is a natural outgrowth of crop and livestock productivity. Hence, strategies for rural development should involve a much broader array of policies than agricultural development per se, including the broadening of credit to nonfarm enterprises, improvement of infrastructure, and expansion of rural education.

Income inequality is quite high in the rural areas. An overall Gini coefficient (a measure of income inequality) of 0.40 is calculated for these populations, compared with 0.75 when landownership is used as a measure of wealth. Of the five sources of rural income—agriculture, livestock, nonfarm, rental, and transfers—agricultural income accounts for the largest share of overall income inequality. On the other hand, income from livestock and nonfarm sources helps decrease income inequality. These findings indicate that policies that seek to promote livestock development and to attract nonfarm investments in rural areas are likely to promote better distribution of income in Pakistan.

Fluctuations in income, even over the relatively short three-year period, were considerable. Weather, illness, and decline in remittances from abroad were among the reasons. This study finds that a moderate share of income fluctuation is explained by district variables and a far greater share by village-level variables. Consumption risks in these households were only partially mitigated by sharing through family networks. Savings played a major role in smoothing consumption. Income risks were also reduced by diversification of income sources.

On average, 70 percent of a short-run increase in income is either saved or used to pay off debt, and even low-income households manage to save half, although net physical savings of only about 10 percent are attained because the rest is usually channeled to repayment of debt. Surprisingly, in these rural settings, households use formal financial instruments such as bank savings accounts to channel half of the remittances from family members abroad. Remittances are mostly saved and the rest (about 30 percent) are channeled into physical property, mostly for housing and physical improvements.

According to this study, fluctuations in income do not translate into fluctuations in calorie intakes in the rural households, however. No evidence of seasonality in consumption is detected in 12 separate observations. Even the shift from eating rice to wheat, which occurs in some areas because their harvest times are different, does not affect total calorie intakes. The households surveyed for this study generally have a higher calorie supply per capita than in most parts of South Asia. They cope with seasonal lows and higher food prices through savings, including storage of grains. Credit—mostly from the informal sector, such as friends, relatives, and local stores—helps maintain a fairly constant expenditure level.

Calorie-income elasticities in the sample households ranging from 0.12 to 0.39 imply that it would take, on average, about a 30 percent rise in income to achieve a 10 percent rise in calorie consumption. Thus, underconsumption of calories in the poorest households is unlikely to disappear in the normal course of economic development. The study, however, also finds that food expenditure elasticities are 1.5-2.0 times higher than calorie elasticities, indicating that as household incomes increase, diets are diversified with higher-quality foods, not necessarily with larger quantities of food.

Other policies to attain higher levels of food security need to be found. One possibility is investment in the education of women, who play a critical role in determining household food acquisition patterns. Education of women is found to be a key factor in achieving better nutrition. Educating women to at least the primary level is likely to be nearly three times more effective than increasing incomes by 10 percent. Clearly, public investments in education for women will have a very high payoff.

But this study also finds that increases in calories will not automatically translate into better nutrition and health in children unless the high rates of infection are addressed. The low association between calorie intake and child nutrition found in many past studies was primarily due to the failure to consider the interaction between diet and disease. In an environment such as the rural area in this report, where disease is widespread, the role of infection is often magnified. Diarrhea and illness strongly determine the nutritional status of the preschoolers.

The nutritional status modeling in this study indicates that critical community services—including health services, sanitation, village water supply, and public drainage systems—are necessary to stem the spread of infectious diseases. Public health programs that reduce illness, such as immunization, or those that encourage prenatal care are important instruments for influencing nutrition. However, the mere physical presence of the services in a community is not enough: quality of services is equally important. For the most part, households cannot provide these services from their own resources. Support from the government for the provision of such critical community services is essential.

2

INTRODUCTION

In Pakistan, as elsewhere, rural development involves more than increasing the production of food crops and agricultural goods. General concern for raising the productivity of the rural population also involves specific concerns for health, nutrition, and other aspects of household and individual welfare. Quite obviously, economic progress and improved welfare are linked, but a disaggregation of sectoral data makes it clear that some regions often fall behind general growth in the rural economy. Similarly, a number of households within any region, prosperous or otherwise, fail to obtain the resources necessary for maintaining adequate health and nutrition, much less the means for investing to obtain future gains in income.

Any measures aimed at improving the welfare of the rural population and at alleviating poverty—whether relative or absolute poverty—must begin with an understanding of the characteristics of poor households. The levels and distribution of various welfare indicators help define the policy issues that need to be addressed. Similarly, a better understanding of the sources of income of poor households and how they allocate their resources can help in conceptualizing approaches to poverty programs. If the poor are disproportionately engaged in a particular type of employment or have different patterns of consumption than the general population, these observations can serve as the foci for poverty programs.

A number of recent studies have devoted attention to such correlates of household welfare (Glewwe 1988; von Braun and Pandya-Lorch 1991). Any study of the determinants of poverty, however, must address the issue of how poverty should be measured. Three major considerations must be addressed. First, poverty is not one-dimensional. Since income is generally considered the least normative measure of welfare, policymakers are often interested in the consumption of certain goods or investment in certain aspects of human capital and the distribution of such investment among household members (Lipton and Ravallion forthcoming).

Second, researchers, as well as governments, obtain imperfect information regarding household welfare; different measures of poverty may entail different errors in classification. The concern for classification is not just to improve measurement for its own sake; as Glewwe and van der Gaag (1990) indicate, the issue of measurement has a direct bearing on policy design. Not only does any targeting of programs require fairly sensitive definitions, but the choice of policy instruments to achieve a desired welfare goal may depend critically on the correlation of different measures.

Third, poverty is not static. Even in a period as short as three years, rural incomes can change substantially, leading to changes in indicators of poverty (Gaiha 1988, 1989). A distinction can be made between chronic and transitory poverty. Similarly, Iliffe (1987) draws a distinction between structural and conjunctural poverty—that is, between poverty due to limited access to resources and that due to health- and weather-related shocks. To the degree that these distinctions are clearly observed—some fluctuations are, of course, due to measurement error—they point to different causal pathways, hence different avenues for intervention. For example, insurance, including privately provided transfers of goods or money from one household to another and other risk-reducing factors, can deal with transitory poverty, but transfer of assets or changes in land and labor productivity may be required to deal with chronic poverty.

Analysis of the different dimensions of poverty requires repeated observations of households, preferably over a period of more than two years. To date, only a few institutions have been willing to make the long-term investment that gathering of such information requires. The list, however, is growing, along with understanding of households' ability to cope with shocks and how they fall into and rise out of poverty.

The study that follows is a contribution to this analysis of the temporal dimensions of poverty. Although the three-year panel of data analyzed here is too short to fully model the dynamics of poverty, it is sufficient to indicate the fluidity of the economic environment that households face. Thus, the panel adds to the literature on the coping strategies of households. Clearly, fluctuations in income do not translate fully into fluctuations in expenditures or household welfare. In principle, savings, dissavings, and credit are used to smooth ups and downs in income and therefore are an important part of the dynamics of poverty. Remittances may be as well, both from the perspective of income diversification and as an example of intra- and interhousehold insurance. In addition to levels and fluctuations of incomes in the sample villages, this report discusses some of the means that households use to insulate their consumption from fluctuations in income.

The study also focuses on nutrition and food consumption as a measure of welfare, contributing to the debate on whether poverty, defined as limited control over private resources, correlates strongly with a household's inability to function (Sen 1992).[1] This issue, in turn, feeds into the issue of the roles of government infrastructure and health services and how they affect the choice of health and nutrition interventions.

The rest of this chapter discusses the villages surveyed and their sources of income. It provides a description of the project site to serve as a reference for a number of other studies that are using this data set. Chapter 3 describes fluctuations in income and consumption and Chapter 4 indicates how these fluctuations affect poverty measures. Chapter 5 discusses how these fluctuations affect savings and investments, while Chapter 6 discusses food-purchase and food-security issues, tying the analysis of purchasing patterns to the earlier discussion of consumption smoothing. Since, however, food and nutrition are not synonymous, Chapter 7 looks at the relationship between nutrition and health, placing the discussion in the context of the roles of public and private resources. The report ends with a discussion of policy implications.

Research Setting

The core data for the analysis were collected in a series of 12 interviews over a three-year period beginning in July 1986. Because data collection was initiated after the wheat harvest, the period covered essentially begins with the 1986 monsoon (*kharif*) planting season and ends with the 1989 winter (*rabi*) harvest. Six interviews were undertaken in the first year and three each in the subsequent two years. This panel approach allows for an in-depth understanding of the flow as well as the stock of household resources. By its very nature, however, this intensive approach rules out extensive coverage: rather than national coverage, the project focuses on selected districts.

---

[1] Similarly, education reflects both infrastructure and household resources. Education is a major topic for a series of studies undertaken with the data analyzed here (see Alderman et al. 1992).

The least-developed district in each of the four provinces was chosen (with one exception) based on a variety of production and infrastructure indices. The methodology follows Pasha and Hasan (1982), although more recent information and current district boundaries have been used. The selected districts are Attock in Punjab, Badin in Sind, Dir in North-West Frontier Province (NWFP), and Mastung/Kalat in Baluchistan (Figure 1). In actuality, there are districts in Baluchistan somewhat less developed than Mastung/Kalat, but the special logistic conditions in that province ruled against fielding an intensive survey in those districts. Mastung/Kalat, nevertheless, is less developed than any of the districts outside of Baluchistan and many within the province. Although these districts were chosen because they are relatively underdeveloped, it should be kept in mind that there are poor households even in the most prosperous districts. In order to obtain a perspective on such households, Faisalabad, also in Punjab, was chosen as a fifth study site.

The districts were chosen purposively, but the villages and households were selected from a stratified random sample. Within each district, two markets (*mandis*) were chosen at random. For each *mandi*, three lists of villages were drawn up—those within 5 kilometers of the *mandi*, those within 5 to 10 kilometers, and those within 10 to 20 kilometers. Villages were chosen randomly from these lists. Households were then chosen randomly from a complete list of families in each village. Minor variations in the process reflect special conditions in each area. For example, in villages in Punjab, hundreds of families are typically located around a central core, whereas in the lower Sind, villages are administrative units made up of a number of physically separate settlements or *dehs*. This necessitated an additional random sampling to select a subset of *dehs* from the village list.

Each team included one male and one female interviewer, who filled out separate questionnaires for males and females in each household. In addition, a village questionnaire was filled out in each round to obtain information on infrastructure, current prices, and wage rates. Anthropometric measurements (weights and heights) were also taken in all rounds for children under six years of age and in 5 out of the 12 rounds for adults.

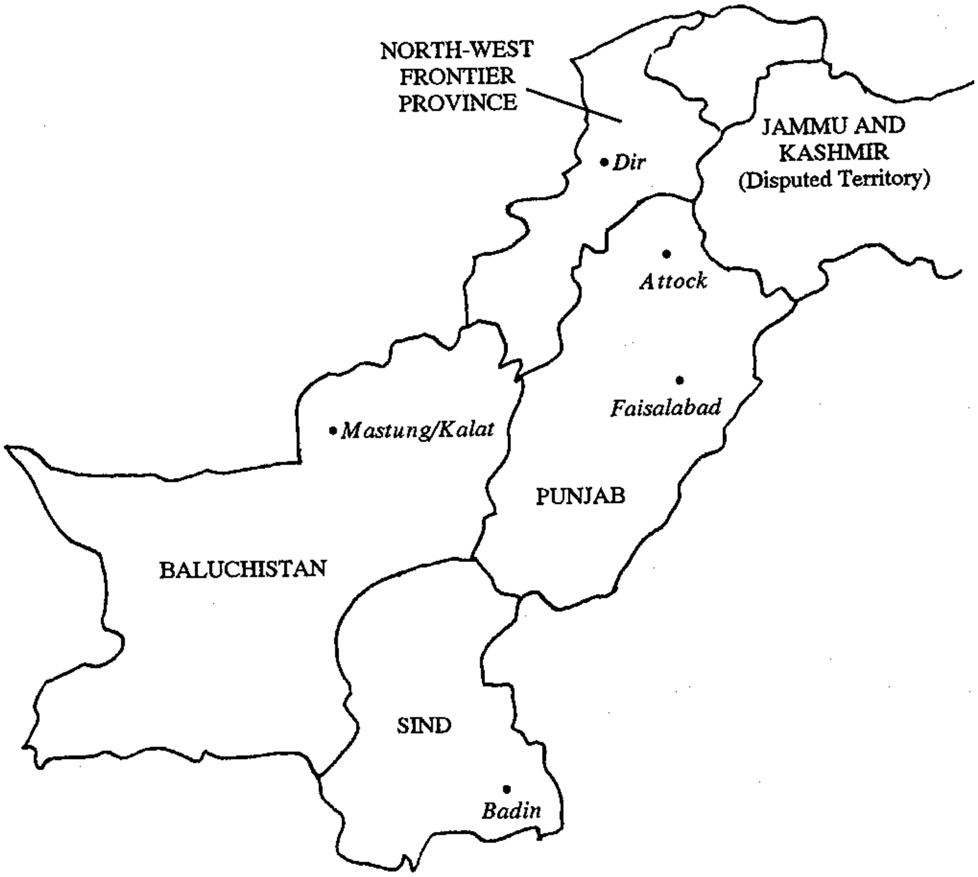
In panel surveys, attrition is always a concern, not so much because the sample size is reduced, but because selectivity of sample dropouts could bias the results. The major reasons for households leaving the survey prior to the final round, however, appear to reflect administrative and community politics rather than household self-selection. For example, Mastung/Kalat was dropped at the end of the first year in order to simplify the logistics of continued data collection. In both the Sind and NWFP, an entire village dropped out following disputes between survey staff and the village head. While this was unfortunate, it is not likely to have introduced a selection bias.

It should be pointed out that the focus of the study is on household decisions and behavioral relationships. There is little need to add to the extensive data base on district averages of, say, farm output in Pakistan, except where the relationships studied in this panel are indicative of choices and responses that link various household assets and external conditions to household welfare outcomes. The goal is not to gain more precision regarding levels of various inputs and outcomes and surely not to extrapolate for the entire country. Nevertheless, the data are well suited to an exploration of the relationship between inputs and outputs and intrayear variations.[2]

---

[2] Since Mastung/Kalat in Baluchistan was not included in the second and third years, fluctuations in many of the variables of interest for that district cannot be reported.

Figure 1—Map of the provinces and districts included in the IFPRI panel survey of Pakistan



Note: Survey districts are in italics.

3

LEVELS AND FLUCTUATIONS OF EARNINGS AND CONSUMPTION

Although the sample is totally rural, it is not strictly agricultural, which affects both the distribution and fluctuations of income throughout the sample. Profits from crops[3] are less than 45 percent of total earnings plus transfers for all regions and expenditure quintiles, often far less (Table 1). For the entire sample, crop profits combined with livestock earnings accounted for only 44 percent of earnings plus transfers and 54 percent exclusive of transfers. Nonfarm wages and enterprises were 41 percent of income (excluding transfers).

From another perspective, only 14 percent of the households in the entire sample failed to earn at least 20 percent of their household incomes from activities outside of crop cultivation and livestock tending. Households in Badin were more reliant on agriculture than those in the other districts sampled, but even in Badin, 77 percent of the households earned at least 20 percent of their income outside of agriculture and animal husbandry.

While the size of this finding may seem surprising, the share of agriculture in rural earnings in the sample is, in fact, fully in accord with national accounts. Although agriculture provides approximately 50 percent of the national labor force, it accounts for only 25 percent of gross national product (GNP). There is no corresponding figure for the rural share of GNP, but one can determine the order of magnitude using the 1984/85 household expenditure and the rural population share (80 percent of the total population). The average rural resident spends only 70 percent of what an urban resident spends. Because the rural share of the population is so large, however, rural areas account for two-thirds of all private consumption in the nation. The ratio of aggregate rural-to-urban incomes plus transfers should be roughly in this proportion. Therefore, if rural consumption is two-thirds of national consumption, agriculture is only one-quarter of GNP; even if all transfers are assumed to have originated outside rural areas, rural nonfarm earnings can be expected to be similar to farm income.

The observation that rural welfare is not synonymous with agricultural development affects both national development strategies and household resource allocation. A number of studies have shown that agricultural development strongly influences the demand for rural services and nonfarm production and the linkages to other sectors of the economy. Nevertheless, a rural development strategy needs to consider

---

[3] Crop profits are calculated as the value of all output including straw, minus the value of cash inputs and the imputed value of inputs such as seeds, the use of own tractor, pumps, and bullock power. Own land and labor, however, are not netted out from agriculture. Straw is also considered an input into livestock and is costed as such. For more details, see IFPRI/AERC/CAPES/PERI 1988.

Table 1—Sources of income by district and per capita expenditure quintile, 1986/87-1988/89

			Sources of Income					
District	Expenditure Quintile	Per Capita Income	Crop Profit[a]	Livestock[b]	Rent[c]	Agricultural Wages	Nonfarm Activities[d]	Transfers[e]
		(1986 rupees)				(percent)		
Attock	1	1,778	6.0	22.0	2.0	1.0	63.0	6.0
	2	2,441	11.0	16.0	4.0	0.0	51.0	19.0
	3	2,604	7.0	14.0	10.0	2.0	43.0	23.0
	4	3,463	12.0	14.0	16.0	0.0	38.0	18.0
	5	5,663	12.0	6.0	19.0	0.0	36.0	26.0
Faisalabad	1	2,699	8.0	13.0	0.0	4.0	70.0	5.0
	2	3,330	14.0	15.0	5.0	2.0	57.0	7.0
	3	3,208	35.0	23.0	5.0	2.0	32.0	4.0
	4	5,042	34.0	17.0	15.0	1.0	22.0	12.0
	5	10,199	38.0	9.0	31.0	0.0	10.0	12.0
Badin	1	1,887	43.0	18.0	5.0	4.0	27.0	4.0
	2	2,580	34.0	19.0	6.0	3.0	31.0	7.0
	3	3,342	36.0	20.0	14.0	1.0	22.0	8.0
	4	5,284	31.0	13.0	33.0	1.0	20.0	3.0
	5	5,976	35.0	16.0	22.0	1.0	19.0	8.0
Dir	1	2,610	21.0	17.0	7.0	0.0	42.0	13.0
	2	2,853	14.0	19.0	6.0	0.0	31.0	29.0
	3	3,982	11.0	17.0	3.0	0.0	22.0	47.0
	4	4,119	10.0	17.0	8.0	0.0	35.0	30.0
	5	6,746	19.0	14.0	12.0	0.0	29.0	26.0
Mastung/Kalat	1	1,821	7.3	4.3	0.8	26.9	44.8	15.9
	2	2,490	7.7	2.8	0.4	30.2	52.2	6.7
	3	3,036	5.1	2.2	1.5	24.8	57.9	8.5
	4	3,990	10.7	5.8	4.3	26.2	57.2	7.4
	5	5,515	17.7	2.7	3.2	10.9	56.5	9.0

Source: IFPRI Rural Survey of Pakistan, 1986/87-1988/89.

Notes: Incomes are averaged over three years except for Mastung/Kalat, for which data from only one year were available. The lowest expenditure quintile is 1; the highest is 5.

[a] Includes profit from all crop production including home production and crop by-products plus returns to agricultural labor.

[b] Includes net returns from traded livestock (cattle, poultry) plus imputed value of home-consumed livestock plus traction power.

[c] Includes rents received from ownership of assets such as land, machinery, and water.

[d] Includes wages from any unskilled, nonfarm activity, such as construction, self-employment (including shopkeeping and artisan activities), government employment, and nonfarm private-sector wages.

[e] Includes pensions (government), internal and international remittances, and *zakat* (payments to poor).

a broader array of policies than those aimed at promoting agriculture, including development of infrastructure and provision of education.

The relationship of various sources of income to asset ownership and to risk reduction strategies has been explored by a number of authors. For example, von Braun and Pandya-Lorch (1991) find comparatively large shares of nonfarm income for poor rural households on three continents. Closer to the sample under consideration, Klennert (1986) observes that even farm households in Pakistan rely appreciably on nonfarm earnings. Whereas von Braun and Pandya-Lorch see little difference in earning sources by rural poverty groups, Klennert presumes that marginalization—

inadequate farm earnings—is the main reason for income diversification. The work of Adams (forthcoming) also pinpoints the importance of nonfarm incomes for the poor in Pakistan.

There are no theoretical reasons why the poor should have a higher share of income from nonfarm employment than those who are not poor. Although landowners in the sample were less likely to work for wages off farm (see Appendix 1), wages themselves increased with education. Other assets also enhance both farm and nonfarm earnings.[4] The evidence, however, indicates a marked pattern of declining shares of earnings from nonfarm labor and own-enterprise (and a corresponding increase of rental income shares), with an increase in expenditure quintile in the two Punjab districts. In these districts, nonfarm earnings often come from artisan activities, which are low-status and low-capital enterprises.

Self-employment is, however, a heterogeneous category. In addition to low-paying village crafts, it includes shop ownership, operation and ownership of trucks and coaches, and, in Dir district, participation in the guerrilla war in Afghanistan, with its attendant trade and opportunities for spoils of war.

Transfers include remittances, pensions, and *zakat* (community-support funds from local mosques), but are dominated by the former. (*Zakat* is a fairly insignificant source of transfer income in all districts.) Transfers provide a major part of household incomes in Dir, where remittances are largely from abroad. Transfers in the other districts are more commonly domestic remittances, with pensions being appreciable in Mastung/Kalat and Attock. In every round, more than 10 percent of the households in Mastung/Kalat also received grain as gifts from other households. These transfers, taken in context with the informal loans discussed below, are evidence of an important social support network, with elements of both patron-client and *biradri* interlinkages. (*Biradri* is an affiliation similar to a fraternal, social, or professional group; it is a looser version of the Indian caste system.)

With the exception of those in Mastung/Kalat, the households in this sample do not rely on casual wage earnings in agriculture for an appreciable share of their incomes (Table 1). For example, only 2 households (out of 260) in Badin received more than half their annual earnings from agricultural wages, although one-third received at least some agricultural wage earnings. The shares are similar for Faisalabad, while less than 5 percent of the sample in Dir or Attock had agricultural wage earnings, and none of the families relied on these earnings for half their annual income.

The small share of total income from agricultural wages reported is in contrast with other parts of the subcontinent and with observations reported by other researchers in Pakistan (Noamon and Nadvi 1987). Nabi, Hamid, and Zahid (1986), for example, state that between 1960 and 1972, there was a major structural change in Punjabi agriculture, leading to an increased emphasis on wage labor. They report that in 1972, 25 percent of the labor force in the Punjab were landless agricultural laborers (Nabi, Hamid, and Zahid 1986, 47). This is, however, a calculation by the authors from the agricultural census data rather than a direct quote from any tables reported in the census. No tables in either

---

[4] Current returns to tractor ownership, pumps, wells, mills, and so forth are included under rental earnings in Table 1. These have known fees for unit work, which makes it easier to attribute rent for use of one's own assets. For a number of own-enterprises, however, it is not possible to separate returns to other assets from returns to labor and management.

that census or in the 1980 agricultural census report the number of rural families involved in wage labor. The 1984-85 Household Income and Expenditure Survey (Pakistan, Federal Bureau of Statistics 1986a, Table 27), however, indicates that less than 1 percent of households engaged in agriculture are classified as agricultural laborers. Curiously, the *Labour Force Survey, 1984-85* (Pakistan, Federal Bureau of Statistics 1986b) says nothing about wage labor in agriculture.

Irfan (1985) calculates that wage employment in agriculture declined at an annual rate of 1.2 percent between 1973 and 1981. Given that agriculture was growing during this period, such a shift probably reflects increased opportunities for nonfarm labor and for migration. Whether Nabi, Hamid, and Zahid (1986) are in error or whether the situation was different in 1972 than today is, to a degree, irrelevant. More important is the question of whether there is currently a large class of wage laborers relying principally on their earnings in agriculture. This does not appear to be the case in this sample.

Wages

Agricultural wages are high in Pakistan relative to neighboring countries. For a day's work of weeding, the amount of wheat that agricultural laborers could purchase ranged from 11.0 kilograms in Mastung/Kalat to 17.4 kilograms in Attock. For Badin, the grain equivalent of wages was 10.4 kilograms in 1986 rice (IRRI varieties). These are consistent with other data for Pakistan. For example, government price data indicate that the wages of unskilled urban workers in wheat flour equivalents in Pakistan has fluctuated around 10 kilograms per day, with no clear trend since independence.[5]

The main reason for putting wages in grain-equivalent terms is to compare the purchasing power of unskilled labor with that in other countries. While no single food commodity is a precise deflator of wages, the number of kilograms of grain obtained for each day of employment is a tangible indicator of purchasing power.

In many developing countries, the quantity of grain that can be purchased with the minimum wage—the wage of an unskilled laborer—is only a fraction of that obtained by both rural and urban unskilled workers in Pakistan (Table 2). There is some evidence of an upward trend in rural wages in some Asian countries, including Bangladesh, Indonesia, and India (Walker and Ryan 1990). Wages in Pakistan, however, were well above those observed in most developing countries in the 1980s. Of the countries with wages near to or higher than those in Pakistan, one—Burkina Faso—is likely to be misleading, because there is no indicator of what percentage of workers receive the minimum wage. Another—Egypt—reflects the extensive subsidization of food in the late 1970s and early 1980s.[6]

In recent years, wages in India in wheat equivalent have begun to close the gap with Pakistan. This is not true for rice or coarse grains; wages in terms of these grains in parts of India ranged between 4.6 and 7.9 kilograms in 1978/79 for various states (Ranade, Jha, and Delgado 1988). Furthermore, the wages reported in India are based

---

[5] See also Alderman, Chaudhry, and Garcia 1988, Table 6.

[6] Abdel-Fadil (1975) indicates that between 1951 and 1971, wages in Egypt remained equivalent to 7.5 kilograms of maize.

Table 2—Comparison of grain equivalents of wages per day of work, various countries and regions

Country	Year	Grain Equivalent	Commodity	Type of Wage
		(kilograms)		
Burkina Faso	1989	10.0	Maize	Minimum wage
Egypt (Cairo)	1982	33.4	Bread, dry weight	Average wage
Egypt (rural)	1982	20.0	Unrefined flour, official price	Wage of unskilled worker
Ethiopia	1988	4.4	Maize	Rural wage[a]
The Gambia	1989/90	3.3	Rice	Minimum government wage (menial)
Ghana (Techiman)	May 1990	2.6	Maize	Minimum wage
	December 1989	4.0	Maize	Minimum wage
	December 1987	1.7	Maize	Minimum wage
Madagascar	1987	2.1	Rice	Minimum wage
	1977	5.3	Rice	Minimum wage
Malawi	January 1988	2.4	Maize	Minimum wage
	January 1989	3.3	Maize	Minimum wage
Mozambique	August 1990	4.1	Maize meal	Minimum wage
	August 1988	2.8	Maize meal	Minimum wage
	August 1987	6.0	Maize meal	Minimum wage
Zimbabwe	1991	9.2	Maize meal	Minimum casual worker wage
	1991	4.1	Maize meal	Food for work wage
Bangladesh	1988	3.6	Rice	Average rural wage
	1973	1.9	Rice	Average rural wage
Bangladesh	1988	5.8	Wheat	Average rural wage
	1973	3.4	Wheat	Average rural wage
India (Punjab)	1986/87	13.2	Wheat	Wage for agricultural laborer
India (Rajasthan)	1986/87	9.0	Wheat	Wage for agricultural laborer
India (Tamil Nadu)	1985/86	2.6	Rice	Wage for plowman
India (West Bengal)	1987/88	8.1	Wheat	Wage for agricultural laborer
Indonesia (East Java)	1986	2.8	Rice	Wages for hoeing
	1976	1.4	Rice	Wages for hoeing
Indonesia (East Java)	1986	6.9	Maize	Wages for hoeing
	1976	2.8	Maize	Wages for hoeing
Philippines (rural Mindanao)	1984-85	5.2	Maize	Average rural wage
	1984-85	3.7	Rice	Average rural wage
Philippines (rural Luzon)	1983-84	5.9	Rice	Average rural wage

[a] Market is very thin.

on harvest-season producer prices, and therefore they exaggerate the average amount of grain that could be purchased throughout the year.

In percentage terms, wage rates in grain equivalents in Pakistan are less variable than those in many other countries. While some of the changes in Table 2 reflect structural adjustment issues—Madagascar and Mozambique, for example—the underlying data also reveal major fluctuations from year to year and even within years due to variability of food prices. Pakistan, however, has been largely successful in stabilizing wheat prices (Pinckney 1989). Although wages in grain equivalents have dipped in a few years, most markedly in 1973, current policies protect consumers from major fluctuations by subsidizing grain storage costs, as well as explicitly subsidizing the price of imported grain in years when there are domestic shortfalls.

In addition to the global perspective in Table 2, Pakistan's high wages for unskilled work can be looked at from a historical perspective. Braudel (1981), in a graph indicating the amount of wheat that could be purchased per 100 hours of work in two French markets between the years 1401 and 1950, depicts a number of sharp increases in the amount of labor necessary to obtain wheat. These are, in effect, entitlement failures similar to the Bengal famine analyzed by Sen (1981). Of greater pertinence to the theme here is the pronounced secular trend that is evident; it was not until the late 1800s that the real wage rose to the level that prevailed in the fifteenth century (Braudel 1981). Braudel—somewhat arbitrarily—claims that 8 to 10 kilograms of wheat per day of labor, in absolute terms, is a dangerous floor. As a historical point, in only a few years in the entire period studied did the grain equivalent of a day of labor in France fall to the level prevalent in most of the countries in Table 2. Abel (1978) presents a number of other examples from preindustrial Europe. While there is extensive regional and temporal variance in his broad study, the general impression is that Pakistan's high wage rates are roughly similar to grain-equivalent wages in preindustrial Europe.[7] Although Pakistan's wages are high compared with most in contemporary Africa and Asia, they do not stand out compared with Europe through much of its history.

Income Fluctuations

The breakdown of sources of income in Table 1 uses average annual household income over three years. However, not only do incomes vary across years, shares from various sources also change (Table 3). For example, the share of income from crop profits was depressed in Faisalabad in 1986/87, due to a hailstorm at harvest-time, and in Attock in 1987/88, due to a drought. Badin experienced localized flooding in 1988/89. The share of income from agriculture in Dir appears to have increased markedly in 1988/89, but this reflects a lower denominator because remittances, considered here as a component of income, declined appreciably over the three years of the survey.

Focusing only on earned income, one notes that average income for the sample in the third year was not significantly different from the first year, although there was an increase in the second; average incomes, with standard errors in parentheses, in the three years were 22,321 (20,410), 26,000 (25,964), and 23,834 (24,225), all in 1986 rupees. The number of households that were gainers or losers were evenly divided over the population. Similarly, the number of households that experienced successive increases in their income (119) was nearly equal to the number that had successive declines (128).

How many of these changes can be explained either by changes in production factors or by shocks that are covariate across villages? The latter are a concern for a number of potential government policies. Highly correlated income shocks not only make the design of private and public insurance schemes difficult, they put major strains on localized credit structures. To address this, one also needs to consider how many income changes are due to measurement error or regression toward the mean.

---

[7] Compare, for example, Abel's (1978) Table 3, showing wages between 9.6 and 15.0 kilograms of wheat in England between 1251-1350, with Table 2 of this report.

Table 3—Sources of income, 1986/87-1988/89

Distric	Year	Average Household Income, Including Transfers	Share of Income from					
			Crop Profits	Livestock	Rent	Agricultural Wages	Nonfarm Activities	Transfers
		(1986 rupees)			(percent)			
Attock	1986/87	19,935 (14,079)	12	22	13	0	34	19
	1987/88	17,518 (18,987)	3	4	9	1	56	27
	1988/89	15,861 (13,316)	15	12	12	0	46	14
Faisalabad	1986/87	33,383 (38,200)	24	17	16	1	32	9
	1987/88	35,048 (34,745)	31	13	16	1	30	11
	1988/89	34,650 (69,348)	44	10	14	1	21	5
Badin	1986/87	25,167 (22,764)	38	16	16	1	18	11
	1987/88	31,642 (31,505)	36	16	18	2	23	6
	1988/89	29,439 (29,588)	32	17	21	2	26	2
Dir	1986/87	39,019 (22,764)	12	14	5	0	32	38
	1987/88	39,400 (30,784)	12	21	6	0	32	29
	1988/89	28,922 (23,811)	23	15	12	0	30	20

Source: IFPRI Rural Survey of Pakistan, 1986/87-1988/89.
Note: The numbers in parentheses are standard deviations.

The regressions in Table 4 provide perspective on these changes. Changes in income between the second and first year or the third and second are regressed on changes in various assets, the number of adult males, teenage males, and males with an education residing in the household. Strictly speaking, these changes reflect choices in the recent past that are endogenous to the household. However, the management and taste factors that influence such choices should be fixed, and therefore are not likely to introduce bias into the estimates. The coefficients of physical assets in first differences are similar to those observed in cross-sectional regressions, a result that is not always found, given the increase in the noise-to-signal ratio (the ratio of measurement error to information) that is characteristic of first differences. Changes in assets owned and the size of the household labor force explain 7.7 percent of the change in income in the first year and 12.5 percent in the second year. These figures rise to 11.7 and 14.4, respectively, if the district dummy variables are included. This implies that district covariates provide a significant improvement in the explanation of changes in income between years after accounting for changes in assets.

Eliminating the dummy variables for districts and replacing them with dummy variables for villages increases the total explained portion of the variance to approxi-

Table 4—Regressions explaining first differences in earned incomes

Dependent Variable	Income in Year 2 Minus Income in Year 1			Income in Year 3 Minus Income in Year 2		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Change in irrigated land	783 (2.06)**	632 (1.68)*	530 (1.36)	1,067 (4.78)**	1,055 (4.77)**	969 (4.23)**
Change in rainfed land	193 (0.42)	119 (0.27)	12 (0.03)	138 (0.39)	149 (0.43)	224 (0.64)
Change in livestock value	0.204 (3.19)**	0.155 (2.42)**	0.197 (2.98)**	0.216 (3.48)**	0.149 (2.40)**	0.197 (3.13)**
Change in value of vehicles	0.079 (1.49)	0.068 (1.28)	0.072 (1.38)	0.115 (4.26)**	0.111 (4.11)**	0.113 (4.19)**
Change in value of machinery/tools	0.113 (2.97)**	0.119 (3.13)**	0.128 (3.20)**	0.185 (5.61)**	0.185 (5.61)**	0.181 (5.32)**
Change in number of adult males	3,054 (3.98)**	2,541 (3.32)**	2,386 (3.11)**	421 (0.74)	604 (1.04)	606 (1.04)
Change in number of teenage males	–1,295 (–1.23)	1,476 (1.42)	1,143 (1.08)	984 (1.04)	569 (0.60)	464 (0.48)
Change in number of males with primary education	3,812 (2.15)**	3,107 (1.75)*	2,580 (1.44)	–564 (–0.57)	–719 (–0.73)	–325 (0.32)
Change in number of males with more than a primary education	–1,196 (–1.08)	–1,826 (–1.64)*	–1,460 (1.29)	782 (0.86)	392 (0.42)	729 (0.78)
Constant	2,695 (4.10)**	5,099 (5.27)**	. . .	–1,910 (–3.57)**	–962 (1.12)	. . .
Faisalabad	. . .	–2,685 (1,563)	Replaced by village dummy variables		–2,390 (1,452)	Replaced by village dummy variables
Attock	. . .	–8,235 (1,521)			1,824 (1,403)	
Dir	. . .	–1,347 (1,459)			–3,346 (1,317)	
Joint significance of covariates		f=10.89 df=(3,713)	f=2.49 df=(41,675)		f=4.77 df=(3,713)	f=1.85 df=(41,675)
R^2	0.077	0.117	0.198	0.125	0.144	0.214

Note: The numbers in parentheses are *t*-values.
*Significant at the 10 percent level.
**Significant at the 1 percent level.

mately 20 percent. The level of covariation of income shocks in the data is comparable to that reported for the Côte d'Ivoire by Deaton (1990), who finds that the F-statistic of the cluster dummy variables did not exceed the logarithm of the sample size, a critical value that he uses to accommodate the risk of both type I and type II errors. Deaton comments that even if the observed income changes were composed of equal parts of measurement error and real change, statistics of the magnitude observed with the Côte d'Ivoire sample cluster covariates still imply only modest covariate risk.

How much measurement error is in the income variables? One would need to know the true values to be able to state this with any confidence, but one indicator of the order of magnitude is available. Assume, for the purpose of this illustration, that incomes are the only variable measured with appreciable error. Assuming further that income shocks are random, landownership is controlled for, and so forth, a plausible value for the coefficient of income (Y) in a regression of Y_t on Y_{t-1} or Y_{t+1} should be 1.0. That is, if

$$Y_{t+1} - Y_t = f(A_{t+1} - A_t) \tag{1}$$

is reformulated to

$$Y_{t+1} = f\,[(A_{t+1} - A_t), Y_t], \tag{2}$$

and

$$Y_t = f\,[(A_{t+1} - A_t), Y_{t+1}], \tag{3}$$

where A is assets, a prior expectation for either the coefficient Y_t or Y_{t+1} is 1.0. That is, after accounting for changes in assets, last year's income (Y_{t-1}) should be the expected value for this year's income (Y_t). If the fixed-effect regressions for villages in Table 4 are reformulated in this manner, retaining the differences in assets on the right-hand side, the coefficient of Y_2 when Y_1 is the dependent variable is 0.638 (0.021); it is 0.763 (0.022) when Y_3 is the dependent variable. Similarly, the coefficient of Y_1 is 0.887 (0.031) when Y_2 is the dependent variable and the coefficient of Y_3 is 0.817 (0.024) when Y_2 is the dependent variable.[8]

Based on the econometric theory of errors in variables, one would expect that a variable measured with error would be biased toward zero, with

$$\hat{B}_{plim} = \frac{\sigma_v^2}{\sigma_v^2 + \sigma_u^2}\, B = \gamma\beta\,, \tag{4}$$

where σ_v^2 is the true variance of the variable and σ_u^2 is the variance of the measurement error.[9] The value of γ, then, is a measure of the ratio of the true variance of the variable X to the observed variance. Under all these assumptions, $\gamma = \hat{\beta}/1$; hence the true variance of income can be assumed to range between 60 and 80 percent of the observed variance.

Note, however, that the dependent variables in Table 5 are in terms of first differences of two variables, *both* of which are probably measured with error. The variance of the difference of Y_t and Y_{t+1} depends on the interyear covariances:

$$\text{Var}\,(Y_{t+1} - Y_t) = \text{Var}\,Y_{t+1} + \text{Var}\,Y_t - 2\,\text{Cov}\,(Y_{t+1}, Y_t). \tag{5}$$

To obtain an order of magnitude estimate of the relative share of the measurement error in the total variation of the difference, one needs to make some further assumptions. In particular, in using subscripts v and u to denote real variation and measurement error as in equation (4), assume that

$$\text{Cov}\,(u_t\,, u_{t+1}) = 0: \text{ measurement error is uncorrelated over years,} \tag{6}$$

---

[8] The signs of the variables for differences in assets do, of course, switch when the equations are reformulated.

[9] This presumes that there is no correlation between the measurement error in the regressor and that in the dependent variable.

Table 5—Share of variation in the difference of incomes due to measurement error, under alternative assumptions

Real Correlation of Incomes	Share of Variation in Any Year Due to Measurement Error	
	0.20	0.30
1.0	1.0	1.0
0.9	0.71	0.81
0.8	0.56	0.68
0.5	0.33	0.46
0.0	0.20	0.30

Note: For other assumptions, see text.

and

$$\text{Cov}\,(u_t, v_t) = \text{Cov}\,(u_t, v_{t+1}) = \text{Cov}\,(u_{t+1}, v_t) = 0. \tag{7}$$

The latter assumption extends the earlier assumption that the measurement error is uncorrelated with the real value of the observation. Moreover, it is both convenient and reasonable to assume that

$$\text{Var}\,Y_t = \text{Var}\,Y_{t+1}. \tag{8}$$

The total variance can then be arbitrarily scaled at 1.0.

The restrictions on covariances imply that the relative size of the measurement error to the total variation depends critically on the covariance of actual incomes over time. For example, if individual deviations from the population mean do not change over years, that is, if

$$\text{Cov}\,(v_t, v_{t+1}) = \sigma^2_{v_t} = \sigma^2_{v_{t+1}}, \tag{9}$$

then the measurement error would account for all of the variation of the difference in incomes *no matter what share* it is of the variation in either year. Conversely, if incomes were a complete random draw (with no correlation), the share of measurement error in total variance would be the same in the difference as in an individual year. A few examples of the relationship of the real interyear correlation of incomes and the share of error in the variation of differences of income are given in Table 5.

Although the true interyear correlation of incomes is not known, it is likely to be high; therefore, much of the observed variance in the difference of increases is measurement error, and a plausible starting assumption for the amount of true income variance explained by model 3 in Table 4 is half or more.[10]

One would expect that a similar exercise focusing on agricultural incomes would lead to a greater degree of covariance of incomes. This, however, does not appear to be the case, in part because a number of households that engage in agriculture in one or two years do not do so in all three, perhaps because they cease to rent in land or

---

[10] That the r^2 of the regressions formulated as in equations (2) and (3) is between 0.66 and 0.73 is another indication. If measurement error is really 20-30 percent, there is very little unexplained variance in the equations. This formulation is not used here, in part because the authors are interested in comparing results of this study with those of Deaton (1990).

Table 6—Regressions explaining first differences in expenditures

Dependent Variable	Expenditure in Year 2 Minus Expenditure in Year 1			Expenditure in Year 3 Minus Expenditure in Year 2		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Change in irrigated land	–332 (–1.95)*	–172 (–1.04)	–56 (–0.34)	50 (0.67)	58 (0.33)	44 (0.57)
Change in rainfed land	102 (0.50)	100 (0.51)	28 (0.14)	183 (1.37)	195 (1.49)	165 (1.25)
Change in livestock value	–0.009 (–0.32)	0.011 (0.39)	0.015 (0.54)	0.021 (0.91)	0.022 (0.96)	0.027 (1.12)
Change in value of vehicles	0.034 (1.55)	0.017 (0.81)	0.025 (1.19)	0.013 (1.44)	0.013 (1.44)	0.017 (1.89)*
Change in value of machinery/tools	0.027 (0.16)	0.036 (2.25)**	0.022 (1.29)	0.029 (2.42)**	0.025 (2.08)**	0.024 (2.00)**
Change in number of adult males	758 (2.19)**	1,193 (3.53)**	1,184 (3.52)**	476 (2.17)**	585 (2.65)**	619 (2.80)**
Change in number of teenage males	1,286 (2.72)**	1,735 (3.80)**	1,656 (3.57)**	1,373 (3.77)**	1,320 (3.67)**	1,401 (3.82)**
Change in number of males with primary education	–71.5 (–0.09)	1,120 (1.43)	706 (0.90)	76 (0.25)	–152 (–0.50)	–152 (–0.49)
Change in number of males with postprimary education	313 (0.61)	1,069 (2.12)**	1,077 (2.13)**	608 (2.23)**	320 (1.16)	563 (2.00)**
Constant	–2,473 (–8.35)**	–4,777	–1,080 (–5.17)**	–244 (0.75)	. . .	. . .
Faisalabad	. . .	3,141 (687)	Replaced by village dummy variables		–614 (553)	Replaced by village dummy variables
Attock	. . .	2,624 (672)			–2,832 (547)	
Dir	. . .	4,923 (648)			962 (501)	
Joint significance of covariates		f=10.89 df=(3,713)	f=2.49 df=(41,675)		f=4.77 df=(3,713)	f=1.85 df=(41,675)
R^2	0.077	0.117	0.198	0.125	0.144	0.214

Note: The numbers in parentheses are *t*-values.
*Significant at the 10 percent level.
**Significant at the 1 percent level.

begin to rent out. This would lead to a major change in agricultural incomes reported but not necessarily to a comparable change in total income. In the sample, 508 households were cultivated in all three years, 47 cultivated only in two years, and 42 only in one year.[11]

---

[11] The initial round of the survey also indicates cropping patterns (but not inputs) for the previous year. Similarly, a credit survey conducted a year after the main body of the data were collected indicates patterns for the intervening years. Using these data, it can be seen that 17.5 percent of the group did not cultivate at all during the five-year period and 61.7 percent cultivated in all five years. The percentages of households engaged in cultivation from one to four years are 3.1, 4.2, 4.9, and 8.6 percent, respectively.

Table 7—Regression explaining changes in consumption

	Consumption in Year 2 Minus Consumption in Year 1		Consumption in Year 3 Minus Consumption in Year 2	
Dependent Variable	**Model 1**	**Model 2**	**Model 1**	**Model 2**
Change in income[a]	0.059 (1.48)	0.118 (1.46)	0.045 (1.55)	0.115 (2.80)**
Change in number of adult males	377 (1.01)	727 (1.83)*	327 (1.48)	386 (1.71)*
Change in number of adult females	1,178 (2.67)**	652 (1.53)	461 (1.48)	796 (2.54)
Change in number of teenage males	1,127 (2.35)**	1,500 (3.16)**	1,221 (3.33)**	1,244 (3.40)**
Change in number of teenage females	1,143 (2.22)**	1,569 (3.22)**	529 (1.51)	637 (1.81)*
Change in number of children	234 (0.61)	409 (1.10)	580 (2.22)**	645 (2.44)
Constant	–2,474 (–7.23)*	Replaced by village dummy variables	–1,086	Replaced by village dummy variables
Joint significance of covariants		f = 0.391 df = (41,675)		f = 2.52 df = (41,673)
R^2	0.034	0.219	0.046	0.173

Note: Numbers in parentheses are *t*-values.
[a]Predicted variable.
*Significant at 10 percent level.
**Significant at 1 percent level.

A consequence of this flexibility in land and rental use is that fewer agricultural than total income changes are explained by village covariates. For example, 16.7 percent of the difference between agricultural incomes in year 2 and year 1 could be explained by community covariates, and 13.2 percent of the change between years 3 and 2. When, however, the sample is restricted to households that cultivated in all three years, these percentages rise to 25.4 and 16.3 percent, respectively. Unlike wage income, agricultural income is a residual between the sum of all output and the sum of all inputs; a small percentage change in either could lead to a large percentage change in estimated profits. This affects both measured and real variability.

Consumption Smoothing

There is no reason why a short-term fluctuation in incomes should translate into a similar fluctuation in consumption. Households not only seek ways to reduce income fluctuations, they also endeavor to smooth consumption. One way to achieve this is through saving and borrowing, which will be discussed in a later chapter. Another possibility is for the community to provide a form of coinsurance against individual or idiosyncratic shocks (Townsend 1991; Deaton 1990; Alderman and Paxson 1992). In models of coinsurance, households within a community share income risks due to states of nature such as droughts or floods.[12] Conceptually, this is

---

[12] The theory is derived as an extension of the Arrow-Debreu model for a complete market of state contingent contracts (Arrow and Hahn 1971).

to be distinguished from savings under, for example, a permanent income hypothesis in which a household smoothes consumption over time based on the expected value of the returns to its assets and labor.

Townsend (1991) has tested a coinsurance model using data from the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) from South India. While he rejects the complete model of coinsurance, he finds that most changes in household consumption are explained not by changes in their own income, but by changes in average village consumption.[13]

For the coinsurance hypothesis to be supported, two empirical findings are necessary. First, fluctuation in individual incomes should not explain consumption fluctuations. This alone is not sufficient, however, because a relationship would also be absent if a household used financial markets or savings to smooth consumption. Therefore, the hypothesis also requires that household consumption move with changes in average consumption of the village, with an expected coefficient of 1. As mentioned, this cannot be rejected with the ICRISAT data, although consumption does move with individual incomes as well.

Townsend (1991) reports the number of individual coefficients that differ or fail to differ from 1 when each household regression is done separately, a test that the long panel of ICRISAT data makes possible. It is not possible with the data here, however, if a full year's income is to be considered as a single observation.

The models presented in Table 4 are repeated in Table 6 with changes in current expenditures as the dependent variable. While the explanatory powers of these equations are similar to those in Table 4, most of the coefficients of assets are far fewer than those in the income models. The main exceptions are the two variables that measure changes in the numbers of adults and teenage males in the household. These measure changes in demand per se as well as changes in the income that finances consumption. If the portion of the change in income that is explained by changes in assets were perceived as a long-run change in the stream of income, one would expect the coefficients of assets in the expenditure model to be similar to those in the income model. The coefficients for the change of individual income in the consumption regressions in Table 7, however, indicate that changes in consumption do respond to changes in individual income, contrary to the full coinsurance module. The marginal propensities to consume out of predicted changes in income (using model 3 from Table 4) are small—0.059 (1.48) and 0.045 (1.55) for the difference between years 2 and 1 and between years 3 and 2, respectively. (The numbers in parentheses are t-statistics.) The coefficients of income *rise* to 0.118 (1.46) and 0.115 (2.80), however, when community covariates are included in the consumption function. This rules out a strict version of a coinsurance hypothesis; if changes in household income affect consumption only indirectly through its impact on overall community consumption, the inclusion of community covariates would lead to a decrease in the measured impact of household income on consumption.

It is nevertheless noteworthy that consumption does not change very much when incomes fluctuate. This implies that households are able to protect their consumption

---

[13] A number of other tests of coinsurance in recent literature are reviewed in Alderman and Paxson (1992). This study focuses on Townsend's work because it has been seminal.

levels from short-term changes in income. This protection presumably is through household savings, which are discussed in depth in Chapter 5.

Income Mobility

Given that average incomes have not changed despite a fair amount of short-term fluctuation (as well as measurement error in income), it is worthwhile to ask if any income movement can be unambiguously deemed mobility. As mentioned, Gaiha (1989) found changes in income in periods as short as the one studied here, but he did not address the issue of measurement error. Similarly, Lanjouw and Stern (1991) present a transition matrix that illustrates the mobility of households in Palanpur, India, during various periods from 1957/58 to 1983/84. They found few households on the diagonal of a cross-tabulation of rankings between periods. This, again, is indicative of income mobility, although of current income plus measurement error.[14]

A similar result is found for the households in this study. Few households stayed in the same income quintile every year. For example, of the 146 households in the lowest income-per-capita quintile in year 1, only 36 were in that quintile in both of the successive years. The average income of this group increased 70 percent between the first and third year. Over the entire sample, only 234 households failed to change quintile rankings between the first and the third year. A similar exercise can be done with expenditure rankings, with half rather than a third of the households on the main diagonal. This is consistent both with the view that expenditures are less volatile than incomes and with the possibility that there is less measurement error in expenditures than in income.

An analogous transition matrix that is less sensitive to measurement error can be constructed by calculating income using the district average of the coefficients from the annual income-instrumenting equations (Appendix 1, Tables 39 and 40). The average return to assets over the three years multiplied by the assets held in a given year gives a measure of expected income for each household. The measure looks at changes in long-term income rather than transitory shocks (such as an illness or an exceptionally good harvest) and is calculated exclusive of transfers. As the coefficients are kept constant, estimated incomes differ only with regard to the assets held or family composition. A transition matrix with predicted income per capita in rounds 1 and 3, holding the coefficients in the predicting equation constant, has 50 percent of all households on the main diagonal when ranked by quintiles. From another perspective, 19.8 percent of the 212 households with a predicted income of less than 2,000 rupees (Rs) per capita,[15] based on assets held in the first year, had predicted real income above that cutoff point by the second year, and 30.7 percent by the third year. Unlike rankings that require symmetric declines for every upward movement, there is no reason why there should be a corresponding number of households with a change in predicted income bringing the households below the cutoff point. Nevertheless, this was the case in this period. These changes reflect only a measure of

---

[14] See also Walker and Ryan 1990.

[15] US$1.00 = Rs 17.16 in 1986/87.

increased assets, including education and potential laborers as well as physical capital. The fact that there are considerable movements in wealth in the short span of the survey indicates fluidity in the villages surveyed.

Unless, of course, there are appreciable errors in the measurement of the assets themselves. A priori, one would expect that there would be less error in household composition or landholdings (although errors in the date of sales or transfer of title to relatives can introduce some error). Moreover, as the coefficients in the first-difference equations above are plausible, it is less likely that measurement error drives the movement in assets observed. Changes in landownership are particularly illustrative of these movements, and these data were verified in the course of later work in the same villages in 1991.

Although landholding is believed to be fairly constant in South Asia, 73 households increased their irrigated landholdings during the period of the survey and 34 decreased them. The corresponding figures for rainfed land are 42 increases and 34 decreases. As a point of reference, 296 households surveyed in all three years had irrigated land in the first year and 208 had some rainfed land. In the period of the survey, 22 landless households acquired land and 5 landed households became landless. From another perspective, there was a *net* increase of irrigated acreage in the sample equal to 8.4 percent of initial holdings; the total amount of sales, purchases, and land newly irrigated through investments in wells was 17.2 percent of the initial holdings. Although there was no net increase in rainfed area, sales and purchases were 10 percent of initial holdings.

Part of this change in assets represents life-cycle changes. Some reductions are due to family separations. There is a significant decrease in household size, both for the group of households with decreases in irrigated land and for those who reduced their rainfed holdings. No corresponding increase of household size for the households that increased holdings was observed. In addition, land purchases and sales are part of savings out of remittances or following transitory shocks. Causes of asset movement, however, are hard to distinguish in a short panel. Nevertheless, the data on land movement, as with those on predicted incomes, indicate dynamic economic positions even within a comparatively stagnant community economy.

4

POVERTY MEASURES

Sensitivity of Poverty Measures

There is a large body of literature on the concept and measurement of poverty (see, for example, Glewwe and van der Gaag 1990; Lipton and Ravallion forthcoming; and Anand and Harris 1991). Clearly, any development strategy that places a value on the alleviation of poverty, which is distinct from the general objective of raising aggregate income, needs to define how poverty is measured. Specific examples of such strategies would be transfer programs that are targeted or those that direct subsidized inputs or consumer goods to households or individuals defined as poor. While some of the conceptual issues will remain in question, whether alternative definitions change who is decreed poor is an important researchable issue. For example, Glewwe and van der Gaag (1990) examine the question of whether different definitions of poverty matter, using a cross-sectional data set. Lanjouw and Stern (1991) also compare alternative definitions, both in cross-section and between a single year's income and a measure of income over three decades. Chaudhuri and Ravallion (forthcoming) follow in the same direction, using the ICRISAT South India panel.[16] Using average income as a reference point, they determine the cost of poverty alleviation by means of income transfers that are determined by data from a single year. They find that transfers based on landholdings or food shares are imprecise, compared with the preferred income measure or current expenditures.

There are a number of behavioral reasons why alternative measures of poverty may lead to different classifications. For example, expenditure patterns may reflect life-cycle changes, such as the birth of a child or aging. Similarly, food expenditures can vary, although resources are similar, due to differences in health, energy outlay, and taste. Expenditures and other measures can fluctuate between years, due to movements in prices or temporary changes in requirements and resources. However, these measures may also appear to differ in cross-section or over years due to random error. As discussed throughout this report, it is often hard to tell whether shifts in these indicators are the result of difficulties in measurement. Comparisons of poverty indicators, then, show the data limitations that researchers and planners are likely to face, as well as the uncertainty of welfare in poor communities.

Glewwe and van der Gaag (1990) address the issue of whether the measures obtained from survey data are robust. They define the poor as the lowest 30 percent of the population (urban or rural, taken separately) by different measures and ask how many poor are misclassified by each measure. Since one does not know who is "truly" poor, however, they use as their standard the poor population as defined by consumption per adult equivalent.

---

[16] See also Ravallion and Bidani 1992.

Table 8 essentially reproduces Glewwe and van der Gaag's (1990) analysis with the following modifications. Although interyear fluctuations are examined, in order to partially separate the issue of transitory poverty from chronic poverty, incomes, expenditure, and so forth are averaged over the three years. Thus, the measures in Table 8 should be less subject to random measurement error than the single year in Glewwe and van der Gaag (1990). Here, the poor are defined as the lowest 20 percent of the population by the alternative rankings. This roughly corresponds to the number of households who would be defined as poor, using a poverty cutoff line of Rs 2,000 per capita (in 1986 constant rupees) of either income or expenditures, a cutoff close to that calculated based on food expenditures by Malik (1993) in his comparison of national household expenditure data. Quintile rankings force each measure of poverty to define the same number of households as poor. This is an advantage for this exercise, although not necessarily so for program design. An exception is landholding; since more than 20 percent of the sample households do not own land, poverty is defined as landlessness rather than as the lowest quintile.

The current analysis also uses adult equivalency scales based on caloric requirements. The welfare equivalence weights used by Glewwe and van der Gaag (1990) have children and teenagers between 0.20 and 0.50 adult equivalents, while the calorie-based measures range from 0.50 to 0.85. Finally, and most important, the present study does not presume any single measure as the standard for comparison.

Table 8 indicates the percentage of households in each category that are classified as poor by alternative measures. Households are ranked over the entire sample. The degree to which various measures of poverty overlap is similar to that reported in the Côte d'Ivoire study. For example, using the data reported by Glewwe and van der Gaag (1990), one can calculate that 88.1 percent of the households categorized as being in the lowest group based on per capita expenditures in Côte d'Ivoire are also in that group based on expenditures per adult equivalent (which accounts for differences in age of household members). The overlap of per capita income and expenditures per adult equivalent in that study was 58.9 percent in rural areas. While the 88.1 percent figure is close to the 88.4 percent reported in Table 8, the 58.9 percent figure exceeds the overlap in Pakistan.[17] As in Chaudhuri and Ravallion (forthcoming), the overlap of food share with any of the other measures is comparatively weak.

It is not particularly interesting to discuss the χ^2 tests of whether any pairs of measures are correlated; if only 25.8 (27.9) percent of households overlap, then the hypothesis that the measures are uncorrelated is rejected at the 5 percent (1 percent) level of significance. It is of greater interest to discuss the *functional* rather than the *statistical* significance of the difference. To do this, one has to ask what is the objective of classifying individuals as poor and nonpoor.

Clearly, one objective is to determine eligibility for targeted poverty alleviation efforts. This is the prime reason for Glewwe and van der Gaag's exercise. One has to be concerned about individuals or households that may be misclassified, whether

---

[17] Note, however, that there are no variables in common in the calculations of income and expenditure in the IFPRI data set. Often, this is not the case. For example, if consumption of foods produced on one's own farm is used to calculate both expenditures and income, a correlation of errors will strengthen the overlap of these two variables. A similar situation results if the same set of prices is used to impute both expenditures and income.

Table 8—Overlap of poverty indicators as defined by various indices ranked over sample

Indicator	Per Capita Expenditure	Per Capita Income	Per Capita Income Plus Transfers	Expenditure Per Adult Equivalency	Per Capita Food Expenditure	Per Capita Calorie Consumption	Landless	Per Capita Predicted Income	Food Share	Household Expenditure
					(percent)					
Per capita expenditure										
Per capita income	34.9									
Per capita income plus transfer	34.2	73.3								
Expenditure per adult equivalency	88.4	30.8	32.9							
Per capita food expenditure	87.0	32.2	27.4	79.5						
Per capita calorie consumption	48.6	31.5	25.3	45.2	52.7					
Landless	61.0	54.8	53.4	61.0	61.0	57.5				
Per capita predicted income	37.2	60.7	52.0	37.2	36.6	36.6	62.1			
Food share[a]	36.7	31.3	34.9	39.5	27.9	17.7	48.3	27.6		
Household expenditure	35.6	25.3	24.6	38.4	35.6	20.5	64.4	20.7	25.9	

Notes: Number of households in sample = 734. Each cell represents the percentage of households classified as poor by one index that are also classified as poor using another. For example, 88.4 percent of households in the lowest quintile of per capita expenditures are also in the lowest quintile when ranked by expenditure per adult equivalents. Because landless covers more than a quintile, the cells are not symmetric. The row implies, for example, that 61.0 percent of the lowest quintile for per capita expenditures are landless. A smaller percentage of all landless, however, are in the lowest quintile.

[a] Inverse ranking.

poor households are misclassified as nonpoor or nonpoor households are deemed poor and hence eligible for a targeted program.[18] Under this objective, a weak overlap between various criteria is indicative of potential difficulties in determining whether any household is in poverty or not.

Alternatively, if the objective is not to find the poverty level of the different entities but rather to discover the characteristics of the poor,[19] one looks at statistical correlates of the poor in order to design programs that take into account their constraints and attributes. A basic correlate is the geographic distribution of poverty. Table 9 is indicative of the lack of robustness of poverty definitions. The correlates of poverty (the coefficients in the probit regressions) in this table change as the poverty cutoff is redefined (this was also the case in a similar exercise in Lanjouw and Stern 1991). Note, for example, that the probability of poverty as defined by income per adult equivalent is statistically higher in Attock than the other districts. This is not the case when poverty is defined by an expenditure measure. Through most of the three-year period, Attock endured weather-related shocks. Through savings and by

Table 9—Probit regressions on probability of poverty

Poverty Definition	Lowest Quintile of Expenditure per Adult Equivalent	Lowest Quintile of Income per Adult Equivalent	Calories per Adult Equivalent Less Than 2,360
Intercept	–2.46 (10.55)	–1.33 (7.10)	–2.11 (11.02)
Live in Badin	–1.40 (4.75)	0.19 (1.04)	–0.18 (1.00)
Live in Dir	1.28 (7.09)	0.10 (0.56)	–0.46 (2.60)
Live in Attock	0.26 (1.04)	1.06 (5.58)	–0.23 (1.14)
Household size	0.20 (8.41)	0.03 (1.51)	0.15 (8.62)
Irrigated area owned	–0.06 (6.60)	–0.03 (2.92)	–0.03 (3.86)
Rainfed area owned	–0.33 (2.19)	0.06 (3.52)	–0.03 (2.17)
Percent of household members less than six years old	–0.64 (1.18)	0.83 (1.91)	1.80 (3.77)
Migrants/household	0.86 (0.38)	–2.65 (1.93)	–3.30 (2.00)

Note: The numbers in parentheses are *t*-values.

---

[18] For a discussion of targeting, see Alderman 1991.

[19] There is at least one other major reason for classifying poverty. Often one is concerned with counting the number of poor individuals or measuring the depth of poverty. Clearly, defining poverty in terms of the lowest quintile is not suitable for this purpose. For a discussion on this approach in the Pakistani context, as well as references to the overall literature, see Malik 1993.

selling assets, the households in the district apparently maintained their levels of consumption.[20] This result, however, appears to represent real conditions in the three years. The other coefficients in this comparatively simple model also change in magnitude, sign, or significance as the definition of the poorest quintile changes.

The main purpose of Table 9, however, is not to indicate the correlates of poverty, but rather to argue that on both philosophical and empirical grounds, there are enormous pitfalls in defining poverty in a single dimension (see Lipton and Ravallion forthcoming). The various definitions of poverty used in Tables 8 and 9 are based on a longer period of observation (three years) than is commonly used to construct poverty profiles. Similarly, the amount of information obtained in the 12 visits exceeds that commonly available from representative samples. Nevertheless, it would still be difficult to use the data available to determine unambiguously the poorest households in the communities studied.

In the above discussion, measures averaged over three years are presented and may be viewed as illustrative of the difficulty of determining chronic poverty. The problems are even greater when one is concerned with short-term states of poverty. Repeated observations on income or expenditures may be more accurate than a single measure if incomes are relatively stationary and measurement errors are uncorrelated over time. The data on yearly classifications of poverty in Table 10 thus bolster the argument that survey data cannot determine poverty unambiguously. The rows in this table show different households ranked as poor, using three-year averages and a cutoff point of Rs 2,000 per capita or landlessness. The columns indicate the number of households that were poor by this criterion in any given year and the number of times this occurred.[21]

Except when established by construction (for example, when the row is the mean of the annual values in columns), there are always some nonpoor households by one criterion that appear to be poor in all three years by another criterion, or vice versa. Comparatively few households in each category are either never poor or always poor during the three-year period. Moreover, there is only a slight difference in the classifications when average income includes additional income found in a survey in the same villages undertaken two years after the main body of data was collected.[22]

Table 11 reports similar measures for a subset of the sample having at least one child aged less than 60 months in each of the three years. This table concentrates on measures of malnutrition. One measure indicates the number of years in which a decline in weight was observed for at least one child. The other two measures indicate the number of years in which at least one child was acutely malnourished (weight-for-height more than two standard deviations below the norms) in at least one round or

---

[20] Malik's (1993) study of household income and expenditure survey data indicates that the Barani Punjab (defined as Jhelum, Rawalpindi, and Attock) had the lowest levels of rural poverty in the country in both 1984/85 and 1987/88, despite the district's low ranking on other criteria.

[21] An alternative approach to this matrix would show the number of households that are poor in any year. See Chaudhuri and Ravallion forthcoming. Whereas this would convey some information not illustrated in Table 9, it would not show whether the same households were classified across the years.

[22] The data in this supplementary survey differ slightly from the other three years in the period of recall and the degree of aggregation. They are not used for the bulk of this study, as little information on consumption and no anthropometric data were obtained.

Table 10—Cross-classification matrix of poverty measures

Long-Run Measures	Income Group	Number of Households	Number of Times Classified Poor by																			
			Annual Income				Annual Income Plus Transfers				Predicted Annual Income				Consumption Expenditure				Calories per Adult Equivalent			
			0	1	2	3	0	1	2	3	0	1	2	3	0	1	2	3	0	1	2	3
Average three-year income below Rs 2,000 per capita	Nonpoor	493	277	175	41	0	320	151	22	0	401	40	32	20	283	89	78	43	266	127	73	27
	Poor	241	0	20	88	133	26	50	80	85	104	45	44	48	117	40	125	39	95	69	60	17
Average three-year income plus transfers below Rs 2,000 per capita	Nonpoor	565	277	183	76	29	346	184	35	0	458	52	35	20	332	102	86	45	293	151	90	31
	Poor	169	0	12	53	104	0	17	67	85	47	33	41	48	68	27	37	37	68	45	44	13
Average four-year income plus transfers below Rs 2,000 per capita	Nonpoor	535	265	163	78	34	330	166	36	3	424	51	30	20	324	97	74	40	285	139	83	30
	Poor	165	0	19	54	92	0	26	62	77	47	28	43	47	60	28	41	36	61	47	44	13
Predicted three-year income plus transfers below Rs 2,000 per capita	Nonpoor	690	266	169	102	73	334	143	72	31	505	79	25	0	346	105	100	59	317	161	98	34
	Poor	124	11	20	27	60	12	28	30	54	0	6	50	68	54	29	73	23	44	35	35	10
Average three-year consumption expenditure below Rs 2,000 per capita	Nonpoor	561	235	141	96	89	300	142	73	46	406	59	51	45	400	116	45	0	317	140	84	20
	Poor	173	42	54	33	44	46	59	29	39	99	26	25	23	0	13	78	82	44	56	49	24
Average calories below 2,300 per adult equivalent	Nonpoor	593	242	153	100	98	300	151	84	58	427	64	55	47	360	161	88	44	361	179	53	0
	Poor	141	35	42	29	35	46	50	18	27	78	21	21	21	40	28	35	38	0	17	80	44
Landless, 1986-89	Nonpoor	458	195	120	79	64	245	122	54	37	345	43	28	32	303	74	51	30	264	117	61	16
	Poor	276	82	75	50	69	101	79	48	48	160	42	38	36	97	55	72	52	97	79	72	28

Table 11—Cross-classification of poverty based on income, expenditure, and malnutrition

Definition of Long-Run Measure	Income Group	Number of Households	Number of Times Classified as Malnourished by											
			Acute Malnutrition				Low Weight-for-Age				Weight Loss			
			0	1	2	3	0	1	2	3	0	1	2	3
Average three-year income below Rs 2,000 per capita	Nonpoor	262	98	87	52	25	16	34	88	124	86	108	61	9
	Poor	173	69	63	19	22	5	24	45	99	44	93	30	6
Average three-year income plus transfers below Rs 2,000 per capita	Nonpoor	211	122	104	58	27	17	45	101	148	92	136	72	11
	Poor	124	45	46	13	20	4	13	32	75	38	63	19	4
Average four-year income plus transfers below Rs 2,000 per capita	Nonpoor	310	122	103	57	28	17	47	97	149	90	140	69	11
	Poor	125	45	47	14	19	4	11	36	74	40	59	22	4
Predicted three-year income plus transfers below Rs 2,000 per capita	Nonpoor	354	135	126	60	33	19	48	107	180	108	159	73	13
	Poor	81	32	24	11	14	2	10	26	43	22	40	17	2
Average three-year consumption expenditure below Rs 2,000 per capita	Nonpoor	289	123	103	43	20	20	47	103	119	74	138	67	10
	Poor	146	44	47	28	27	1	11	20	104	56	61	24	5
Average calories below 2,300 per adult equivalent	Nonpoor	320	129	107	49	35	19	52	99	149	100	151	51	8
	Poor	115	38	43	22	12	2	5	34	74	24	48	36	7
Landless 1986-89	Nonpoor	263	102	81	51	29	17	42	82	122	83	119	51	10
	Poor	172	65	69	20	18	4	16	51	101	47	80	46	5

Note: Households included had at least one child under 60 months in all three years.

had low weight-for-age. Since these are household measures, the number of households that are flagged by such filters exceeds the number of individuals in similar categories. For example, in any given round, roughly 10 percent of the young children were acutely malnourished, yet a third of the households had at least one child in this category in any given *year*.

Thus, these measures are distributed across the nonpoor and the poor. While poorer households generally have a statistically higher-than-proportional share of households with two or three cases of malnutrition, and there is a statistical relationship between the probability of being malnourished and income (see Chapter 7), there are numerous misclassifications, which, as mentioned, reflect both measurement errors and that malnutrition is a manifestation of many factors, of which household-level resources are only one.

The results do not, however, indicate that targeting makes no improvement in the distribution of resources. On the contrary, whereas roughly one-fifth of the sample households are poor, based on various measured averages over three years, the long-run measures will capture about half the poverty in any given year. For example, 23.1 percent of the households have average incomes (including transfers) below Rs 2,000 per capita. Of the 507 annual observations of the poor, defined in this manner, 42 percent of the households had expenditures below the cutoff. This is roughly twice the percentage that would have occurred if 23.1 percent of the households were randomly chosen.[23] Even with inaccuracies and ambiguities, targeting based on poverty data is better than no targeting at all. If the landless are deemed poor, then slightly more than 40 percent of the time in any given year the group deemed poor would include those households with incomes or expenditures of less than Rs 2,000 per capita in that year. However, since 38 percent of the households are landless, this indicates that landlessness is not a precise screening mechanism.

Given that the data for this study, like similar studies cited, were collected as part of a labor-intensive research effort, such results indicate the level of uncertainty that can be expected in targeting based on poverty according to income or various proxies. In practice, various formulas based on landholding, household size, reported wage income, and quality of housing are used by administrators to target programs. As indicated in this study as well as in Chaudhuri and Ravallion (forthcoming) and Ravallion (1989), data on landlessness, though easy to collect, need to be augmented to be useful as a means of determining the poverty of individuals and households. The precision that can be obtained with additional data, however, should not be overestimated; an allowance for inherent uncertainty is necessary. This is not only because of the transitory nature of incomes and expenditure but because any reasonable expectation should assume appreciable measurement error at any plausible level of monitoring effort.

It is argued here, however, that this does not rule out targeting programs to the poor or monitoring the impacts of programs and policy on poverty, but the inherent imprecision should be acknowledged in any such endeavors. For example, the level of errors of inclusion and exclusion deemed acceptable in targeting needs to be wide enough to accommodate not only the political and economic costs of targeting (Alderman 1991) but to acknowledge the inherent uncertainty in any definition. Self-targeting measures—including public works programs—do that to a degree. Similarly, types of poverty alleviation programs that combine a wide but shallow safety net with a narrower but deeper one (Alderman, Sahn, and Arulpragasam 1991), or similar programs that do not have an all-or-nothing cutoff, are consistent with this view. Criteria for programs that decide eligibility on the basis of one or another filter rather than using a single cutoff or a cumulative combination of cutoffs also recognize that poverty is neither defined nor measured by a single set of correlates.

This perspective also underlies the use of community assessment to define poverty. Lanjouw and Stern (1991) discuss this in terms of a long-run study of a single village. Community assessments of poverty use a wider range of information than is generally available in survey data. Moreover, such assessments use what is referred to in computer programming as "fuzzy logic"—an ability to understand gradations and near fits that is seldom found in algorithms used to establish poverty cutoffs.

---

[23] Chaudhuri and Ravallion's six- and eight-year panel data show a larger percentage of long-term poor indicated in any year's data. However, the poverty line identified a proportion of poor that was roughly twice that in this sample. Errors of exclusion should decrease as the cutoff becomes less stringent.

Grosh (1992) also indicates that community assessment is a plausible operational tool for a number of targeted programs. This approach may be best suited to nongovernmental organizations (or local *zakat* committees), but the use of flexible poverty programs on national or regional scales is relatively unexplored.[24]

Income Inequality

In addition to reducing poverty, policymakers often are concerned about reducing income inequality. This reflects, in part, the possibility that strategies that lead to income growth and at the same time increase inequality may be unsustainable. Thus, there is a need to determine not only the level but also the structure of income inequality.

There are various measures that can be used to decompose the sources of income inequality reported in Table 1. According to the literature (Kakwani 1980; Foster 1985), the inequality measure chosen should have five basic properties: transfer sensitivity, symmetry, mean independence, population homogeneity, and decomposability.

Transfer sensitivity holds if the measure of inequality increases whenever income is transferred from one person to someone richer. Symmetry holds if the measure of inequality remains unchanged when individuals switch places in the income order. Mean independence holds if a proportionate change in all incomes leaves the measure of inequality unchanged. Population homogeneity holds if increasing (or decreasing) the population size across all income levels has no effect on the measured level of inequality.

Decomposability, for the purposes of this analysis, refers to source decomposability. Ideally, one would expect that an inequality measure is source decomposable if total inequality can be broken down into a weighted sum of inequality by various income sources (for example, agricultural and nonagricultural income). However, this is not possible if there is covariance among the sources of income. Thus, no inequality measure is source decomposable if it cannot deal with covariance among the income sources.

One of several inequality measures that meet these five conditions,[25] the Gini coefficient is a commonly used measure of inequality that ranges from 0 (equal distribution of income) to 1 (total concentration of income). The decomposition of the Gini coefficient can be developed as follows. Pyatt, Chen, and Fei (1980) have shown that the Gini coefficient of total income, G, can be written as

$$G = \frac{2}{n\mu} \text{ Cov } (y, r), \tag{10}$$

where n is the number of observations, μ is the mean income of the sample, y refers to the series of total household incomes, and r refers to the series of corresponding

---

[24] As with community participation in program design, which is philosophically similar, this approach has the potential for corruption and capture by local elites. The probability and costs of such diversions, compared with centralized projects, are unknown.

[25] Alternative decomposition methodologies are presented in Adams and Alderman 1992. See also Glewwe 1986 and Ercelawn 1984.

ranks. On this basis, the Gini coefficient of the i^{th} source of income, G_i, can be expressed as

$$G_i = \frac{2}{n\mu_i} \text{Cov}\,(y_i, r_i), \tag{11}$$

where y_i and r_i refer to the series of incomes from the i^{th} source and corresponding ranks, respectively. Since total income is the sum of income from all sources, the covariance between total income and its rank can be written as the sum of covariances between each source of income and rank of total income. Equations (10) and (11) can then be used to express the total income Gini as a function of the source Ginis:

$$G = \sum \frac{\mu_i}{\mu} R_i\, G_i, \tag{12}$$

where R_i is the correlation ratio expressed as

$$R_i = \frac{\text{cov}\,(y_i, r)}{\text{cov}\,(y_i, r_i)} = \frac{\begin{array}{c}\text{covariance between source income amount}\\ \text{and total income rank}\end{array}}{\begin{array}{c}\text{covariance between source income amount}\\ \text{and source income rank}\end{array}}\ . \tag{13}$$

The decomposition of the Gini coefficient can be further elucidated with the following terms:

$$w_i = \frac{\mu_i}{\mu}\,;\, g_i = R_i \frac{G_i}{G} = \sum w_i\, g_i = 1, \tag{14}$$

where g_i is the relative concentration coefficient of the i^{th} source in overall inequality, and $w_i g_i$ is the factor inequality weight of the i^{th} source in overall inequality.

Table 12 (part A) reports the overall Gini coefficients for income, landownership, and land operation for the four districts. The overall Gini coefficients of income are moderate. However, it should be recalled that the resource base within a district is relatively homogeneous; a sample that is pooled over urban and rural areas or over various districts is likely to show more inequality. Note, for example, that the overall Gini coefficient for income for these four districts is 0.402. That is, the grouped Gini exceeds the separate Ginis recorded for each of the districts.

Table 12 (part B) presents the factor inequality weights of income sources in overall inequality. The contributions of different income sources to total inequality vary considerably by district. For example, in Faisalabad and Badin, agricultural income makes the largest or second largest contribution to overall income inequality. However, in Dir, agricultural income makes only a small contribution to overall inequality; in this district, transfer income makes the largest contribution to inequality.

Since land and property ownership are quite skewed in the sample areas, it is not surprising that rental income makes a large contribution to overall inequality in three of the four districts: Faisalabad, Attock, and Badin. In the fourth district, Dir, rental incomes are no less skewed than in Faisalabad, but the share of total income from rental is relatively small; hence, the factor inequality weight is also comparatively small.

Table 12—Decomposition of per capita income inequality by districts, 1986/87-1988/89

Coefficient	Attock	Faisalabad	Badin	Dir
A. Overall Gini coefficients				
Gini coefficient for income	0.369	0.397	0.314	0.314
Gini coefficient of land ownership[a]	0.783	0.726	0.763	0.759
Gini coefficient of land operation[a]	0.646	0.640	0.499	0.728
B. Factor inequality weights[b] of source incomes in overall inequality				
Proportion of inequality contributed by				
Agricultural	0.175	0.455	0.315	0.138
Rental	0.281	0.287	0.339	0.107
Nonfarm	0.346	0.102	0.147	0.208
Transfers	0.185	0.098	0.056	0.465
Livestock	0.012	0.059	0.143	0.083
C. Concentration coefficients[c] of source incomes in overall inequality				
Agricultural	1.615	1.395	0.841	0.980
Rental	2.071	1.853	3.002	1.845
Nonfarm	0.509	0.347	0.586	0.503
Transfers	0.649	0.159	1.818	1.718
Livestock	1.342	0.414	0.844	0.446

[a] Based on 1986/87 holdings and operations.

[b] Factor inequality weight: $w_i g_i$ where $w_i = \frac{\mu_i}{\mu}$ and $g_i = R_i \frac{G_i}{G}$.

[c] Concentration coefficient: $g_i = R_i \frac{G_i}{G}$.

In any decomposition exercise, an income source can be defined as inequality-increasing or inequality-decreasing on the basis of whether an enlarged share of that income leads to an increase or decrease in total income inequality. As defined, an income source is inequality-increasing or inequality-decreasing according to whether or not the relative concentration coefficient (g_i) for that income source is greater or less than unity.

Table 12 (part C) shows that two income sources—nonfarm and livestock—generally represent inequality-decreasing sources of income since their relative concentration coefficients are less than 1.0. Nonfarm income is important because it is a major and growing share of total rural income. Livestock is also of interest because the impact of livestock on income distribution is often debated. While cross-section data by themselves cannot completely resolve this debate, that livestock income represents an inequality-decreasing source of income in three of the four districts is an encouraging sign that this income source is evenly distributed. On the other hand, the data suggest that rental income represents an inequality-increasing source of income in all four of the districts. This suggests that rental income—either from land rent or capital rent (machinery, water)—is unevenly distributed.

Adams and Alderman (1992) have also decomposed Gini coefficients for agricultural incomes (including land rent and imputed land rent) from the pooled sample. That study finds that returns to labor and crop profit make roughly the same contribution to inequality as does landownership. Because it is probably easier to change

5

HOUSEHOLD SAVINGS

The literature in developing countries recognizes the importance of savings to both macro- and microeconomic concerns. At the household level, for example, savings are a buffer to help households cope with the uncertainty of both income and needs. This motive for saving is particularly important in the absence of adequate credit and insurance markets (Alderman and Paxson 1992; Deaton 1989; Paxson 1992; Zeldes 1989a). An understanding of savings behavior contributes to an understanding of household welfare over and above its contribution to modeling aggregate investment behavior. Given the fluidity of income in the sample, nutrition and consumption in particular will be strongly influenced by a household's ability to save and its access to credit.

Moreover, since capital accumulation is at the heart of many models of development, a better understanding of the process at the household level can also contribute to an understanding of the aggregate process. Does one rule out, for example, the contribution to national savings of millions of semisubsistence farmers, as Lewis (1954) did? Similarly, do the predictions of the effects of population growth in a life-cycle savings model—with or without inheritances—hold with extended family structure?

In a related vein, with earnings in rural areas being seasonal and often highly variable, an understanding of the means by which households smooth income fluctuations from year to year—fluctuations that may be strongly correlated within a region—can contribute to an understanding of market integration and capital flow. Financial savings may play a different macroeconomic role than savings in kind, depending, in part, on whether the savings are in the formal or informal sector. That is, the form as well as the level of savings is important to the development process.

Household savings are, however, notoriously difficult to measure (Kozel 1987). Most commonly, in household-level studies, savings are taken as the residual between observed expenditures and observed income. If, as Visaria (1980) reports, households are more likely to underreport incomes than expenditures, savings are probably underestimated. Moreover, incomes are subject to transitory shocks, which in an agriculture-based economy are likely to be correlated across households. Consequently, in any given year, it is possible that a large percentage of a community will have negative savings (dissavings), although this is unlikely to persist over many years.

An alternative to using residuals as a measure of savings is to take the sum of reported purchases and sales of capital goods and financial assets. Observed savings (investment behavior) have the advantage of being uncorrelated with errors in estimating income. Furthermore, they have the potential of being divided into subcategories such as financial savings and physical capital. They may be either under- or overestimated, however, to the degree that cash flows are unreported. Savings under the mattress or purchases of gold are rarely recorded in a survey. The direction of the bias is indeterminant. For example, if such unrecorded cash holdings (lagged savings) inequalities in crop profits than in landholding, this implies a potential means of decreasing inequality by focusing on techniques and technologies of production as well as on asset distribution.

Short-Term Changes in Income Distribution

Nugent and Walther (1982) argue that measured income inequality may vary appreciably between years in a rural population because poor weather increases income inequality. This need not always be the case; it depends, among other things, on the covariance of weather shocks across households as well as between sources of income. Thus, the Gini coefficients were also estimated and decomposed separately for each year. While the results are not reported here for the sake of conciseness, the following points were noted. First, the year with the most widespread shocks (1986/87) has the lowest amount of income inequality, although no direct relationship can be inferred.

Second, the relative magnitude of the concentration of source inequality—a measure of the weighted skew of income from a given source compared with overall distribution—changes little over the three years. If the sources are ranked in order of the largest to the least concentration, the five sources are ranked as follows in years 1 and 3: rental, transfers, agriculture, nonfarm, and livestock. In year 2, the positions of livestock and nonagricultural income are reversed. Rental incomes are the most skewed and nonfarm incomes, the least, controlling for correlations across income sources, with agriculture having an intermediate position. Depending on the year, agricultural incomes account for 26.9-36.8 percent of total income inequality in the sample. The interyear change reflects changes in the income weights of the various income sources more than changes in the skewness of agriculture, compared with other sources. Similarly, the pronounced drop in the contribution of transfer income to total income inequality—from 22.6 percent to 8.7 percent of total inequality—is primarily due to the decline of its income weight rather than any change in its relative concentration. This implies that short-term fluctuation in the measure of inequality can be attributed to changes in source shares rather than differences in concentrations within sources.

Third, when agricultural incomes are disaggregated by year, returns to labor and crop profits contribute a larger share of total inequality than when the data are aggregated over three years. This probably reflects the fact that interyear fluctuations of rent and imputed rent are less than those for labor and crop profits. Thus, aggregation over time reduces cross-section variance—the basis for measures of inequality—less for land than it does for other sources of profits (Adams and Alderman 1992).

are used to finance easily observed construction—as is often the case when credit markets are rudimentary—positive savings may be recorded when the actual household asset position has not changed. Alternatively, savings will be underestimated when proceeds from a good harvest are set aside in liquid but not recorded cash resources.

Which types of expenditures should be considered current consumption and which should be considered savings is another measurement issue. While certain items such as services or food are clearly consumption, some expenditures are on goods that yield a flow of services over many years and, therefore, allow a household to use current income to contribute to future utility. This is clearly one of the main functions of savings. Consumer durables and even housing fall in this category.

Accordingly, four definitions of savings for the five districts surveyed in the first year are presented in Table 13. Gross savings are calculated from residuals and also as the sum of observed real and financial investment. The components of this investment

Table 13— Household savings rates by expenditure quintile, 1986/87

		Observed Investments (Net)		Residual Savings	
District	Expenditure Quintile	Including Durables	Excluding Durables	Including Durables	Excluding Durables
Attock	1	0.061	0.059	–0.616	–0.618
	2	0.060	0.058	–0.283	–0.284
	3	0.293	0.273	–0.168	–0.188
	4	0.392	0.385	–0.234	–0.241
	5	0.564	0.563	–0.133	–0.132
	Average	0.382	0.347	–0.236	–0.246
Faisalabad	1	–0.084	–0.088	0.163	0.159
	2	–0.058	–0.061	0.085	0.082
	3	0.023	0.021	0.244	0.245
	4	0.088	0.088	0.207	0.207
	5	0.206	0.200	0.226	0.221
	Average	0.082	0.078	0.113	0.110
Badin	1	–0.086	–0.092	0.162	0.155
	2	0.145	0.139	0.052	0.046
	3	0.194	0.186	0.213	0.205
	4	0.243	0.236	0.349	0.342
	5	0.135	0.124	0.181	0.170
	Average	0.150	0.142	0.218	0.210
Dir	1	0.088	0.073	0.001	–0.013
	2	0.051	0.028	0.083	0.060
	3	0.477	0.418	0.078	0.023
	4	0.329	0.267	0.181	0.120
	5	0.403	0.342	0.146	0.084
	Average	0.336	0.286	0.085	0.035
Mastung/Kalat	1	0.100	0.052	0.079	0.031
	2	0.118	0.022	0.079	–0.017
	3	0.120	0.107	0.167	0.153
	4	0.198	0.173	0.218	0.193
	5	0.263	0.227	0.205	0.168
	Average	0.172	0.130	0.160	0.118

Source: IFPRI Rural Household Survey of Pakistan, 1986/87-1988/89.

Notes: Savings rates are defined as net savings divided by income. The lowest expenditure quintile is 1; the highest is 5.

include land purchases, tree plantings, housing and construction, purchases of animals and equipment, and net additions to savings accounts. The estimates are net of all disinvestment—that is, net of asset sales but not depreciation. In addition, loan repayment is considered savings, while borrowing is dissavings. Note, then, that a purchase of a tractor with a bank loan is a net addition to savings only to the degree that the household has an equity share. This category of savings also includes health and education expenses (which are considered investments in human capital) as well as the cost of permits, tickets, and so forth necessary to obtain employment abroad.

Both observed savings and savings defined as residuals are presented with and without consumer durables. The consumer durables category includes furniture and appliances but clothing is considered a current expenditure in this report (unlike Paxson 1992). A catch-all category of "other savings" encompasses investment goods, not consumer durables. This category is clearly heterogeneous: it may include weapons as well as chicken coops and may even include some durables. Ceremonial expenses are considered current consumption.

Table 14 presents the absolute level of savings in each district as well as relative shares. One objective of the research is to break down the propensities to save into types of investments.

One particular savings model is the permanent income model, under which consumption will be a function of long-run expected (or permanent) income (denoted as Y^P, a measure of the returns to assets and human capital wealth and only the annuity value of transitory shocks to income, Y^T). As Zeldes (1989b) points out, this model is generally made tractable by assuming either that the utility function is quadratic or that income is not stochastic and that there are no borrowing constraints. Moreover, in a common version of the permanent income model, the marginal propensity to consume out of permanent income is assumed to be unity, although under other formulations it can vary over a lifetime or if the interest rate does not equal the subjective discount rate (Zeldes 1989b). Most empirical studies have found that this propensity is generally significantly smaller than 1.0 and often varies by levels of wealth.[26]

A fair portion of the literature on household savings has centered on measuring how households form their expectations of lifetime returns to assets as well as what constitutes a shock to expected income. Recent specifications of lifetime income have paid particular attention to innovations in labor earnings and the degree to which such income follows a moving average or autoregressive process (Deaton 1991). For agrarian communities, however, one is often concerned with weather shocks that have a direct but short-term effect on the returns to assets as well as labor income.

Rejection of implications of the permanent income framework, then, cannot easily be distinguished from rejections of these implicit assumptions, mismeasurement of lifetime income and similar errors in measuring the portion of current income that is unanticipated. Nevertheless, as Paxson's 1992 paper as well as earlier ones by Bhalla (1980) and Musgrove (1979) indicate, when the measurement problems are solved, the permanent income framework does provide a means of studying the marginal savings rate in a population.

---

[26] Deaton (1989) presents a theoretical argument why this would be the case under liquidity constraints.

Table 14—Breakdown of household savings by type, 1986/87-1988/89

Savings by Type	Attock		Faisalabad		Badin		Dir		Mastung/Kalat[a]	
	Share	Amount	Share	Amount	Share	Amount	Share	Amount	Share	Amount
	(percent)	(1986/87 Rs)	(percent)	(1986/87 Rs)	(percent)	(1986/87 Rs)	(percent)	(1986/87 Rs)	(percent)	(1986/87 Rs)
Average net savings		888		4,747		2,691		10,298		4,698
Total savings	1.00	14,681	1.00	15,938	1.00	7,920	1.00	22,247	. . .	7,093
Education	0.02	367	0.02	330	0.01	106	0.02	429	0.01	46
Medical	0.07	1,096	0.09	1,448	0.24	1,895	0.09	1,931	0.06	460
Durables	0.05	777	0.05	770	0.03	239	0.10	2,242	0.16	1,106
Land purchase	0.10	1,442	0.08	1,249	0.09	697	0.10	2,276	0.10	737
Animal purchase	0.07	1,050	0.12	1,981	0.22	1,780	0.07	1,653	0.09	646
Building	0.31	4,576	0.20	3,165	0.13	1,065	0.27	5,926	0.10	737
Other savings	0.33	4,764	0.37	5,825	0.27	2,108	0.22	4,851	0.27	1,842
Net bank flows	0.05	609	0.07	1,170	0.01	29	0.13	2,939	0.21	1,519
Total dissavings	–1.00	–13,793	–1.00	–11,191	–1.00	–5,229	–1.00	–11,949	. . .	–2,395
Land sales	–0.06	–805	–0.09	–1,002	–0.03	–142	–0.47	–5,579	–0.04	–93
Animal sales	–0.11	–1,560	–0.23	–2,548	–0.62	–3,264	–0.12	–1,455	–0.15	–368
Other sales	–0.03	–465	–0.04	–515	–0.09	–463	–0.20	–2,406	–0.50	–1,197
Net loans	–0.80	–10,963	–0.64	–7,126	–0.26	–1,359	–0.21	–2,509	–0.31	–737

Source: IFPRI Rural Survey of Pakistan, 1986/87-1988/89.

[a] Mastung/Kalat data are for 1986/87 only.

This study, then, follows, to a degree, Paxson (1992) and Bhalla (1980), using the more general model to provide perspective on the results. The study also makes use of the identity

$$C_t + S_t = Y_t^P + Y_t^T, \tag{15}$$

where S indicates savings. To utilize available information on change of assets, all income is either saved (S) or consumed (C).

As mentioned, empirical studies of savings rates not only need to consider possible mismeasurement of savings, but also that lifetime income, and, hence, deviations from it, are not directly observed. Moreover, these two measurement problems are often linked; when savings are defined as a residual (current income minus consumption), any error in measurement will lead to a positive correlation between savings and transitory income. That is, one can calculate residual savings and transitory income as follows:

$$S_t = Y_t^O - C_t, \text{ and} \tag{16}$$

$$Y_t^T = Y_t^O - Y_t^P, \tag{17}$$

where Y^O denotes observed income.

$$Y_t^O = Y_t + \mu_t, \tag{18}$$

where μ is measurement error and Y is true income. When both savings and transitory income are defined in this manner, $(S_t + \mu_t)$ and $(Y_t^T + \mu^t)$ are in the regressions and will necessarily be correlated. On the other hand, by using *observed* savings, as is done below, one avoids the spurious correlation in these variables.

This, however, does not remove the bias toward zero that is expected when a variable on the right-hand side is measured with error. This issue is discussed in the context of the savings estimates of Paxson (1992) and Bhalla (1979). With a long panel, a household's average income or an income trend can be used as a measure of permanent income, and the difference from the trend can be used as an estimate of transitory income. This is, in effect, what Bhalla (1980) coaxes out of a three-year panel. There is some question, however, whether a three-year panel is sufficiently long enough to avoid being affected by individual-level transitory shocks.

Paxson (1992), who did not have a panel available, predicted transitory income based on the expected effects of deviations from a time series of rainfall for various districts in her sample. That is, she devised a measure of transitory income (deviations from expected income) that was instrumented rather than directly measured from household reported income. Moreover, she noted a third component of income, which is a residual of household observed incomes and estimated permanent and transitory components. This component, though not an error-free instrument, is included in her study because it contains elements of both permanent (household fixed effects) and transitory incomes.

The model below follows Paxson in that both permanent and transitory income are estimated, as well as an idiosyncratic residual element of income. That is, transitory income Y^T is further decomposed into an instrumented income shock ($\hat{Y}^S$) and a residual ($\hat{Y}^E$). Permanent income is estimated by predicting Y with income-instrumenting equations. The dependent variable in these equations is income from wage and profits; transfers are not included. Because the variable is instrumented, it does not include any household-specific fixed effects that influence income. Note that the predicting equations are run separately for each year. Moreover, the estimates of permanent income are district-specific, allowing the coefficients of assets—for example, land—to affect predicted income differently across districts (see Appendix 1).

A household's permanent income is defined as the average of income predicted with these three sets of coefficients, using household composition and assets held in any given year. The fact that the coefficients of the equations relating income to assets vary across years also provides the measure of predicted transitory income. It is assumed that the changes in parameters represent shocks to the district, say, a change of prices that increases the returns to irrigated land or a shortfall in rain that reduces the output per unit of rainfed land. That is, in each year, the estimated parameters represent a draw from a larger set of possible parameters that vary according to factors exogenous to the household. Under that assumption, the difference between the income predicted on the basis of one year's coefficients and that predicted using the average of all three would be an unbiased predictor of transitory income. This implies that in any year,

$$\hat{Y}_t^S = \hat{\gamma}_t A_t - \tfrac{1}{3} (\hat{\gamma}_1 + \hat{\gamma}_2 + \hat{\gamma}_3) A_t , \qquad (19)$$

$$\hat{Y}_t^P = \tfrac{1}{3} (\hat{\gamma}_1 + \hat{\gamma}_2 + \hat{\gamma}_3) A_t , \text{ and} \qquad (20)$$

$$\hat{Y}_t^E = Y_t - \hat{Y}_t^S - \hat{Y}_t^P , \qquad (21)$$

where $\hat{\gamma}_t$ is a parameter that maps assets, including human capital (A), into income in any given year. These parameters are derived from the estimation equations:

$$Y_t = \hat{\gamma}_t A_t + e_t ; \quad t = 1,2,3. \qquad (22)$$

The estimations reported here break savings into four subcomponents: repairs and construction, other physical capital (including durables), financial savings, and medical expenditures. In addition, consumption is divided into two components, which, in keeping with earlier studies, are denoted as permanent consumption (C^P) and transitory consumption (C^T). This latter category largely consists of ceremonies, which should be included in the model to allow income to be fully spent, but it also needs to be distinguished from other consumption and savings. While Bhalla (1980) places such ceremonies on the right-hand side in his estimates,[27] the variable can be treated as endogenous and placed on the left-hand side in a system of six equations, one each for permanent and transitory consumption as well as equations for the forms of savings studied. By distinguishing between these categories, marginal income of households can be allocated among the categories at different rates. The optimum level of assets may depend not only on the lifetime consumption plan and the equating of marginal returns across types but also on differences in liquidity and riskiness. Although these issues are frequently addressed, the literature that tests the

---

[27] Bhalla found coefficients smaller in absolute value than the predicted value of 1.

propensity to save using household data rarely presents evidence on different forms of savings.

Although income is equal to savings and consumption, when savings are obtained from reported investments rather than as a residual of income minus consumption, the various left-hand-side variables in the system are not constrained to add up identically to $Y^P + Y^S + Y^E$. It is not necessary, therefore, to drop an equation from any system estimates. One can, however, *impose* the constraint that the coefficients of Y^P, Y^S, and Y^E add up to one. This requires that each additional unit of income is completely allocated to some form of consumption or savings.

The basic system estimated (suppressing the time subscript) is

$$X_j = \alpha_j + \beta_{1j}\hat{Y}^P + \beta_{2j}\hat{Y}^S + \beta_{3j}Y^E + \beta_{4j}T^a + \beta_{5j}T^d + \beta_{6j}P + \delta_j \text{ (percent elderly)}, \quad (23)$$

where X_j is a vector comprised of current (or permanent) expenditures, construction, other physical capital savings, financial savings, medical expenditures, and ceremonial expenditures (transitory consumption). T^a is transfers or remittances from abroad, T^d is domestic transfers, and P is pensions. The j subscripts, then, denote different equations in the system. There are three variables for income as described above: $\hat{Y}^P$ is the expected return to assets, $\hat{Y}^S$ is the predicted transitory shock, and Y^E is the idiosyncratic component with both permanent and transitory elements. It is presumed that the coefficients of Y^E will lie between those of $\hat{Y}^S$ and $\hat{Y}^P$. This, however, need not be the case because this variable is more prone to errors in variables than the other income measures.

The model also recognizes that both savings and consumption will be affected by transfers, but there is no strong prior expectation as to whether households treat such resources as a return to long-run household wealth or as a temporary shock. Indeed, one of the motivations for this study is to investigate how transfers are spent. Accordingly, three categories of transfers are included as right-hand-side variables and are denoted by remittances from abroad (T^a), domestic remittances (T^d), and pensions (P). The percent of household members who are elderly is also included in the equation to account for any life-cycle effects.

The constraints imposed are

$$\sum_j \beta_{ij} = 1 \text{ for all } i\text{'s}, \quad (24)$$

and

$$\sum \delta_j = 0.$$

One can, in principle, also constrain $\sum \alpha_j = 0$, but given the average values reported, this would merely impose a counterfactual state, with no impact on the parameters of interest. One inherent problem with this specification is that it presumes that marginal savings are constant as income increases. Clearly, there is an interest in assessing this. To this end, the model is also estimated separately by income quartiles.

The results of both the constrained and unconstrained versions of the model are reported in Table 15. The mean values of the variables used in the estimation are given in Table 16. The constraints are clearly rejected (the χ^2 value with seven degrees of freedom is over 500). The sum of the parameters for the three measures of

Table 15—Household savings propensity regression equations

	Unconstrained						Constrained					
Dependent Variable	Current Expenditures	Construction	Other Capital Savings	Financial Savings	Medical Expenditures	Ceremonial Expenditures	Current Expenditures	Construction	Other Capital Savings	Financial Savings	Medical Expenditures	Ceremonial Expenditures
Constant	13,885	1,189	−1,890	–4,394	655	1,629	11,932	253	–4,907	–6,030	503	–479
	(51.43)**	(3.37)**	(–2.39)**	(–5.89)**	(6.97)**	(4.46)**	(47.16)**	(0.74)	(–6.68)**	(–8.27)**	(5.41)**	(–1.38)
Permanent	0.265	0.040	0.180	0.034	0.035	0.069	0.310	0.084	0.323	0.117	0.042	0.124
income	(24.09)**	(3.64)**	(7.20)**	(1.42)	(11.67)**	(5.75)**	(36.75)**	(0.78)	(14.04)**	(5.09)**	(14.00)**	(11.27)**
Transitory	0.107	0.045	0.126	0.163	0.031	–0.031	0.175	0.112	0.341	0.279	0.042	0.051
income	(4.46)**	(1.41)	(1.77)*	(2.43)**	(3.88)**	(–0.94)	(7.95)**	(3.73)**	(5.41)**	(4.29)**	(5.25)**	(1.70)*
Income	0.049	–0.026	0.121	0.041	0.009	–0.012	0.148	0.070	0.435	0.212	0.025	0.108
residual	(4.08)**	(–1.62)*	(3.36)**	(1.24)	(2.25)**	(–0.75)	(13.45)**	(4.67)**	(13.59)**	(6.62)**	(6.25)**	(7.20)**
Remittances	0.135	0.082	0.336	0.596	0.010	0.080	0.106	0.053	0.244	0.545	0.006	0.045
from abroad	(15.00)**	(6.83)**	(12.44)**	(23.84)**	(3.33)**	(6.67)	(13.25)**	(4.08)**	(10.17)**	(22.71)**	(2.00)**	(4.09)**
Remittances,	0.182	0.504	–0.157	0.049	0.384	0.235	0.155	0.418	–0.204	0.045	0.351	0.262
local	(7.08)**	(3.71)**	(4.62)**	(–1.52)	(3.77)**	(7.68)**	(6.91)**	(3.37)**	(4.31)**	(–2.04)**	(3.46)**	(7.47)**
Pensions	0.168	0.143	0.400	0.696	0.002	0.124	0.103	0.079	0.194	0.585	–0.008	0.046
received	(2.18)**	(1.41)	(1.78)*	(3.27)**	(0.07)	(1.19)	(1.47)	(0.83)	(0.97)	(2.90)**	(–0.31)	(0.48)
Percent of	–5,983	–777	225	1,822	988	–1,944	–5,294	–101	2,405	3,005	1,098	–1,113
elderly	(–3.42)**	(–0.33)	(0.04)	(0.38)	(1.62)*	(–0.82)	(–3.34)*	(–0.05)	(0.53)	(0.64)	(1.83)*	(–0.51)

Note: Figures in parentheses are *t*-values; N = 2,193.
*Significant at the 10 percent level.
**Significant at the 1 percent level.

Table 16— Means of variables in household savings estimates

Dependent Variable	Mean	Standard Error
Current expenditures	20,355	9,792
Physical capital savings	6,974	25,409
Construction	2,630	9,792
Other	4,344	22,752
Financial savings	-1,832	28,963
Medical expenditures	1,664	2,736
Ceremonial expenditures	4,384	11,589
Permanent income	25,785	20,748
Transitory income[a]	-1,693	7,273
Income residual	337	13,346
Remittances from abroad	3,077	17,436
Remittances, local	1,486	4,236
Pensions received	216	2,327
Percent of elderly	0.042	0.090

Source: IFPRI Rural Survey of Pakistan, 1986/87-1988/89.

Note: N = 2,193.

[a] Unlike conventional measures of transitory income, this variable need not sum to zero since assets and household compositions change between rounds. Such changes are presumed to lead to changes in expected income rather than to transitory income shocks as measured here.

transfer income all exceed 1.0 in the unconstrained model, while the two transitory income measures each sum to less than 0.4. Particularly noteworthy is the difference in the parameters of the constrained and unconstrained equations for other capital. The parameters in the current expenditures model change less in absolute terms when the constraints are imposed, although the percentage changes are large.

The interpretation of these differences and, hence, the model that is preferred depend somewhat on temperament. The rejected restrictions are not that onerous; they merely imply that all income is either spent or saved. They are implicit in other models of savings, although not directly tested. Indeed, it is unlikely that it will be found, based on any survey data, that all income, including transfers, is exactly equal to reported uses, except by construction—for example, when a catchall category is created to balance the budget. In most surveys, observed expenditure categories are not exhaustive; many categories—particularly savings under the mattress and the purchase of gold—are likely to be underreported. From this perspective, the cross-equation restrictions can be viewed as imposing prior information and the constraints as bringing the results closer to actual behavior. That is, the restrictions can be viewed not as a test of behavior, but merely as a budget identity. This is preferable to arbitrarily allocating the residual between income and reported expenditures to any category. Many readers, however, will prefer neither. Thus, the unconstrained results are reported as well.

The preceding discussion implies that any errors lie in the left-hand variables. Alternatively, or additionally, the variables on the right-hand side may be measured with error. This is most likely for the income residual, since permanent income and transitory income are predicted variables in this model. Nevertheless, errors in one variable can bias all parameters in a direction that generally is indeterminant a priori. The authors know of little in the literature on errors in variables under cross-equation restrictions. Alternative measures of transitory income were used in order to indicate the sensitivity of the results. Few conclusions differ with alternative measures. For example, dropping the income residual led to a 1.7 percent increase in the coefficient of transitory income in the current expenditure equation and to decreases of less than 0.5 percent in the equations for physical and financial savings.[28] Similarly, the model is basically the same if one uses the predicted income in the *current* round as a measure of permanent income and then uses the difference between this variable and observed income as transitory income.[29]

At first glance, the marginal rate of consumption out of permanent income appears small, especially relative to the value of 1.0 predicted in some forms of the permanent income model. The results are, however, comparable to Kozel (1987) and Paxson (1992), particularly if ceremonial expenditures are considered as a component of consumption. Moreover, when the sample is divided into quartiles by predicted income per capita, the marginal propensity to consume declines with income and the savings rate increases (Table 17), a result observed by Bhalla (1980) and predicted in Deaton's (1989) analysis.

For the general population (all income quartiles), marginal savings out of transitory income are higher than those out of permanent income. If medical expenditures are considered a form of investment and included as savings, 0.75 rupee out of the marginal 1.00 rupee of transitory income is saved. Despite some deviations from a smooth trend in Table 17 as incomes rise, perhaps reflecting comparatively small cell sizes, marginal consumption out of transitory income declines and total (physical plus financial) savings increase. That is, among the wealthiest households, budgeting of transitory income most closely conforms to the theoretical prediction that transitory income is entirely saved. The χ^2 values with five degrees of freedom for the two tests were 263.8 and 26.4, respectively.

Moreover, while marginal savings of the poorest quintile are higher than observed by Bhalla (1980) for his low-income subpopulation, the results here are consistent with the view that low-income populations face more credit and liquidity constraints and, therefore, cannot fully adjust consumption in the face of downward shocks. Similarly, at extremely low levels of income, income from positive shocks will also be consumed; at such levels, there is little distinction between consumption and investment. That is, increased consumption may also enhance future income streams (Gersovitz 1983). To be sure, few of the sample households are likely to be at so low a subsistence level, yet elements of such constraints may account for the differences of savings out of transitory income across income groups.

A further perspective on savings out of transitory income can be derived by distinguishing positive from negative income shocks and reestimating the equations.

---

[28] This example pertains to the constrained estimates. The percentage changes in the unconstrained estimates were similar in magnitude, but all positive.

[29] The standard errors in Table 15 are not adjusted for correlation of errors among households. That is, they do not account for the fact that each household is included three times, once for each year. Using random effects versions of the unconstrained model, one notes that the gain in efficiency is apparently small. For example, the standard error of the coefficient of remittances from abroad in the unconstrained physical savings equations increases by 1.45 percent when a random effects model is run. The bias in the *t*-statistics introduced by not controlling for such effects in the constrained model is probably small.

Table 17— Coefficients of permanent and transitory incomes by income quartiles

	Income Quartiles			
Coefficient	1	2	3	4
Coefficient of permanent income in equation for				
Current expenditure	0.703	0.591	0.525	0.266
	(17.58)**	(25.70)**	(27.63)**	(22.17)**
Physical savings[a]	0.141	0.183	0.158	0.363
	(1.74)*	(3.16)**	(2.59)**	(7.56)**
Financial savings	–0.021	–0.020	0.115	0.193
	(–0.23)	(–0.36)	(1.98)**	(12.87)**
Medical expenditures	0.074	0.063	0.051	0.035
	(5.29)**	(6.30)	(8.50)**	(4.38)**
Ceremonial expenditures	0.106	0.183	0.151	0.143
	(1.86)*	(5.38)**	(4.31)**	(7.15)**
Coefficient of transitory income in equation for				
Current expenditure	0.344	0.128	0.078	0.046
	(4.30)**	(2.03)**	(1.50)*	(1.53)
Physical savings[a]	0.300	0.846	0.258	0.602
	(1.85)*	(5.39)**	(1.83)*	(4.93)**
Financial savings	0.216	–0.154	0.406	0.222
	(1.19)	(–1.03)	(3.03)**	(1.93)*
Medical expenditures	–0.024	0.040	0.022	0.067
	(–0.89)	(1.48)	(0.16)	(4.47)**
Ceremonial expenditures	0.163	0.139	0.236	0.062
	(1.43)	(1.51)	(2.68)**	(1.19)

Notes: Quartiles are defined in terms of predicted income per capita. Figures in parentheses are *t*-values. The lowest income quartile is 1; the highest is 4.

[a] Construction capital and other capital are combined here.

*Significant at the 10 percent level.

**Significant at the 1 percent level.

Some precision is lost, especially when disaggregating by income quartiles, since the variance of the estimate of transitory income is reduced. With the complete sample, however, marked differences in financial savings out of unexpected positive income, compared with negative shocks, can be observed (Table 18). The χ^2 value of the five restrictions that the parameters of positive shocks are the same as negative shocks was 18.5. The marginal propensity to save out of a positive shock is 0.149, while, at the margin, households increase their debt by 0.296 when incomes temporarily decline. The differences between propensities to consume or to save or dissave in physical terms are less dramatic. There is, in addition, a surprising difference in the tendency to increase ceremonial expenditures when incomes increase, yet not to appreciably reduce them when incomes decline.[30]

It is noteworthy that households in all but the wealthiest quartile increase their consumption with positive transitory incomes but do not decrease their consumption with an income decline (Table 19). As mentioned above, it is difficult to interpret

---

[30] It should be noted that some ceremonial expenditures—for example, funerals—may correlate with negative individual income shocks, but such shocks are not included in the transitory income as measured here.

Table 18—Marginal propensities to spend out of transitory shocks disaggregated by the direction of the shock

Variable	Positive Shocks	Negative Shocks[a]
Current expenditures	0.131	0.163
	(2.38)**	(5.26)**
Physical savings[b]	0.516	0.455
	(3.15)**	(4.89)**
Financial savings	0.149	0.296
	(0.93)	(3.25)**
Medical expenditures	0.034	0.059
	(1.61)*	(4.92)**
Ceremonial expenditures	0.170	0.026
	(2.10)**	(0.96)

Note: The figures in parentheses are *t*-values.

[a] A positive coefficient of a negative shock implies that when income declines, expenditures also decline.

[b] Construction capital and other capital are combined.

*Significant at the 10 percent level.

**Significant at the 1 percent level.

Table 19—Coefficients of positive and negative shocks disaggregated by income quartile

Coefficient	Income Quartiles 1	2	3	4
Coefficient of positive shocks				
Current expenditure	0.288	0.367	0.185	–0.019
	(2.64)**	(3.11)**	(1.75)*	(–0.22)
Physical savings[a]	0.476	0.928	0.356	0.427
	(2.02)**	(3.19)**	(1.03)	(1.20)
Financial savings	0.020	–0.621	0.090	0.530
	(0.08)	(2.26)**	(0.28)	(1.57)
Medical expenditures	–0.067	0.062	0.032	0.081
	(1.86)*	(1.22)	(0.94)	(1.84)*
Ceremonial expenditures	0.283	0.323	0.336	–0.019
	(1.91)*	(1.90)*	(1.71)*	(–0.12)
Coefficient of negative shocks				
Current expenditure	0.014	–0.195	0.043	–0.080
	(0.23)	(1.61)*	(0.41)	(–1.18)
Physical savings[a]	0.154	0.891	0.291	0.672
	(0.34)	(2.48)**	(1.32)	(4.07)**
Financial savings	1.051	0.345	0.560	0.127
	(2.09)**	(1.22)	(2.69)**	(0.81)
Medical expenditures	0.049	0.005	0.006	0.061
	(0.64)	(0.10)	(0.29)	(3.05)**
Ceremonial expenditures	–0.262	–0.050	0.188	0.096
	(–0.83)	(–0.29)	(1.49)	(1.37)

Notes:The figures in parentheses are *t*-values. The lowest income quartile is 1; the highest is 4.

[a] Construction capital and other capital are combined.

*Significant at the 10 percent level.

**Significant at the 1 percent level.

some of the coefficients at this degree of disaggregation due to the limited variance within comparatively small cells; nevertheless, it is plausible that the poorest households allocate all of their negative income shocks to financial dissavings. Restating this in more intuitive terms, these households increase their debt when incomes fall. They have relatively few assets to sell and therefore cannot dissave in terms of physical assets as do the wealthiest households and (anomalously) the second quartile.

Nevertheless, all households appear to maintain levels of consumption. This disaggregation, then, also presents a challenge to the interpretation of liquidity constraints as accounting for differences in savings and consumption-smoothing across income groups. Since the lowest income group does not show a tendency to save in financial terms out of permanent income, this difference in the coefficients of negative and positive shocks also implies an increasing debt position over time. This may accurately reflect conditions during the three-year period of the panel, or it may reflect mismeasurement of increases in cash reserves. Alternatively, because credit in these communities often comes from relatives at no interest or a fixed fee, the increase in debt may be disguised as a transfer.

Although the income residual includes household-specific fixed effects, savings and current expenditures out of this category are not appreciably different from savings out of transitory income as already defined. Nor are savings out of remittances from abroad different. Contrary to the popular notion that remittances are primarily used to raise consumption, the marginal propensity to save out of external remittances is 0.84. Most of these savings are financial, either in the form of bank deposits or in paid-off loans.[31] This type of savings is different from savings out of transitory income, which is less likely to be in financial accounts. For all practical purposes, pensions are saved in much the same way as remittances from abroad. Many of these pensions are lump-sum payments on retirement and are apparently viewed as transitory.

The marginal expenditure on construction out of international remittances is less than it is out of domestic remittances or transitory income. While the parameter of international remittances increases if the largest transfers from abroad are excluded, under no variant of the model is the tendency to use international remittances for immediate construction different from that from other transitory sources. This differs from the conventional wisdom that remittances go first and primarily for home improvements. Note, however, that the study deals with remittances per se, not retained earnings of returned migrants. Moreover, if remittances are initially banked and withdrawn in a subsequent year, the use of remittances for construction would not be directly apparent.

These results on spending out of international remittances are somewhat at odds with previous studies on average spending out of remittances (Amjad 1986, for example).[32] The study differs, in part, because marginal savings are measured here as part of an entire household accounting. This is more accurate than recall of spending

---

[31] When the two largest remittance values—both over Rs 200,000—are excluded, the mix between physical and financial savings shifts toward physical capital, including construction, although the sum changes little. These two values, however, are valid observations; there is no justification for excluding them.

[32] A recent study of remittances in Egypt by Adams (1991), however, also shows appreciable savings out of remittances.

out of a particular income source that is fungible over all resources. Moreover, this study includes financial savings (including net debt), which has proven to be a major share of all uses of remittances. The results also differ from the analysis of aggregate data by Burney (1987). In part, this difference may reflect the differences in the types of data used. Conceptual issues also account for part of the difference; household sales and purchases of assets or contraction of debt may either increase or reduce individual savings positions in accord with the desire to smooth consumption, yet have a small impact on aggregate savings. Nevertheless, it is hard to explain why the level of savings out of remittances observed with these data would make no contribution to aggregate net national savings.

Domestic remittances, however, are not treated in the same manner as international remittances and pensions. Marginal consumption out of local remittances is higher than that out of the other transitory sources, a result that holds even for low-income groups. Nevertheless, these local remittances are mostly used for physical capital expenditures and for ceremonial expenses.[33] Moreover, these remittances appear to encourage financial *dissavings* in the form of increasing net debt. Given the predominance of informal-sector loans in the total credit flow observed in this sample, it is possible that the source of credit is the same as the source of remittances. Indeed, some double counting or even misclassification is possible.

Neither medical nor ceremonial expenditures can be taken as strictly exogenous. Although the individual equations have comparatively low r^2 values, the F-statistic for each equation is significant at a .01 level of significance. It is noteworthy that local remittances have a comparatively high coefficient for medical and ceremonial expenditures, which could indicate that local family and friends make transfers when household expenses for medical care and ceremonies increase. Local remittances, then, may serve a risk-sharing function (see Rosenzweig 1988).

One final set of regressions was run using first differences of the variables in the main model. To the degree that current assets or remittances reflect household fixed effects, there is a potential bias in the cross-sectional model. Consequently, a first-difference version is presented in Table 20. It is not possible to include changes in permanent income in such a model; the difference in predicted income between year t and $t + 1$ reflects, in part, assets acquired or sold in the interval. Consequently, it is not possible to infer a causal direction between changes in income and changes in savings.

The results in Table 20, however, do confirm the patterns of savings out of remittances reported earlier. Indeed, the three constraints imposed on the sum of the coefficients of transfers cannot be rejected at the 1 percent level of significance (χ^2 value = 3.411 with three degrees of freedom). In the second model, changes in transitory income are also included. Although the coefficients on transfers are not affected, the χ^2 statistic for the four restrictions is 69.9, a clear rejection of the restriction.[34] The table presents the restricted model; in the unrestricted model, marginal expenditures on current consumption are negative, and savings, while positive, are far less than in the constrained model. Whereas the results reported here

---

[33] Remittances are taken as exogenous in this study. There is, however, some element of causality in that relatives may increase transfers when a ceremony occurs.

[34] This differs from the cross-sectional results in which restrictions on transfers alone are rejected as conclusively as those on income and transfers.

pool both years, regressions of either first difference taken individually reach the same conclusion; the restriction on transfers in either year is not rejected at the 10 percent level of significance, although the joint restriction including transitory income is rejected.

The first-difference regression confirms that pensions and remittances from abroad are almost entirely saved.[35] There is, however, a significant amount of consumption from local remittances. Expenditures out of local remittances also differ from other transfers in that they are not used for financial savings. Finally, while changes in transitory income explain changes in ceremonies and in savings, there is no apparent relationship between these changes and changes in current expenditures.

Financial Savings: Credit and Bank Utilization

The analysis indicates that households in the relatively less-developed districts in this study use a variety of instruments, including financial institutions, for saving. These savings, in total, including an increase in or disposal of physical capital, enable households to cushion transitory shocks. Although some differences are observed across income groups, all households save out of transitory income and out of international remittances and pensions. Low-income households, however, appear to increase their financial debt in the face of a negative shock, but not to decrease it following a positive shock.

One subset of the category of financial savings indicated above is credit. In particular, informal loans are readily available in the communities studied. Indeed, more than 90 percent of the households in the survey reported obtaining such loans in a given year. Although this finding clearly differs from the conventional wisdom about credit constraints, village shopkeepers extend credit (the functional equivalent of credit cards in developed countries) routinely to obtain an advantage over larger market centers. Eighty percent of the annual loans obtained by the survey households were from the informal sector (90 percent of the total number of loans). Of these, 40 percent came from shopkeepers, and 45 percent from relatives and friends.

The total amount of credit obtained from the informal sector in any year is substantial (Table 21), as much as a third of the average value of current expenditures. During the survey period, not all of this was a net increase in debt, although the net increase (including formal and informal loans) was more than half of the value of loans. When one looks at the average over the three-year period, the pattern is a bit puzzling.[36] While it is not uncommon for loan recovery to be poor in the formal sector, this has not generally been observed for informal lending. The percentage of

---

[35] No variables were significant in an equation investigating first differences in building; hence, building is aggregated here with other investments.

[36] Loan and repayment data were obtained in each round. At the end of each year, households were asked about all loans taken during the year. While there were some discrepancies for individual households, this double-checking did not reveal any patterns different from those detected earlier. A special credit survey a year after the main survey indicated a similar net increase in debt, as did the 1985 rural credit survey (Pakistan 1986).

Table 21—Loans obtained from the informal sector, by expenditure quintile

Expenditure Quintile	Loans Obtained			Net Increase of Debt[a]		
	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3
	(constant Rs)					
1	6,811	6,887	5,434	3,581	4,757	3,011
2	6,887	8,879	5,429	5,482	3,841	2,853
3	7,722	9,020	4,662	3,534	3,590	2,092
4	6,903	9,709	6,545	1,508	3,969	1,904
5	8,063	12,131	5,752	4,028	5,199	2,826
Total	7,278	8,333	5,561	3,628	4,266	2,535
	(9,048)	(22,305)	(11,191)	(15,936)	(19,234)	(13,204)

Source: IFPRI Rural Survey of Pakistan, 1986/87-1988/89.
Note: The figures in parentheses are standard errors.
[a] Includes formal and informal loans.

loans taken during a year that remain outstanding at the end of the year (two months after the *rabi* harvest) is roughly half as large for shopkeepers as for friends and relatives. This implies that loans from friends have longer-term conditions or are implicit transfers. Although this study does not explain how household debt can increase every year, the credit breakdown supports the finding that savings partially explain the relative constancy of consumption.

Banks provide another source of credit, although they are more often used for long-term loans in asset accumulation or for the purchase of inputs (Malik 1989). The formal banking sector, however, also provides a means of smoothing consumption via savings. This form of savings, which is generally believed to be underused in rural areas, also has the potential to contribute to resource mobilization throughout the economy.

More than 14 percent of the households in the sample reported having one or more domestic bank accounts. The percentage of households using banks was highest in Attock and lowest in Badin. The average of all annual gross deposits was Rs 1,600 in the first year, rising to Rs 2,000 in the second year, and nearly Rs 2,600 (constant) in the third year.

Probit regression analysis (not presented here) indicates that much of the difference in the probability of having an account across districts is explained by the effects of the variables for number of migrants, income, and education; increases in all of these factors increase the probability that a household will have a bank account. A larger amount of travel time decreases the probability of having a bank account as well as total annual gross deposits. The number of migrants abroad or returned also influences total deposits, mainly through the probability of having an account. International remittances, but not domestic remittances, were banked at higher rates than other income, consistent with earlier results. Households with more children and adolescents banked more than other households.

6

HOUSEHOLD FOOD SECURITY

Spending on food accounts for an average of 70 percent of current expenditures for the sample households. The dominance of food in the household budgets of the poor puts food security at the center of any analysis of the effects of policies on rural welfare. Changes in food prices affect welfare directly by influencing real income, and indirectly through changes in nutritional status.

In examining nutritional status, it is essential to understand how household food security affects nutrition. Food security is seen as a necessary but not sufficient input for adequate nutritional status (Gillespie and Mason 1990). It is possible to be malnourished in a food-secure household as a result of disease, inadequate care, or inequitable allocation of food. A household may be food secure in terms of calories, but dietary quality determines the likelihood of micronutrient deficiencies in individuals. It is also possible for some individuals in a food-insecure household to be well-nourished if they receive preferential food allocation and care at the expense of other members of that household.

The challenge is to quantify the role of food relative to other inputs to nutrition in order to derive the necessary parameters for policy. Some of these inputs are purchased by the households; others, such as services, are provided by the government, including health facilities, education, and infrastructure. A model is laid out in the following chapter. In this chapter, one aspect of food security—dietary food energy (calorie) intake—is analyzed, because it often lies at the center of policy discussions.

Food Consumption Patterns

Since the main interest in this section is calorie consumption at the household level, the caloric content of food acquired from various sources is estimated using the conversion rates from the food composition tables for Pakistan. Twelve separate visits to households were made in three years to assess food acquisition behavior. There are three main ways for households to acquire food: purchases from the market, own production, and gifts from friends or relatives. All three sources are aggregated.

The average calorie supply per capita of 2,400 per day indicates that households in these rural districts have moderately high intakes, compared with many countries in Asia. This level of intake is also comparable to that in urban areas in Pakistan. There are distinct regional differences in absolute levels of calorie availability, however. People in the two districts in Punjab—Attock and Faisalabad—consumed about 20 percent more calories than those in Badin and Dir. Average food availability figures, however, are rarely useful for understanding food security. It is much more informative to examine the distribution of calories across the population—for example, the proportion of households consuming less than 1,800 calories per capita per day

(Table 22).[37] The results also indicate the regional differences in underconsumption. Nearly 33 percent of the households in Dir consume less than 1,800 calories per person per day, compared with only 13 percent in Attock and 22 percent in Faisalabad.

In Badin, about 60 percent of calories come from rice, compared with only 4 percent in Attock and Faisalabad, and 10 percent in Dir (Table 23). Wheat and flour, the predominant sources of calories in Attock and Faisalabad, provide 60 percent of calories there and 51 percent in Dir. There is, however, a seasonal dimension to the diet composition, particularly in Badin. During the *rabi* harvest, the share of wheat and flour in the Sindhi diet increases to about 26 percent of total calories from a low of 5 percent for the period in between the *rabi* harvests. Households tend to switch to rice, particularly after the *kharif* rice harvest. The dependence on rice is heavily influenced by the cropping pattern in the Sind. More than two-thirds of Badin's households are rice farmers, whereas only 29 percent plant wheat in the *rabi*.

Households in Dir depended less on own production (a third of the calorie supply) than did households in Attock, Faisalabad, or Badin, which obtained half of their total calorie supply from production on their own farms. This means that for households in

Table 22—Calorie consumption patterns by season

District/Season	Calorie Consumption per Capita	Coefficient of Variation	Percent of Households Consming Less Than 1,800 Kilocalories per Capita per Day
Attock	2,792	. . .	12.7
November-February	2,781	0.38	12.2
March-June	2,828	0.38	12.2
July-October	2,769	0.40	13.7
Faisalabad	2,461	. . .	21.8
November-February	2,355	0.42	23.9
March-June	2,457	0.35	21.7
July-October	2,573	0.35	19.8
Badin	2,257	. . .	18.8
November-February	2,205	0.32	19.5
March-June	2,271	0.28	17.9
July-October	2,295	0.30	19.1
Dir	2,189	. . .	32.9
November-February	2,009	0.32	37.8
March-June	2,409	0.42	30.1
July-October	2,150	0.30	31.0
All areas	2,399	. . .	24.5
November-February	2,324	0.31	23.3
March-June	2,461	0.35	20.4
July-October	2,412	0.33	29.9

Source: IFPRI Rural Survey of Pakistan, 1986/87-1988/89.
Note: Mastung/Kalat is excluded because it had only three survey rounds, and, therefore, seasonality could not be picked up.

---

[37] The cutoff of 1,800 calories per person per day is used to understand the distribution of intake and has no relation to any measure of energy requirements. This helps avoid the ongoing controversy and confusion regarding "recommended dietary requirements."

Table 23—Sources of calories

District	Average Intake of Calories per Day	Sources of Calories					
		All Grains, Including Flour	Wheat and Flour	Rice	Milk	Meat, Fish, and Poultry	Own Production, Food Received as Gifts or Wages
Attock and Faisalabad	2,673	65.2	60.0	4.2	6.3	2.0	57.3
Badin	2,257	70.0	9.5	60.3	9.1	1.8	50.0
Dir	2,189	68.5	51.4	10.4	5.0	3.1	33.1
Mastung/Kalat	2,424	70.1	67.1	3.1	1.0	1.5	13.5

Source: IFPRI Rural Survey of Pakistan, 1986/87-1988/89.
Note: Data for Attock and Faisalabad, both districts in the province of Punjab, are combined here.

Dir, a dominant portion of basic staples was purchased from the market. Calorie intakes in Dir differed statistically between the months prior to and after the *rabi* wheat harvest. For other districts, however, there was no evidence of seasonality in the total calorie acquisition pattern, although the composition of the grains consumed changed with the seasons. These households, as well as those in other studies (Paxson 1993), were able to mitigate the effects of seasonal patterns through savings, including household storage of grains.

Differences in income are also reflected in variations in regional calories. Calorie consumption rises as total expenditures increase (Table 24). In Faisalabad, households in the highest expenditure quintile consumed 70 percent more calories than those in the poorest quintile.

The Debate on the Relationship of Income to Nutrient Intakes

Reutlinger and Selowsky (1976), in their influential essay on malnutrition and poverty, present a cogent argument that increases in the aggregate food supply are only indirectly related to solving the problem of malnutrition, while income growth

Table 24—Calories per capita per day, by per capita expenditure quintile (average all rounds)

District	Expenditure Quintile				
	1	2	3	4	5
Attock	2,145	2,523	2,645	2,941	2,763
Faisalabad	1,874	2,274	2,445	2,926	3,231
Badin	1,973	2,085	2,206	2,339	2,653
Dir	1,810	1,907	2,003	2,124	2,348
Mastung/Kalat	1,931	2,212	2,458	2,598	3,105

Source: IFPRI Rural Survey of Pakistan, 1986/87-1988/89.
Note: The lowest expenditure quintile is 1; the highest is 5.

and distribution are central. They also discuss policies to augment the regular process of income growth, including subsidies and transfers, the efficacy of which can be enhanced through improved knowledge of household food demand. This theme was echoed by the World Bank (1980) and explored in various contexts by Pinstrup-Andersen and Caicedo (1978); Timmer, Falcon, and Pearson (1983); and Sen (1981).

Reutlinger and Selowsky's study is not an empirical investigation of household budgets, but a number of other economists have attempted to quantify the responses of households to changes in income. A recent study by Bouis and Haddad (1992) estimates that calorie elasticities—the percentage change in calories consumed with a percentage change in income—range from 0 to more than 1. They argue that most of this divergence is due to errors in measurement and faulty estimation techniques. Making a similar argument, Behrman and Deolalikar (1987) distinguish between increases in the quality of foods purchased in price per nutrient as incomes increase and increases in the quantity of nutrients obtained. Behrman and Wolfe (1984) present another theme: education is not only an important policy instrument, but is also a crucial variable in studies of food demand, the exclusion of which will bias income response upward.

These potential biases in estimates of calorie responses can be categorized under three headings: (1) errors in variables, (2) missing variables, and (3) improper definition of food demand (Alderman 1993).

A common example of the problem of errors in variables that appears in basic textbooks is also relevant to the issue of the demand for nutrients. If a household responds to permanent income but the econometrician observes only a combination of permanent and transitory income, then estimates of the coefficient of income will be biased toward zero. This is a general condition of variables measured with error, assuming that the expected value of the error is zero and that the errors are uncorrelated with the dependent variable.[38] To avoid this downward bias in estimates of income response, analysts often use total expenditures as a proxy for a household's assessment of its long-term income prospects. This, however, introduces another bias, since total expenditures (*TX*) are the sum of all observed expenditures (X_i) plus any measurement errors in such expenditures (u_i):

$$TX = \sum_i (X_i + u_i). \tag{25}$$

Even if $E(u_i) = 0$ over all individuals, *TX* will correlate with the errors in measurement. This biases the coefficient of *TX* toward 1 in a regression that has X_i as the dependent variable. This was discussed over a quarter of a century ago by Leviatan (1961), but, commonly, researchers assume that if all X_i's are a small proportion of a total budget, the bias will be small. Only a few cases exist that illustrate the magnitude of the bias that may be observed. Estimates of calorie consumption, which have a weighted sum of all food purchases as a dependent variable, may be particularly prone to this bias, as are total food expenditures.

Since the coefficient of income is likely to be biased toward 0 and that of expenditure toward 1, the most suitable approach is to use an instrumental variable

---

[38] Bouis and Haddad (1992) review the relevant mathematics.

that is strongly correlated with the true value of total expenditures (or long-run income) and not correlated with the errors in measurement. One approach is to use predicted expenditures or income. This is a theoretically valid approach. Another approach, used in this section, is to use a lagged observation of total expenditure as an instrument for current expenditures. If errors are uncorrelated across rounds of repeated surveys, the lagged variable should correlate strongly with the true value of total expenditures in the current period, yet not introduce a bias toward 1.[39]

A "missing variable" bias is also well known. The direction of such a bias, when a variable (Z) explaining the dependent variable (Y) is excluded, is the product of the signs of the correlation of Z and Y and of Z and X. The magnitude is also functionally related; the correlation of Z and Y is often known a priori, although that of Z and X is more often an empirical issue. As mentioned earlier, Behrman and Wolfe (1984) argue that education correlates positively with income as well as nutrient consumption; hence, its exclusion biases the coefficient of income upward.

Similarly, Bouis and Haddad (1992) imply that the numbers of guests and laborers are positively correlated with income and calorie intake. Bouis and Haddad attempt to apply corrections for these factors, but they conclude that the corrections are only partial when using purchased and home-produced foods as a measure of nutrient consumption (as opposed to recall of meals eaten). This implies that the bias they observe is more properly considered a systematic mismeasurement of the dependent variable than an exclusion of right-hand-side regressors. They suggest that the use of 24-hour food consumption recall is a more accurate source of food intake information than the recall of food purchases over a week or month.

Behrman and Deolalikar (1987) also argue that estimates for demand for nutrients may be biased when the demand is derived from data on food expenditures. Their explanation differs from that of Bouis and Haddad, however, in that they explain the bias as the difference between the demand for food quantity and the demand for food quality. If the unit price of a nutrient increases as income rises, then expenditures on food or on commodities are inappropriate to determine nutrient elasticities. This issue was first discussed by Prais and Houthakker (1955), who observed then that an income elasticity can be decomposed into a quantity elasticity and a quality elasticity, where quality is the unit price of a good:

$$\frac{\partial \ln Exp_i}{\partial \ln TX} = \frac{\partial \ln P_i}{\partial \ln TX} + \frac{\partial \ln Q_i}{\partial \ln TX}, \tag{26}$$

where Exp_i is expenditure per capita on food i, P_i is the price of food i, and Q_i is the quantity of food i. If $\partial \ln P_i / \partial \ln TX$ is large, then the bias in estimates of nutrient response, using elasticities derived from commodity expenditures, is also large.

Alderman (1986) provides an indication of the quality response of total food expenditures; frequently, half or more of the income elasticity for food as an aggregate good is due to quality effects. There is less evidence on the quality response by disaggregated commodities. Deaton and Grimard (1991) have recently addressed this issue in the context of measurement errors and price response and have found quality

---

[39] This instrument does not, however, address any endogeneity of income that may occur if calorie consumption influences earnings.

effects relatively modest in Pakistan. This conforms to results from Côte d'Ivoire (Deaton 1988) and Indonesia (Case 1987). Behrman and Deolalikar's (1987) results, however, imply fairly substantial quality elasticities even for disaggregated groupings of commodities.

The study below addresses this issue. The primary purpose, as stated above, is to get a more accurate measure of the response of households to changes in income and education in Pakistan. A secondary goal is to illustrate the magnitude of the types of biases to guide similar endeavors.

Some of the difference in reported demand estimates in the literature may represent real differences between communities and time periods as well as differences in estimation techniques and variable definitions. Bouis and Haddad (1992) as well as Behrman and Deolalikar (1987) report variation of estimation techniques using the same sample, although not necessarily the same data within the sample. This study follows that approach in that it investigates the sensitivity of results to alternative specification. As indicated below, while some of the hypothesized sources of bias indicate real behavioral responses, the estimated calorie elasticities are fairly robust with regard to missing variable bias and quality effect. The results also show that errors in expenditure variables can impose a moderate upward bias if not corrected.

Estimation and Results

Calories are derived by converting the quantities of 40 food items purchased or obtained in kind.[40] Total expenditures encompass all current expenditures, including clothes, cosmetics, transport, fuel, and so forth, but do not include education, curative health expenditures, or expenditures on ceremonies.

As discussed in the previous section, the error in current expenditure is probably correlated with the error in the dependent variable; the potential bias in using current expenditure cannot even be signed a priori. An instrument derived from information on income or from assets, including human capital, can be used. Alternatively, the longitudinal (panel) nature of the survey can provide an instrument. Since household expenditure in one period should be strongly correlated to household consumption in any other period, this should be a potentially valid instrument. But serial correlation of errors must be considered as well.

Table 25 compares the regressions of the logarithm of calories on current expenditures, expenditures lagged one period, and expenditures lagged two periods. In each case, rounds 3-6 are used in order to have the same sample to compare results.

Consistent with Bouis and Haddad's use of an instrumental variable for expenditures, the coefficient of the logarithm of total expenditures (ln*TX*) declines markedly when the lagged variable is substituted. Elasticities drop by an average of one-third when current expenditures are replaced by expenditures lagged one period. With the exception of one district, there is a far less marked difference when the variable lagged two periods is substituted. There appears to be contemporaneous correlation of errors, but not serial correlation of errors.

---

[40] Since quantities, rather than expenditures, are used, there is no possibility of quality effects biasing the elasticities.

Table 25—Results of alternative lagged specifications

District	Coefficient of LTX_T	Coefficient of LTX_{t-1}	Coefficient of LTX_{t-2}
Attock	0.549	0.328	0.298
	(19.29)**	(10.25)**	(9.61)**
Faisalabad	0.350	0.292	0.213
	(14.58)**	(11.23)**	(8.52)**
Badin	0.157	0.093	0.080
	(13.08)**	(7.15)**	(6.15)**
Dir	0.201	0.121	0.121
	(14.36)**	(8.64)**	(8.07)**
Mastung/Kalat	0.338	0.243	0.228
	(13.52)**	(8.38)**	(9.12)**

Notes: The figures in parentheses are t-values. LTX is the logarithm of current expenditure. In all cases, the dependent variable is the logarithm of calories per capita. Other variables are similar to those in Table 26.
**Significant at the 1 percent level.

Nevertheless, the use of lagged expenditure is still inefficient because the instrument does not employ all of the information available in the panel. Accordingly, the instrument for expenditure used in the subsequent analysis is the average of the household's per capita expenditure in all rounds, excluding the round under consideration.

An alternative approach to estimation uses the panel nature of the data to sweep away individual household heterogeneity due to individual variations in tastes or preferences. Suppose that each household can have its own separate intercept. For such an analysis, a fixed-effect model was tested as an alternative. Recall that the panel data consist of 12 rounds, covering three years. Thus, for each household, the average value of all variables for all the rounds was calculated and regressions were estimated, using the household's deviations in period t from the average of the 12 rounds. The alternative specification, using the household fixed-effect model, is thus of the form:

$$Kcal_t - K\bar{c}al\ mean = b\,(X_t - \bar{X}\ mean), \tag{27}$$

where $Kcal$ stands for kilocalories and X stands for the regressors in equation (27). Under this formulation, the regressions do not include an intercept, which in effect means that each household has an implicit intercept.

In addition to eliminating any bias caused by the exclusion of taste and other factors that are unobserved but influence consumption, this approach has the advantage of providing estimates of price elasticities that measure short-term adjustments. This differs from the usual interpretation of price response in cross-sectional analysis. A drawback, however, is that variables that do not change over the period, such as education of the main earner and location, net out in the process and cannot be included in the basic form of a fixed-effects model. Thus, the data are studied using both approaches.

There is one further consideration in the fixed-effects model. The approach reduces total variance of regressors by eliminating cross-sectional variance, and, thus, increases the errors in the variable bias. If, for example, expenditures are a proxy for permanent income, then the temporal variation in a sample is largely measurement error. Thus, an instrumenting approach for changes in total expenditures, similar to the difference equations in Chapter 3, is used.[41]

Results of Cross-sectional Models

The results of the calorie regressions for each district are presented in Table 26. These are estimates of household calories per capita purchased in a given period as a function of expenditures, household demographics, education, and the number of visitors. The equation is

$$\begin{aligned} \ln Kcal_T = f\,[&INV\ln TX_{T\neq t}, (INV\ln TX_{T\neq t})^2, HHSize_T, HTX_{T\neq t}, \\ &\ln Wheatpr, \ln Ricepr, \%\ Children, \%\ Elderly, \\ &Mprim_T, Mhigher_T, Fprim_T, Fhigher_T, MV_T], \end{aligned} \tag{28}$$

where

$\ln Kcal_T$ = the logarithm of daily household calorie consumption in per capita terms in round T, as measured by food purchases and stocks drawn down;

$INV\ln TX_{T\neq t}$ = the inverse of the logarithm of per capita current expenditures of the household averaged over all but the current round;

$(INV\ln TX_{T\neq t})^2$ = the square of the previous term; this term was included in all regressions to avoid forcing curvature in the calorie elasticity. It was, however, never important and hence dropped;

$HHSize$ = the number of household members present the week prior to the interview;

HTX = the product of $HHSize$ and $\ln TX$;

$\%\ Children$ = the number of children under 6 years divided by household size;

$\%\ Elderly$ = the number of adults over age 65 divided by household size;

$Mprim$ = a dummy variable defined as 1 if the household head has a primary education, but not higher;

$Mhigher$ = defined as 1 if the household head has completed any postprimary schooling;

---

[41] There are few other fixed-effects approaches to calorie demand reported. See, for example, Alderman (1988) and Behrman and Deolalikar (1990). The latter mistakenly cites Alderman as using village as opposed to household fixed effects. Neither of these studies, nor Bouis and Haddad (1992), instruments changes in income or expenditure.

Table 26—Regressions explaining the logarithm of per capita daily calorie consumption

	Attock			Faisalabad			Badin			Dir			Mastung/Kalat		
Variable	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Constant	10.697 (22.81)**	10.704 (22.77)**	10.071 (22.09)**	9.361 (16.63)**	9.436 (16.82)**	9.248 (16.72)**	9.082 (17.07)**	9.057 (17.02)**	9.153 (18.05)**	8.255 (34.78)**	8.228 (33.35)**	8.103 (17.07)**	10.184 (25.78)**	10.497 (26.11)**	10.088 (25.27)**
INV ln*X*	–15.934 (–10.31)**	–16.165 (–10.17)**	–14.361 (–9.33)**	–14.922 (–7.93)**	–15.082 (–8.04)**	–13.307 (–7.11)**	–7.970 (–6.42)**	–7.958 (–6.41)**	–7.529 (–6.35)**	–6.446 (–5.98)**	–6.364 (–5.73)**	–5.683 (–5.01)**	–17.430 (–5.84)**	–19.783 (–6.50)**	–16.169 (5.32)**
HHSize Log X_{t-1}	–0.009 (–2.25)**	–0.009 (–2.25)**	–0.008 (–2.00)**	0.000001 (0.0002)	–0.0002 (–0.04)	0.002 (0.40)	–0.006 (–1.50)	–0.006 (–1.50)	–0.007 (–2.33)**	–0.003 (–1.50)	–0.002 (1.00)	–0.002 (–1.00)	0.016 (4.00)**	0.015 (3.75)**	0.017 (4.25)**
Household size	0.063 (1.50)	0.060 (1.43)	0.061 (1.49)	–0.019 (–0.35)	–0.061 (–1.13)	–0.044 (–0.83)	0.032 (1.33)	0.033 (1.38)	0.036 (1.57)	0.020 (1.05)	0.013 (0.65)	0.009 (0.45)	–0.149 (–4.26)**	–0.132 (–3.77)**	–0.151 (4.44)**
Percent of elderly	0.047 (0.58)	0.056 (0.69)	0.069 (0.88)	0.048 (0.71)	0.017 (0.25)	0.005 (0.07)	0.242 (2.97)**	0.229 (2.83)**	0.221 (2.83)**	0.044 (0.40)	0.066 (0.61)	0.059 (0.55)	–0.111 (–1.37)	–0.133 (1.66)*	–0.159 (–2.01)**
Percent of children	–0.280 (–4.38)**	–0.265 (–4.01)**	–0.267 (–4.24)**	–0.220 (3.79)**	–0.246 (4.24)**	–0.231 (–4.05)	–0.520 (–13.33)**	–0.525 (13.12)	–0.514 (–13.53)**	–0.689 (–19.14)**	–0.690 (–19.17)**	–0.690 (–19.17)**	–0.259 (–4.89)**	–0.246 (–4.64)**	–0.234 (–4.50)**
Education Female Primary	. . .	–0.028 (–1.17)	–0.027 (–1.17)	. . .	0.007 (0.26)	0.015 (0.58)	. . .	0.087 (2.29)**	0.104 (2.89)**	. . .	–0.008 (–0.47)	–0.009 (–0.53)	. . .	0.114 (2.43)**	0.113 (2.51)**
Male Primary	. . .	–0.030 (–1.07)	–0.034 (–1.26)	. . .	0.107 (3.45)**	0.095 (3.06)**	. . .	–0.016 (–0.80)	–0.015 (0.79)	. . .	–0.057 (–3.56)	–0.054 (–3.38)**	. . .	–0.058 (–1.61)*	–0.048 (–1.37)
Female Higher	. . .	0.055 (1.62)*	0.045 (1.36)	. . .	–0.028 (0.85)	–0.017 (–0.53)	. . .	. . .	. . .	. . .	0.011 (0.55)	0.010 (0.50)	. . .	. . .	. . .
Male Higher	. . .	–0.068 (–3.09)**	–0.063 (–3.00)**	. . .	–0.020 (0.80)	–0.026 (–1.04)	. . .	–0.018 (–0.64)	–0.018 (–0.07)	. . .	–0.003 (–0.23)	0.002 (0.15)	. . .	–0.077 (–3.21)*	–0.074 (–3.21)**
Visitors	. . .	. . .	0.113 (9.42)**	. . .	. . .	0.162 (5.79)**	. . .	. . .	0.271 (11.29)**	. . .	. . .	0.021 (3.00)**	. . .	. . .	0.093 (6.20)**
R^2	0.299	0.308	0.362	0.409	0.418	0.437	0.293	0.297	0.361	0.419	0.425	0.428	0.470	0.480	0.504

Notes: The figures in parentheses are *t*-values. The numbers 1, 2, and 3 indicate survey rounds. Other variables for round 3 ln (wheat price) and ln (rice price) were also included, but not reported here for the sake of brevity.

*Significant at the 10 percent level.

**Significant at the 1 percent level.

former is also—but because it does not contain an explanation of why the data collected should correlate with income to produce such differences.

Food expenditure elasticities are roughly 1.5-2.0 times the calorie elasticities, with this rate being roughly the same for the poorer groups. Stated somewhat differently, there was no evidence that the poorer groups, with total per capita expenditures only two-thirds of the average, are either more or less likely to allocate their comparatively larger increases in food expenditures to quantity over quality or the reverse.

Although the number of visitors is always highly significant, it does not have a major impact on the estimated calorie or food expenditure elasticities, as indicated in the alternative elasticities in Table 27. The difference in the estimated elasticities whether the visitor variable is included or not is only 5-15 percent of the elasticity. The potential missing variable bias, then, is significant in statistical terms but does not account for more than a small share of calorie demand elasticities.

A more limited effect was observed with the addition of the education variables. While education does matter, particularly in the Sind and Baluchistan with regard to female education, it is not an either-or situation as implied in the title of Behrman and Wolfe's (1984) study. The impact of female education is, however, not the same in each district. The effect of primary education appears to be higher where there is little of it. Primary education for the head of the household is positive and significant in one case, Faisalabad. The effect is, however, negative in Dir, and postprimary education of the household head never has a positive effect. This variable, however, pertains to the nominal head—often the eldest—who may only tangentially influence the allocation of the day-to-day household budget. This highlights the difficulty in finding a proper measure for education, which is an even less accurate measure of internal household resource distribution than budgets, especially when dealing with an extended family with more than one adult of either gender.

Bouis and Haddad (1992) hypothesize that food expenditures are partially used to feed laborers as well as family and guests. This is one of the reasons they prefer 24-hour calorie recall as a measure of intake. While the data set used here does not have such a recall, the Bouis and Haddad hypothesis implies that purchased calories should correlate with land operated even after controlling for income or expenditures. Three variations of equation (27) were employed to investigate this correlation.

In each of these variations, alternative measures of land operated, labor hired, or meals given to laborers—all in per capita terms—were introduced into the equation.[42] None of these variables is ideal since they all reflect endogenous household choices. The purpose, however, was to determine the degree of correlation and whether the estimated elasticity was robust for these alternatives. In no case did the estimated elasticity change by even 1 percent when these variables were included. This reflects, in part, instructions to the survey team to collect data regarding household consumption only, although some households did indicate that the division of household expenditures and those for meals given to laborers was difficult. The absence of a strong relationship does not disprove the conclusions of Bouis and Haddad (1992) but does suggest that the observed calorie demand is not a derived demand for wages inkind.

---

[42] This information was collected in a separate questionnaire from the food expenditure schedule, which was answered by women in the household; the former questionnaire was answered only by males.

Fprim, Fhigher = analogous variables for education of female adults (over 25) in the household; and

MV = number of meals reported for visitors eating with the family in the previous week divided by household size.

Each equation includes the logarithm of the average wheat and rice prices in the village for each round ($\ln Wheat_{pr}$ and $\ln Rice_{pr}$). In addition, each equation has dummy variables for each round except the final. These are included to pick up any effects of seasonal patterns or other price movements. Little of either was observed in the period of the study, however, and often these variables are not significant. For the sake of brevity, they are not reported in Table 26.

No functional form dominated the others. In most cases, a quadratic term in logarithm proved not significant in either log inverse, double, or semi-logarithmic specifications. Most likely, this reflects limited variation in expenditures in the unpooled regressions. The equations reported in Table 26 use a log inverse functional form (see Strauss and Thomas 1989), although the basic conclusions would not vary if a semi-log or other form was used instead. Elasticities are calculated as $[-\beta_1/(\ln TX)^2 + \beta_2 \cdot HHSize]$, where β_1 and β_2 are the coefficients of $INV \ln(TX)$ and HTX, respectively.

Calorie elasticities calculated using Model 3 range from 0.124 to 0.393, based on average consumption for each district, and 0.138 to 0.461, using the average consumption of the poorest quintile in each district. The difference between the poor and the average of the population is expected, although the range of estimates across districts is surprising. These cannot reflect methodological differences; the methodology does not vary across samples and reflects either differences in the population's response to changes in income or some difference in the way each survey team handled data. The latter explanation is unsatisfactory, not because it is vague—the

Table 27—Estimates of calorie and food expenditure elasticities

		Calorie Elasticity			Food Expenditure Elasticity		
District	**Model**	**1**	**2**	**3**	**1**	**2**	**3**
Attock	Lowest quintile	0.379	0.389	0.340	0.515	0.480	0.491
	At average	0.336	0.345	0.301	0.469	0.434	0.427
Faisalabad	Lowest quintile	0.456	0.460	0.433	0.653	0.590	0.580
	At average	0.389	0.391	0.367	0.480	0.442	0.429
Badin	Lowest quintile	0.202	0.199	0.179	0.453	0.446	0.456
	At average	0.169	0.167	0.149	0.367	0.360	0.340
Dir	Lowest quintile	0.148	0.163	0.138	0.457	0.446	0.384
	At average	0.132	0.137	0.124	0.421	0.413	0.356
Mastung/Kalat	Lowest quintile	0.470	0.497	0.461	0.796	0.797	0.753
	At average	0.404	0.429	0.393	0.633	0.639	0.586

Note: Based on Table 26 regression results and similar food expenditure regressions. The numbers 1, 2, and 3 indicate survey rounds.

The calorie and expenditure elasticities of seven commodity groupings in Table 28 indicate, for example, moderate increases in wheat consumption with increased income, except in Dir. Little increase in rice consumption with increased income was observed in the principal rice-consuming area of Badin, but such increases were observed elsewhere. Elasticities for milk and even meat in the sampled districts outside the Punjab appear to be lower than those often observed in national surveys, but they are somewhat higher than for other foods.

The results also indicate the implicit quality elasticities for the commodities. In keeping with most other studies, these are generally small. Meat (including poultry and eggs) and oil (including ghee) have the largest quality effects. It is somewhat surprising that there are numerous cases in which the "quality" effect is negative, although generally negligible. Note, however, that what is indicated here as the quality effect is

Table 28—Expenditure, quantity, and implicit quality elasticities by commodities and district

District	Type of Elasticity	Commodity						
		Rice	Wheat	Meat	Milk	Lentils	Sugar	Oils
Attock	Expenditures	1.061 (15.16)**	0.188 (4.70)**	1.282 (16.02)**	0.617 (10.28)**	0.442 (8.84)**	0.422 (10.55)**	0.470 (6.71)**
	Quantity	0.865 (12.36)**	0.213 (5.32)**	1.040 (10.40)**	0.648 (10.80)**	0.436 (8.72)**	0.374 (9.35)**	0.472 (11.80)**
	Implicit quality	0.073	–0.025	0.142	–0.031	0.086	0.048	0.498
Faisalabad	Expenditures	1.076 (13.45)**	0.286 (5.72)**	1.316 (16.45)**	0.584 (8.34)**	0.390 (6.50)**	0.388 (4.85)**	1.010 (14.43)**
	Quantity	0.878 (10.98)**	0.273 (9.10)**	1.055 (13.19)**	0.612 (10.20)**	0.397 (6.62)**	0.340 (4.86)**	0.457 (11.42)**
	Implicit quality	0.198	0.023	0.262	–0.028	–0.007	0.044	0.553
Badin	Expenditures	–0.138 (3.45)**	[a]	0.848 (7.71)**	0.434 (7.23)**	0.369 (6.15)**	0.347 (8.68)**	0.624 (10.40)**
	Quantity	0.133 (3.32)**	[a]	0.817 (13.62)**	0.453 (11.32)**	0.364 (6.07)**	0.374 (9.35)**	0.434 (10.85)**
	Implicit quality	–0.005	[a]	0.031	–0.019	0.006	–0.003	0.190
Dir	Expenditures	0.250 (5.00)**	–0.041 (1.37)	0.404 (6.73)**	0.324 (6.48)**	0.227 (5.68)**	0.179 (4.48)**	0.302 (6.04)**
	Quantity	0.193 (4.82)**	–0.006 (0.30)	0.289 (9.63)**	0.336 (11.20)**	0.160 (8.00)**	0.144 (7.28)**	0.229 (7.63)**
	Implicit quality	0.057	–0.035	0.115	–0.012	0.067	0.035	0.073
Mastung/Kalat	Expenditures	0.410 (5.86)**	0.101 (3.37)**	0.390 (6.50)**	0.118 (0.01)	0.124 (2.07)**	0.392 (7.84)**	0.218 (4.36)**
	Quantity	0.370 (6.17)**	0.124 (4.13)**	0.363 (5.19)**	0.313 (1.57)	0.137 (2.28)**	0.390 (7.80)**	0.246 (4.92)**
	Implicit quality	0.040	–0.023	0.027	–0.195	–0.013	0.002	–0.028

Note: The figures in parentheses are *t*-values.

[a] Wheat purchases in Badin are highly seasonal and confined to postharvest periods.

*Significant at the 10 percent level.

**Significant at the 1 percent level.

$\partial\ln(P_i)/\partial\ln(TX)$.[43] If there are scale economies in purchases, especially if commodities are fairly homogeneous, as is wheat, such results are plausible. The milk results are somewhat puzzling, but since milk is seldom a traded good in the villages in the sample, the absence of a quality effect may be due to the inability to put a price on the quality differences, if any, of home-produced milk and milk products.

Fixed-Effects Results

The results, using household fixed effects for calorie elasticities in Table 29, are contrasted with those obtained using the models in Table 27. There are no appreciable differences in the income elasticities for calories between the fixed-effects model and the cross-section estimates for three districts: Attock, Badin, and Faisalabad. In Dir district, the elasticities using household fixed effects are more than double that of the cross-section estimates (0.314 versus 0.132, for example). These elasticities are based on predicted changes in expenditures. When observed expenditures are used, the fixed-effects elasticities are higher in three districts, and they exceed the cross-sectional results for Dir and Badin.

While it cannot be proved which of the unobservable effects account for the difference between the fixed effects and the cross-sectional results in the two districts with the lowest cross-sectional estimates, it is interesting to speculate. One possibility is that unobserved energy outlay is positively correlated with calories consumed and negatively correlated with income, if, for example, the poorest do more manual work. Excluding outlay would then bias observed elasticities downward (Higgins and Alderman 1992). Thus, these results can be considered the impact of additional expenditures, partially controlling for energy outlay. It is also possible that changes in household composition that affect the dependent variable but are not fully captured by the regressors also correlate with predicted changes in total expenditures. This would add an upward bias even in the fixed-effects model that would not be observed if individual-level data were obtained. In any case, the fixed effects do not lend

Table 29—Estimates of calorie-expenditure and calorie-price elasticities, using fixed effects (based on three-year panel data)

	Elasticity with Respect to				
District[a]	Predicted Expenditures	Wheat Price	Rice Price	Oil Price	Beef Price
Attock	0.278	0.134	0.111	–0.425	–0.093
Faisalabad	0.255	0.026	–0.067	–0.363	–0.028
Badin	0.203	–0.375	–0.202	–0.022	–0.528
Dir	0.314	–0.015	0.335	–0.332	–0.099

Notes: Elasticities are estimated at mean values. The regressions also include the following variables: household size, percent of children under 6, percent of adults, number of visitors, dummy for year 1, and dummy for year 3.

[a] Mastung/Kalat is not reported here because surveys were conducted only during the first year.

---

[43] This is only implicit. The calculations show the difference between the expenditure and the quantity elasticities.

support to the view that the comparatively large calorie elasticities reported are a result of unobserved household heterogeneity.

As mentioned, the price effects can be considered short-run responses to price movements. Results of calorie-price elasticities estimated from the fixed-effects model are given in Table 29 for wheat, rice, oil, and beef. The price elasticities for the main staples indicate wide variation across districts—for rice, –0.067 for Faisalabad to 0.335 for Dir; and for wheat, ranging from –0.015 for Dir to –0.375 for Badin. It should be pointed out that these are not own-price elasticities, but rather total calorie price elasticities with respect to prices.

Total calorie consumption has been shown to be responsive to prices (Alderman 1993; Behrman 1991). In general, positive elasticities are noted when price changes encourage a shift to a more expensive staple. This may explain the positive elasticities for rice in Attock and Dir, where *basmati* rice is generally consumed. The oil price elasticity is similar: much of the temporal growth in calorie consumption in Pakistan can be explained by changes in the price of oil, a calorically dense commodity. The Badin elasticities, however, are a bit surprising. Although the diet in this district is characterized by seasonal shifts between inexpensive varieties of rice and wheat, the fact that all commodity prices are negative implies a net shift from nonfood to foods as much as shifts between commodities if prices decline.

Policy Conclusions

Reutlinger and Selowsky (1976) assumed a calorie elasticity of 0.15 at a level of intake corresponding to the calorie requirements set forth by the Food and Agriculture Organization of the United Nations (FAO). They then illustrated the impact of economic development and targeted nutrition programs based on that plausible assumption. The results here also indicate an appreciable relationship between income or expenditures and the level of calorie consumption. The estimates obtained here are found to be moderate but clearly positive. The policy implications, then, should be similar to those of Reutlinger and Selowsky (1976). Undernutrition, as defined by low energy intake, is unlikely to disappear in the normal course of economic growth, although consumption should be responsive to acceleration in income growth or to income transfers. Yet, by a variety of indicators including childhood mortality and morbidity rates and anthropometric measurements, malnutrition remains a problem in rural Pakistan. A focus on nutrition or on the concomitant health inputs, which augment income or transfer-mediated approaches, appears to be warranted.

The results of the study offer some perspective on one possible component of such an approach. In two of the five districts (those with the highest levels of malnutrition), female primary education influences the level of household food consumption, and in a third, postprimary education plays a similar role. The mechanism of this role is not readily apparent—women are not directly involved in food purchases in any of the districts—but the magnitude is important. For example, a household in Badin that has adult women with some education will consume roughly 150 calories per capita more than a similar household without such education, at the same level of expenditure. Furthermore, if education contributes to household earnings (the evidence is mixed in rural Pakistan), then the impact will be higher still. The issue relating to the health inputs in the production of nutrition will be examined more closely in the next chapter.

7

NUTRITION AND HEALTH STATUS

Despite the economic improvements in the last two decades, infant mortality rates remain high in Pakistan; in 1990, the rate was estimated at 103 per 1,000 live births (World Bank 1992), a figure much higher than in China (29), Sri Lanka (19), or Kenya (67) but close to the levels in India (92) and Bangladesh (105). It is important to note that all of these countries had per capita GNPs of less than US$500 in 1990, yet health outcome indicators were clearly different.

Malnutrition is a serious problem among preschoolers in Pakistan. The 1990-91 national demographic and health survey, conducted by Pakistan's Institute of Population Studies and the Institute for Resource Development (1992), indicates that the proportion of children that are malnourished (children 0-to-59 months old whose weight is below –2 standard deviation according to the standards of the U.S. National Center for Health Statistics [NCHS]) was estimated at 40.4 percent. Earlier national surveys showed a prevalence of underweight children of 47.0 percent in 1985-87 (Pakistan, National Institute of Health 1988), and 54.0 percent in 1977 (ACC/SCN 1993). A reanalysis of national trends based on the ACC/SCN's Second Report on the World Nutrition Situation (ACC/SCN 1993) indicates an annual improvement in the prevalence rate of a little less than 1.0 percentage point per year between 1977 and 1990. During the same period, the annual growth rate in GDP per capita in Pakistan was about 6.3 percent (World Bank 1992). Malik (1993) shows that income growth contributed to a marked decline in poverty in the 1980s. The impressive economic growth achieved by Pakistan in that period is not easily reconciled with slow improvements in nutrition, given the conventional hypothesis about the effects of incomes on welfare.

The general objective of this chapter is to shed light on why levels of malnutrition remain high. The specific objectives are (1) to assess the levels and characteristics of malnutrition and illness in rural areas; (2) to identify the role of household resources (incomes) in improving health and nutrition; and (3) to model the role of communities and community investments in the production of better health and nutrition in households.

Anthropometric Data

Along with socioeconomic information, the survey collected anthropometric and health data for children below six years of age in all 12 rounds and for adults in 5 of those rounds. For each of the 12 rounds, observations on health conditions, specifically on diarrhea and other illnesses, were recorded for each child under six years of age. The major symptoms under the heading of "other illness" include fever and those illnesses related to acute respiratory infections and other health complaints. Major health problems requiring surgery as well as chronic illness were recorded, although not included in the analysis here. Outpatient care was provided in all cases.

In taking illness histories, respondents were asked, "Where did you take the child first?," followed by "Who did you see next?," if a subsequent visit to another health provider was made. The interview also recorded availability, costs, and distances of the various medical care services.

The sample comprised 1,252 children in the first round (July 1986) and 1,223 children in the twelfth round (August 1989).[44] The changes in the number of children were accounted for by births in the intervening period, dropouts, and exclusion of those who reached six years of age during the course of the sampling. A total of 3,440 adults above 20 years old were also included in the sample.

Patterns of Malnutrition in Preschool Children

In presenting the nutritional status indicators, results for the children in rural samples are compared with the normative standards. In keeping with convention, an international standard used by the World Health Organization (WHO) is employed, which uses data from the U.S. National Center for Health Statistics (NCHS 1976) as a benchmark. Growth failure has commonly been equated with malnutrition; therefore, the results of anthropometry are appropriately used to indicate "nutritional status."

Anthropometric data are presented in Table 30 and Figures 2 and 3. The data are standardized into Z-scores (or standard deviations) from the median NCHS reference population.[45] Wasting is defined as those below a cutoff point of –2 standard deviation of the NCHS reference median weight-for-height. Stunting includes children below –2 standard deviation of the reference median height-for-age, and underweight is defined as those below –2 standard deviation of the reference median weight-for-age.

Results indicate that during 1986-89, the level of underweight children in the sample was quite high, with considerable variation by district. The average proportion of underweight children for all rural districts was close to 47 percent, estimated from the 1985-87 national survey (Pakistan, National Institute of Health 1988). Being a national sample, however, the latter is not strictly comparable to the IFPRI data. The average figures of chronic malnutrition (underweight and stunting) in rural areas also indicate marked differences by district. Badin had appreciably higher rates than other districts. Although the prevalence of chronic malnutrition seems to fluctuate by round, no seasonal trends could be detected.

The patterns by age group (Figures 2 and 3) show that chronic malnutrition (stunting and underweight) starts early in childhood. The dramatic shifts in nutritional status in early childhood have been correlated with poor feeding practices. The situation usually occurs in a breast-fed child weaned gradually onto a starchy diet without high protein foods. Failure to breast-feed and very late introduction of supplementary foods with little protein are among the common practices that underlie this condition. Moreover, since chronic malnutrition is cumulative, stunting is likely

---

[44] Mastung/Kalat, which was surveyed only in the first year, is excluded from this figure, but the data are used in much of the subsequent analysis.

[45]

$$\textit{Z-score} = \frac{\textit{Individual's value} - \textit{Median value of reference population}}{\textit{Standard deviation of reference population}}$$

Table 30—Nutritional status of preschool children (0-59 months)

Round/Date	Number of Children	Attock			Faisalabad			Badin			Dir		
		Wasted[a]	Stunted[b]	Under-weightc	Wasted[a]	Stunted[b]	Under-weight[c]	Wasted[a]	Stunted[b]	Under-weight[c]	Wasted[a]	Stunted[b]	Under-weight[c]
							(percent)						
1 July 1986	1,252	14.0	44.9	48.4	3.9	53.2	35.4	9.0	79.1	62.3	10.8	50.9	45.8
2 October 1986	1,305	7.2	48.7	42.5	4.5	49.2	31.5	9.5	73.3	56.1	14.8	55.2	42.0
3 January 1987	1,228	10.0	49.3	40.7	4.8	40.0	29.9	8.4	69.2	53.8	10.2	58.8	38.0
4 March 1987	1,309	18.0	43.5	46.8	5.3	38.2	26.9	9.9	66.3	51.9	9.6	61.5	39.6
5 May 1987	1,298	19.0	41.1	49.6	7.1	30.9	24.5	12.6	64.3	51.1	6.1	61.1	32.7
6 July 1987	887[d]	12.7	40.8	45.3	5.7	30.5	26.0	. . .	. . .	. . .	6.5	55.3	34.0
7 January 1988	815[e]	15.8	46.5	46.8	14.1	50.7	40.6	11.3	51.2	53.4	. . .	. . .	. . .
8 March 1988	761[e]	11.7	46.2	37.7	12.1	49.0	32.1	12.8	48.9	46.9	. . .	. . .	. . .
9 August 1988	776[e]	23.1	48.2	47.8	14.2	40.2	39.6	11.8	48.6	49.4	. . .	. . .	. . .
10 December 1988	835[e]	12.9	49.1	40.0	6.0	39.8	30.8	13.3	52.1	46.4	. . .	. . .	. . .
11 March 1989	1,349	11.9	49.1	40.0	9.3	50.4	29.2	10.9	47.0	49.9	6.7	62.8	33.0
12 July 1989	1,223	9.9	47.8	38.1	11.3	47.9	37.4	9.5	48.6	48.0	6.5	54.3	30.2

Source: IFPRI Rural Survey of Pakistan, 1986/87-1988/89.

[a] Wasted: Z-score of less than −2 standard deviation from median weight-for-height.

[b] Stunted: Z-score of less than −2 standard deviation from median height-for-age.

[c] Underweight: Z-score of less than −2 standard deviation from median weight-for-age.

[d] Excludes Badin.

[e] Excludes Dir.

Figure 2—Weight-for-age, by age

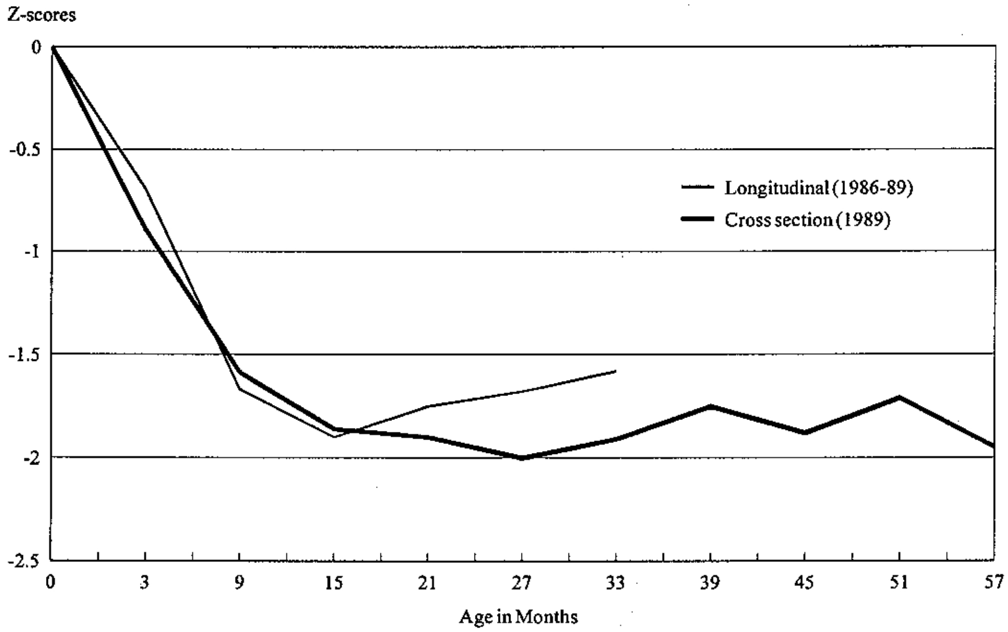
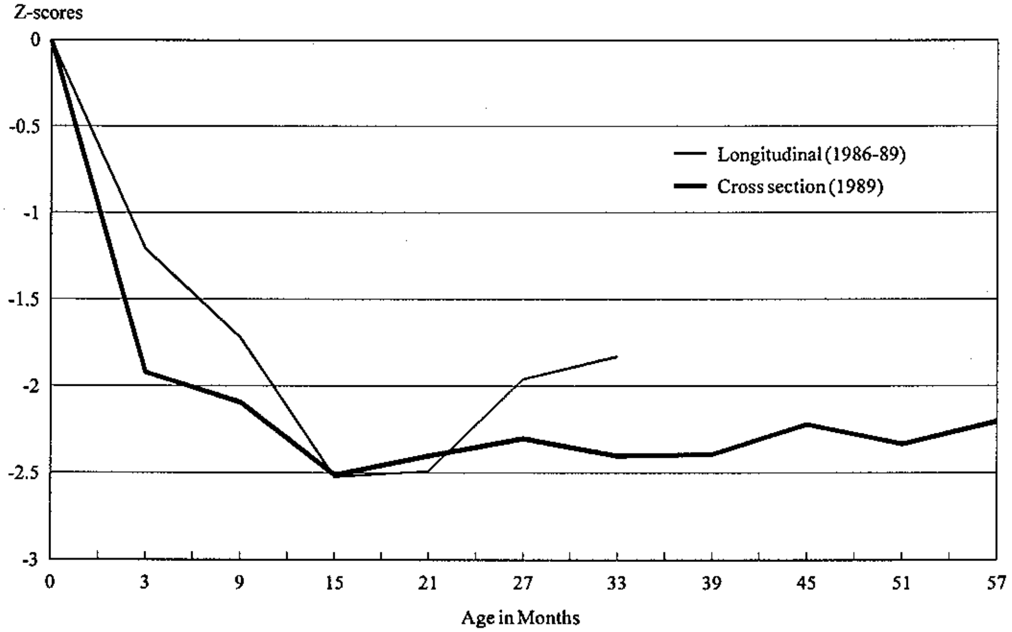


Figure 3—Height-for-age, by age



to be carried over and to increase in the later part of the survey, particularly where catch-up growth is not perfect.

These observations are not peculiar to children in Pakistan. In a review of anthropometric data based on cross-section surveys in 22 countries, Teller and Zerfas (1990) found growth retardation starting even before the second year of life. Comparatively few studies, however, have looked at growth failure from a longitudinal perspective.[46] In the present study, children were observed for a period of three years with measurements done at every quarter of the year (every two months in the first year). Figures 2 and 3 compare the cross-section results observed in the third year with the longitudinal results for deviations in weight-for-age and height-for-age from the international standards. The trend portrayed in the longitudinal data shows one age cohort tracked from 3 months of age through 36 months.

The results indicate close association between the cross-section and longitudinal data at less than 18 months of age for indicators of stunting (Figure 3) as well as underweight (Figure 2). However, the duration of growth failure in the longitudinal sample appears shorter. From about 24 months, both weight-for-age and height-for-age Z-score indicators appear to rise, whereas the cross-section data show that children maintain more or less similar growth trends. On the other hand, the rise in the Z-scores for weight is a real change in the growth-failure pattern, which is not detected when using cross-sectional observations. Beaton (1990) hypothesized that because of age-specific lag, the results from a cross-sectional trend could be due to secular trends.

There are three important implications from these results. First, the appearance of a period of growth failure in rural Pakistani children before six months, continuing until about two years of age, implies that measures to correct for anthropometric deficits will be most effective when these are directed to very young age groups. In practice, this requires nutrition and health programs finely focused on addressing the needs of infants and children less than two years of age. Although some catch-up growth has been shown in the longitudinal data on these children, the response to interventions will generally be higher in early infancy. Second, the slight catch-up growth shown in the longitudinal data deviates from other studies, such as that by Martorell, Rivera, and Kaplowitz (1990) on Guatemalan children, which indicates that linear growth is relatively nonsensitive to influences (dietary or environmental) from 24 months of age onward. Third, dramatic growth deficits in early infancy, compared with those beyond two years of life, imply that growth failures have different etiologies at various ages. This implies that caution should be exercised when considering studies on the correlates of child malnutrition, particularly when age of the child is not properly factored into the analysis. For instance, deaths of the most malnourished could "improve" a cross-section estimate.

To provide a glimpse of the patterns of malnutrition by income groups and landholdings in each district, the share of children at each level of underweight prevalence is shown in Table 31. A clear pattern emerges from this table. Malnutrition in children tends to be more severe in households with lower average incomes per capita in all the districts under study. In Badin, the average income in households where children's weight-for-age is above 80 percent of the standard is 1.4 times

---

[46] See recent work by Martorell, Rivera, and Kaplowitz (1990) and Allen et al. (1990).

Table 31—Incomes, landholdings, and malnutrition, five rural districts in Pakistan, 1986/87

Income/Landholding Group	Weight-for-Age, Less than 60 Percent				Weight-for-Age, 60-80 Percent				Weight-for-Age, Greater than 80 Percent			
	Attock/ Faisalabad	Badin	Dir	Mastung/ Kalat	Attock/ Faisalabad	Badin	Dir	Mastung/ Kalat	Attock/ Faisalabad	Badin	Dir	Mastung/ Kalat
Income per capita (Rs)	2,557	2,350	2,302	2,417	2,990	2,420	2,487	2,280	3,032	3,377	2,772	2,912
Landholding group (percent)												
Landless	69.0	41.3	55.6	40.0	45.3	47.1	39.1	40.3	43.7	40.0	37.2	43.0
Bottom tercile	23.2	24.1	18.3	50.0	20.2	16.7	22.1	17.7	16.2	19.3	19.3	14.3
Middle tercile	0.0	12.6	9.5	10.3	18.9	19.2	18.0	26.3	16.7	22.7	22.7	17.9
Top tercile	8.5	12.7	18.0	0.0	15.1	19.5	20.0	17.0	21.0	23.5	23.5	24.5

Source: IFPRI Rural Survey of Pakistan, 1986/87-1988/89.

Note: Data for Attock and Faisalabad, both districts in the province of Punjab, are combined here.

higher than in households with children below 60 percent of the standard. The incidence of underweight children tends to be much higher among the landless than those with access to land. Even among those who own land, the smallholders (in the bottom terciles) have about twice the proportion of underweight children as those in the top terciles. The differences are more pronounced in Kalat, and less so in Dir. Clearly, access to all resources matters; access to land may only be a proxy.

Nutritional Status of Adults

Diagnosing chronic energy deficiency (CED) in adults has been hampered by the lack of precise methods of identifying affected individuals. Recent approaches to specifying those who are deficient in a population are increasingly being adopted (James, Ferro-Luzzi, and Waterlow 1988). One of the ways of identifying CED in adults is to measure body weight in relation to height, expressed as the body mass index (BMI): weight (in kilograms) divided by the square of height (in meters).

Scientists, however, have varying views on what level of BMI is adequate for good health. Dugdale (1985), for instance, suggests that a BMI of 19.0 is normal, while Payne (1986) suggests 18.0 as the cutoff. In a study of adults in Kenya, the Philippines, Pakistan, and Ghana, Garcia and Kennedy (1993) found that a BMI cutoff of 18.5 did not correlate with morbidity status, indicating that the suggested threshold is not meaningful in certain populations.

James, Ferro-Luzzi, and Waterlow (1988) suggest three cutoffs, which are applied in the present analysis: a BMI below 16.0 is third-degree CED; 16.0-16.9 is second-degree CED; 17.0-18.4 is first-degree CED; and 18.5 and above is normal.

Results for the rural areas in the five districts do not indicate any clear pattern of CED problems according to gender (Table 32). For comparison, the overall BMI averages for the rural sample are similar to the levels found in Ethiopia (Durnin and Womersley 1974) but are higher than those for the urban Indian population (Gopalan 1988).

The BMI rises until youths have finished their growth. It peaks at age 30-34 among Punjabi males and 35-39 years among Sindhi males and NWFP females, then begins to decline as people age. The decline could be part of the normal process of aging, particularly beyond 60 years, or it could reflect secular trends toward taller generations, partly due to improved health environments or economic conditions. The

Table 32—Chronic energy deficiency levels, by gender, of adults 20 years old or more, according to body mass index (BMI)

Chronic Energy Deficiency Level	Body Mass Index	Attock		Faisalabad		Badin		Dir		Mastung/Kalat	
		Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
		(percent)									
Third degree	Less than 16.0	5.0	5.7	6.7	7.0	5.3	6.3	2.9	3.7	3.1	4.9
Second degree	16.1-16.9	7.7	8.4	9.5	9.0	8.9	9.8	2.5	3.7	2.5	3.7
First degree	17.0-18.5	19.7	22.7	14.3	15.7	34.1	36.1	16.4	18.3	18.3	16.1
Normal	18.5 and above	67.4	63.2	68.8	68.0	51.4	47.8	78.1	74.3	75.8	75.2

Source: IFPRI Rural Survey of Pakistan, 1986/87-1988/89.
Notes: N = 3,440. Numbers may not add to 100 due to rounding.

income argument is partly corroborated by Table 33, which shows that groups with higher incomes (in the highest quintile) have on average higher BMIs than groups in the lowest income quintile.[47]

Utilization of Community Health Care Services

The model discussed in this section explores the interaction of public health measures (the reduction of infection) and food policy (levels of food consumption) in producing good nutrition. Since a model in which there is a measurable interaction between illness and anthropometric measurements is presumed and tested in this study, it is useful to examine more closely the availability and use of health care and nutrition services in the villages under study.

Morbidity among the sample children is high. For example, nearly 45 percent of the children had had either episodes of diarrhea or some illness in the two weeks preceding the third visit. Sixteen percent of the children experienced diarrhea for 0.72 days, on average (with a standard deviation of 2.03). Illness other than diarrhea averaged 1.39 days per two-week period, affecting 36 percent of all the children.

This information was obtained by asking female respondents to recall illness and diarrhea during the two weeks prior to the interview for all children under the age of six years. Two important observations are worth noting. The reported illness patterns across districts varied substantially, indicating that the causes of morbidity are affected by locational factors. Nearly 33 percent of the children sampled in the Sind reported illnesses, compared with about 15 percent in the two Punjab districts. Second, morbidity patterns varied across time; for instance, occurrence of diarrhea consistently drops in the winter months. However, no definite seasonal trends are detected for other illnesses.

Given these levels of morbidity, the government is developing a basic health care system that is intended to provide a systematic link between village communities and higher-level health facilities. The highest level in this system is the rural health center (RHC), which is designed to serve a population of about 100,000, with a complement of three doctors and eight auxiliary staff responsible for two small hospital wards of up

Table 33—Mean body mass index (BMI) of adults 20 years old or more, by income group

Income Quintile	Attock		Faisalabad		Badin		Dir		Mastung/Kalati	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1 (lowest)	19.4	19.8	18.2	18.4	19.1	19.6	19.7	20.7	19.5	19.7
2	19.8	20.0	18.6	19.8	18.6	19.0	20.0	21.5	20.1	20.7
3	20.5	20.5	20.1	20.7	18.6	19.4	20.4	22.8	20.5	20.6
4	20.9	21.5	20.6	21.0	19.0	19.6	20.8	22.5	20.6	20.9
5 (highest)	21.1	21.4	21.0	21.3	19.0	20.1	21.4	23.5	21.2	20.9

Source: IFPRI Rural Survey of Pakistan, 1986/87-1988/89.

---

[47] In Ghana, Alderman (1990) found that the BMI was strongly explained by income.

to 10 beds each. Within the sphere of influence of each RHC are 4-10 basic health units (BHU). BHUs are designed to cover 10,000 people with a complement of at least one doctor and four-to-six auxiliary staff. They are equipped to handle only outpatients.

The government's reported coverage closely matches the figures on availability of facilities reported by the sample districts of this rural study. If a household had illness, it was asked whether they sought medical care and, if so, what health provider they chose. The results for each of the districts averaged across the 12 visits is given in Table 34.

The results indicate strongly that private medical care is the predominant choice for health care. On average, about 57 percent of households sought the help of private doctors. Choice of doctors as providers did not vary significantly by district—in Faisalabad, 57 percent chose private doctors compared with 47 percent in Mastung/Kalat and Attock and 52 percent in Badin—in part because private-sector doctors were widely available. It is unclear, however, whether the figures for private doctors also include government doctors, who are normally allowed to undertake private practice in their off-duty hours. Self-care was highest in the Sind. This may

Table 34—Utilization of health care services, rural Pakistan

Province/District/Type of Service	Households Reporting Service Available	Households Using Service
	(percent)	
Punjab (Attock)		
Government clinic (BHU/RHC/MCH)[a]	83.3	15.1
Private clinic (doctor/MBBS)[b]	87.7	59.7
Chemist	30.1	3.5
Siani[c]	1.9	5.1
Punjab (Faisalabad)		
Government clinic (BHU/RHC/MCH)[a]	92.1	12.4
Private clinic (doctor/MBBS)[b]	95.5	57.7
Chemist	77.5	4.3
Siani[c]	95.5	11.6
Sind (Badin)		
Government clinic (BHU/RHC/MCH)[a]	87.5	11.1
Private clinic (doctor/MBBS)[b]	91.1	52.1
Chemist	2.4	5.9
Siani[c]	94.3	2.8
North-West Frontier Province (Dir)		
Government clinic (BHU/RHC/MCH)[a]	39.0	9.2
Private clinic (doctor/MBBS)[b]	51.2	75.2
Chemist	22.4	5.3
Siani[c]	37.5	5.2
Baluchistan (Mastung/Kalat)		
Government clinic (BHU/RHC/MCH)[a]	71.9	21.0
Private clinic (doctor/MBBS)[b]	62.0	47.2
Chemist	42.5	4.9
Siani[c]	72.2	19.9

Source: IFPRI Rural Survey of Pakistan, 1986/87-1988/89.

Note: N = 1,228.

[a] A government clinic can be a Basic Health Unit (BHU), a Rural Health Center (RHC), or a Maternal and Child Health Center (MCH).

[b] An MBBS is a person with a bachelor's degree in medicine and surgery, who is allowed to practice medicine. A doctor of medicine (MD) is a higher degree.

[c] A *siani* is a traditional healer.

be a function of the relative distances of health care providers in this area, compared with the other districts.

To study demand for medical care using the samples from the IFPRI surveys, Gertler and Alderman (1990), for the rural sample, and Alderman and Gertler (1989), for an urban sample, estimate empirical nested multinomial logit models of medical provider choice derived from a life-cycle model of human capital investments. The model is based on the logic of a decision that in the event of illness, households are faced with alternative choices between self-care and an array of providers, including government clinics, private doctors, chemists, or traditional healers (*siani*).

Where these providers are known and available, the choice is hypothesized to be a product of such factors as quality of care, price of treatment, distance, education of the father and mother, and income of the household, taking into consideration household budget constraints.

The main factors that affected the choice of health providers were as follows:

1. *Price and income factors.* The results strongly support the view that price affects the choice of health-care providers. Two types of prices were used in the model: (1) monetary prices or price paid per visit and (2) nonmonetary prices (time costs), which are proxied by the cost of travel and waiting time for each provider. Both price variables were negative and significant, indicating that time costs also matter in household decisions on the choice of provider. Furthermore, the price response also varied for poor versus rich households: demand becomes more price elastic as income falls. This implies that increasing the price paid for medical care would likely reduce the access of the poor to health care proportionately more than the rich. The results also indicate that family resources (incomes) affect choice; families with greater resources are more likely to seek medical care to treat their children's illness. Moreover, the model was specified to allow flexibility of price responses; higher fees for government clinics caused a greater demand for private doctors than for self-care.

2. *Gender of the patient.* In rural areas, there is a tendency to use the high-quality providers (private doctors) more often for boys than for girls. Households are more likely to use the less-preferred types of care (government clinics, chemists, or self-care) when girls are ill, especially in low-income groups. This is consistent with findings in other studies in South Asia on differential rates of human capital investment, such as those found by Rosenzweig and Schultz (1982) in India.

3. *Quality of care.* The most direct measure of quality of care is "improvement in the health of a patient." Since this is not readily observable, alternative proxies are used. A few of these quality indicators were discussed earlier, including availability of different types of health services, equipment, health personnel, and medicine. Others suggest using operational facility costs as a proxy for quality. This assumes that more expensive and better-functioning facilities and equipment are associated with quality of care.

In order to examine the quality factor in the choice of providers, an in-depth anthropological investigation of a subsample of two villages in Faisalabad was conducted as part of the IFPRI study (Rizvi and Chaudhry 1988). The intensive six-month study by two anthropologists included direct observation of actual operation of clinics, as well as detailed interviews on health-seeking behaviors of households in the area.

Use of government clinics varied greatly. The study concluded that low utilization of government health clinics is mainly a result of the poor and unstable services offered by many such facilities. While doctors and dispensers in health centers were generally available during clinic hours, the supply of medicine was very irregular. The doctors in these clinics confirmed that medicines have been in short supply and that, frequently, the doctors compromise by giving smaller doses than required. The time lag between the approval and supply of medicines from the district health offices created major problems for proper health care delivery. For example, one doctor reported that for the whole year, the clinic had a supply of 30 bottles of cough syrup, 10-12 tubes of eye ointment, no antihistamine or iron tablets, and only a small amount of antibiotics.

Modeling the Determinants of Malnutrition in Children

A number of recent studies by economists have explored the relationship of factors other than food to good nutrition.[48] In this, they are joining the ranks of clinical nutritionists who have recognized for some time that nutritional status is determined by infection as well as by levels of food consumption (Scrimshaw, Taylor, and Gordon 1968; ACC/SCN 1990). Malnutrition, for which growth failure is used as a marker, is seen to be a result of two proximal causes: low individual dietary intake and exposure to infection. Dietary intake is affected by the amount of food available at the household level, and exposure to infection depends partly on the health environment (ACC/SCN 1993).

The analytical approach adopted in this research is, therefore, to consider not only the role of a single input—food—but a number of inputs and the efficiency with which they are combined. Given that the ways in which households reduce infections or acquire health care often differ appreciably from the ways in which they obtain food, policy analysis, by viewing nutrition as an output in a production process, can consider a broader set of interventions that may influence nutritional outcomes. Given that some inputs are public goods, the question can be phrased, How does malnutrition respond to current family resources, to lagged investments in human capital, and to community-level investments?

Thomas, Strauss, and Henriques (1991b), for example, in a study of the role maternal education plays in children's nutrition, also investigate whether such effects are influenced by community services and infrastructure.[49] They find that the estimated effects of both education and income are biased if the researcher does not account for community covariates. Such community factors are generally reported for physical health and sanitation infrastructure, although Strauss (1990) finds that the quality of health services may be more important in explaining nutrition than the availability or distance of health care providers.

Such results documenting the importance of community infrastructure may go a long way in explaining why household income is often found to have a comparatively small impact on levels of malnutrition.[50] They may help explain, for example, why some countries have failed to improve nutritional indicators as rapidly as they have increased incomes.

---

[48] See, for example, the review by Behrman (1991).

[49] See, also, Thomas, Strauss, and Henriques (1991a) and Barrera (1990).

[50] This is a generality; it is certainly not universally true (see Alderman 1993).

This study uses a production function approach to ask whether the nutritional status of children in rural communities in Pakistan is responsive to changes in household food availability at the margin. Similarly, it evaluates the role of morbidity in explaining children's weights and heights. In doing so, it also evaluates the degree to which household income accounts for differences in nutritional status and the degree to which other factors, such as education and public health, contribute to the nutritional outcome.

Model and Econometric Considerations

The model employed here is based on the standard Beckerian model of household utility, in which utility is derived both from purchased goods and home-produced goods, including health and nutrition. As the model is now well known, there are only a few features that need recapitulation here.[51] In particular, it is important to recall that the household must include both budget and household technology constraints in its optimization process. Thus, the derived demands for inputs into the production of household goods such as nutrition reflect both the marginal productivity of those inputs and the household's budget constraint. Assume that household utility (U) is a function of consumption of n goods (G_n) and the health of its members (H_i), in particular of the children in the household:[52]

$$U = U(G_n, H_i). \tag{29}$$

There is a technology (Y_j) that produces improved child health that can be described in terms of j inputs that do not directly influence utility and at least one input (G_1) that also contributes directly to the utility of the household:

$$H_i = \Gamma(Y_j,\ G_1,\ \mu_i). \tag{30}$$

Here, μ_i denotes the health endowments of each individual, which are exogenous with respect to current inputs.

Given exogenous income (I) as well as prices (P), which may be broadly defined to include time elements as well as cash outlay per unit of input acquired, one can define demand functions both for goods and inputs:

$$G, Y = f(I, P,\ \mu_i). \tag{31}$$

As depicted, neither prices nor incomes directly enter into the health production function. When undertaking empirical analysis, care must therefore be taken to distinguish demand functions from production functions; many so-called production functions are hybrid combinations of the two.

Individual heterogeneity can cause biased results in studies of the impact of household choices on the production of adequate health or nutrition. A common illustration of this possibility is the example of a family that feeds a sickly child infant

---

[51] See, for example, Schultz 1984. For further details on the model and estimation used in this study, see Alderman and Garcia forthcoming.

[52] The model follows those of Rosenzweig and Schultz (1983) and Strauss (1990).

formula instead of breast milk precisely because the child is less robust than its siblings and cohorts. A researcher unable to measure the genetic endowment of that child might estimate a biased coefficient of the effects of breast-feeding on growth (Habicht, DaVanzo, and Butz 1986).

One way to deal with the problem of heterogeneity is to estimate production functions and input demands as a simultaneous system. Rosenzweig and Schultz (1983), for example, use Cobb-Douglas and translog production functions for birth weight in the United States, with inputs endogenous. Guilkey et al. (1989) use a similar model to examine the effects of prenatal care on birth outcomes in the Philippines.

Frequently, however, it is difficult to find identifying restrictions for more than one or two simultaneously determined health care inputs. Even when such restrictions are plausible, the identifying instruments may have little explanatory power, leading to imprecise, although unbiased, estimates in the nutrition production function. Part of the difficulty is that a limited range of prices are often the only potential identifying instruments for variables such as health care utilization. As noted above, the availability of, or distance to, a health care facility determines health care choices. Unless, however, there are a number of distinct health service centers, such time costs only provide identification for a small number of instruments. Moreover, various factors such as whether the staff is rude or whether the medical technicians are regularly in attendance may be strong determinants of health care utilization but unobservable by the researcher. Finally, for many health care practices, community participation and interactions provide much of the explanation for utilization. Complete modeling of such information, however, may require specialized techniques (Bollinger 1990).

This study circumvents these problems, to a degree, by modeling the effects of (largely unobserved) community factors and, subsequently, the role of such outcomes in the production of anthropometric measures of nutrition. The nonself cluster mean value of the left-hand-side variable in equation (30) is included on the *right*-hand side of the estimating equation. This average implicitly contains information on prices and quality of infrastructure that is useful for identifying the impact of the variable that is being instrumented.

The cluster mean could be a valid instrument in itself. Nevertheless, the instrumenting equations used in this study also contain other information on individuals and households in addition to the cluster mean values. Moreover, a number of variables that can be considered predetermined variables, such as price and distance to clinics, are included. As such, the nonself village means can be considered overidentifying instruments, which increase the precision of the estimates. While this approach does not provide a full understanding of how such prices and quality vectors affect the average community level of the input, it does assist in identifying the role of various inputs in the production process.

There is one further consideration that needs to be addressed. Although the approach used here will address the problem of individual heterogeneity, it will not necessarily result in an instrument that is free from bias that stems from village heterogeneity. Thus, dummy variables for districts are also included in the production function to handle the community-specific effects that cannot be observed.[53] A

---

[53] The details of the underlying error structure of the econometric model are presented in Alderman and Garcia (forthcoming).

statistical test, which indicates that the techniques do not introduce any bias in the results, is presented in Appendix 2.

Model Specification

The specific issue being investigated here, the production of better nutritional status in children as measured by standardized weights and heights, is considered to be a process that is influenced by two proximate factors: nutrient availability and absence of infection. The relationship between diet and disease is complex, but it is well recognized that both are essential for adequate growth and may work in synergy. Household choices and individual characteristics moderate both the amount of exposure and the susceptibility to infection. These are influenced by community factors as well. Exposure to diarrheal and other illnesses is strongly affected by the sanitation in the village and the diffusion of pathogens. The child's susceptibility is further influenced by feeding practices and whether or not the child has been vaccinated. The age of the child also affects susceptibility, as does his health at birth, here proxied by whether the child was born in a hospital, a possible correlate of prenatal care.

These considerations imply the following estimation equations, which are referred to as Model I in the remainder of the paper:

$$\begin{aligned} \textit{Weight–for–height} = f\,(&\textit{calories, protein, vitamin A, prevalence} \\ &\textit{of diarrhea, other illness, hospital birth,} \\ &\textit{vaccination, breast–feeding, household size,} \\ &\textit{parents' education, mother's height, child's} \\ &\textit{age, age squared, gender, district}); \end{aligned} \tag{32}$$

and

$$\begin{aligned} \textit{Height–for–age} = g\,(&\textit{calories, protein, vitamin A, prevalence} \\ &\textit{of diarrhea, other illness, hospital birth,} \\ &\textit{vaccination, breast–feeding, household size,} \\ &\textit{parents' education, mother's height, child's} \\ &\textit{age, age squared, gender, district}). \end{aligned} \tag{33}$$

There are five variables that appear in the production model for nutrition for which community-level infrastructure and interactions are presumed to be important: days a child was ill with diarrhea in the last two weeks; days a child had another illness in the last two weeks; whether a child has been vaccinated; whether a child was breast-fed exclusively; and whether a child was born in a hospital. For each of these variables, community average values are included as instruments. In actuality, to avoid introducing a correlation of individual-specific errors, each cluster mean that is used as an identifying instrument is the cluster mean community value *exclusive* of the value of the individual in question. In addition, individual- and household-specific variables, such as availability of a potable water supply at home and availability of latrine facilities in a home, are included as instruments.

Strictly speaking, with the exception of breast-feeding, the five variables do not denote inputs into nutrition, but rather the outcome of investments in other aspects of health that influence the productivity of inputs into nutrition or the investments themselves. They are, nevertheless, important for understanding the production of improved nutrition as measured by anthropometric indicators. Clearly, an additional variable to explain nutritional status should be the child's food intake. This is not directly observed in this study and can only be proxied by family nutrient availability with separate instrumenting equations for calories, proteins, and vitamin A. Note, however, that government policy—particularly that aimed at guaranteeing food security—often is better able to influence the amount of food a household acquires than how it distributes it within the household. Consequently, per capita household nutrient availability can be considered a measure of the expected impact of such policies on nutrition.

The signs of the two variables for disease prevalence are expected to be negative, while those for hospital birth, vaccination, and breast-feeding, as well as nutrient availability, are expected to be positive. Similarly, higher levels of parental education are expected to lead to higher levels of nutrition. Because women play such a major role in the care of children, women's education is clearly important to adequate caring capacity.

The concern here, however, is not so much to test the signs as to indicate the order of magnitude of the impact on nutrition that feasible changes in the variables can be expected to have. Consequently, simulations of policy variables are included in the discussion that follows the results.

Income is also instrumented. However, given that the concern is with children's nutrition, the bias from differences in taste and individual characteristics in households is less crucial.

For the present study, the analysis of nutritional status uses heights and weights obtained from 1,078 preschool children in the third visit.[54] More than half of the children in the sample are stunted as defined by the World Health Organization reference standards for height-for-age. Approximately 8.7 percent of the children in the sample are wasted (low weight-for-height). This prevalence rate is close to that obtained from the 1990 national demographic and health survey. Being a short-term indicator of malnutrition, wasting is likely to fluctuate greatly in any given population. The two measures of malnutrition should be uncorrelated, although errors in the measurement of height could produce negative correlations. In this sample, the correlation of –0.13 is not significant at any commonly used level.

The correlation matrix of the cluster mean values for various health measures indicates that there is a weak relationship between the various measures or their main determinants (Table 35). The observation is noteworthy inasmuch as roads, proximity to a clinic, and other physical infrastructure are plausible common determinants of most if not all of the measures. It is likely, then, that the structure of specific programs and the set of quality and diffusion variables are more important in explaining these measures, and, further, that these programs differ among villages.

Morbidity was recalled for the past two weeks in each of the six visits in the first year. The availability of the panel information on morbidity allows the data to be used in two different ways. By averaging incidence of illness over the six survey rounds,

---

[54] As expected, *Z*-scores are highly correlated between rounds. Unless one is modeling growth (a very different exercise from modeling status), little is gained by using all rounds of anthropometric data. The panel nature of the data could be used to address issues of velocity and catch-up, but the study would be different from that intended here.

Table 35—Simple correlation matrix for village averages of health and nutrient measures

Variable	Days of Diarrhea	Days Ill	Birth at Hospital, (1 = yes)	Vaccination, (1 = yes)	Breast-fed, (1 = exclusively)	Calories per Capita	Vitamin A	Protein Expenditures
Days of diarrhea	1.00							
Days ill	0.22	1.00						
Birth at hospital	0.01	0.02	1.00					
Vaccination	–0.04	–0.01	–0.03	1.00				
Breast-fed	–0.01	–0.01	0.05	0.15	1.00			
Calories per capita	0.02	0.05	–0.03	–0.04	–0.21	1.00		
Vitamin A per capita	0.05	0.11	–0.03	–0.04	–0.01	0.22	1.00	
Protein per capita	–0.03	0.02	0.01	0.12	0.12	0.55	0.27	1.00
Expenditures per capita	–0.02	–0.10	0.07	0.05	–0.06	0.47	0.42	0.53

the morbidity variable in fact distinguishes between longer-term health effects and those from a more recent bout of diarrhea or illness. This information is the basis for the illness-prevalence instrument. In addition, to capture recent health effects, the morbidity variable was constructed as a difference between the recent (third-round) diarrhea or illness incidence and the average incidence over six survey rounds. This variable is discussed further below.

Child feeding and weaning practices are intertwined with the general problem of hygiene and sanitary environment. Around 65 percent of the infants were exclusively breast-fed up to the age of six months. The alternative, however, is generally not infant formula. From the age of six months, mothers generally start giving buffalo milk to infants, usually diluted with equal amounts of water, as a supplement to mother's milk. These patterns were confirmed in an ethnographic study of two villages in Punjab in conjunction with this research project. As mentioned, this practice has been associated with the higher prevalence of diarrhea and wasting among children in the 6-24 month age bracket.

The average distance to the nearest government clinic is about one-half hour of travel time, indicating that availability of health services is relatively high in these poor areas. On average, private doctors are about an hour away from these households.

The means and standard deviations of the variables used in the analysis are given in Table 36.

Empirical Results

The main results of the regressions are shown in Table 37. The instrumenting equations using all the predetermined variables in Table 36 are not reported for space reasons. In most of these regressions, the signs of the variables are in keeping with the expectations of the underlying structural model.[55] For example, the variable predicted total household expenditures has the expected sign in all instrumenting

---

[55] A previous version of this study, Alderman and Garcia 1992, does report structural equations. These differ slightly from the instrumenting equations in that a few nonsignificant variables are excluded from the structural equations but not from the instrumenting equations.

Table 36—Means and standard deviations of variables used in the analysis

Variable	Mean	Standard Deviation
Z-score of height-for-age	-2.54	1.62
Z-score of weight-for-height	-0.40	1.23
Expenditures per capita per year (predicted Rs)	2,494	891
Days of diarrhea, past two weeks	0.93	1.25
Days ill, past two weeks	1.39	1.67
Probability of illness	0.35	0.18
Probability of diarrhea	0.32	0.16
Birth in hospital (1 = yes, 0 = no)	0.06	0.23
Vaccination (1 = yes, 0 = no)	0.49	0.50
Breast-fed exclusively (1 = yes, 0 = no)	0.65	0.48
Education of mother (1 = primary and above, 0 = none)	0.04	0.26
Education of father (1 = primary and above, 0 = none)	0.38	0.46
Mother's height (centimeters)	151.22	8.67
Household size	10.55	5.02
Age of child in months	35.56	19.04
Sex of child (1 = male, 0 = female)	0.51	0.50
Tap water (1 = yes, 0 = no)	0.22	0.41
Percent of children below six years	0.25	0.11
Calories per capita (visitors excluded)	2,077	507
Protein per capita (visitors excluded)	51.78	18.66
Vitamin A (retinol equivalent) per capita (visitors excluded)	222.91	127.00
Price of wheat (Rs per kilogram)	2.29	0.25
Price of rice (Rs per kilogram)	4.67	0.95
Price of milk (Rs per kilogram)	4.65	1.35
Price of beef (Rs per kilogram)	14.73	1.79
Price of eggs (Rs per kilogram)	1.07	0.11
Interaction of household size x total expenditures	86.45	43.66
Distance to private doctor (minutes)	54.91	36.11
Distance to government clinic (minutes)	27.94	37.30

Source: IFPRI Rural Survey of Pakistan, 1986/87.
Note: N = 1,078.

equations, although the significance is occasionally low. Higher wheat prices lead to reduced calorie and protein consumption, while higher parental education and the availability of a clean and potable tap water supply for the household[56] reduce the incidence of diarrhea and other illnesses. In all equations, the average of the cluster values (exclusive of the individual in question) provides a significant amount of information for identifying the variables in question. As mentioned, this may reflect a combination of the proximity and quality of infrastructure as well as diffusion of community norms. For example, although income and education have some independent effects on whether a child is vaccinated, the probability is largely explained by the community average. This presumably reflects the availability of a vaccination program in the community. Similarly, the prevalence of illness in a community strongly affects the morbidity of a child, regardless of household income.

---

[56] This variable is taken as exogenous, although in the long run, it reflects household choice as well as community factors.

Table 37—Nutritional status determinants: second-stage regression of alternative models

Variable	Model I Z-Scores		Model II Z-Scores		Model III Z-Scores	
	Weight-for-Height	Height-for-Age	Weight-for-Height	Height-for-Age	Weight-for-Height	Height-for-Age
Intercept	–0.059	3.168	–1.161	4.733	–1.288	2.173
	(–0.36)	(0.39)	(–0.23)	(0.52)	(1.76)*	(2.28)**
Log of calories per capita[a]	1.034	1.226	1.235	1.470	1.845	2.723
	(1.11)	(1.00)	(1.22)	(1.11)	(1.19)	(1.13)
Log of protein per capita[a]	1.342	0.109	1.222	1.240	. . .	. . .
	(2.82)**	(1.74)*	(2.32)**	(1.76)*		
Log of vitamin A per capita[a]	2.164	0.156	2.100	0.084	. . .	. . .
	(5.58)**	(0.30)	(5.24)**	(0.15)		
Days of diarrhea, past two weeks[a]	–0.148	–0.403	–0.201	–0.441	–0.249	–0.307
	(–1.62)*	(–1.91)*	(–1.65)*	(–1.81)*	(–3.15)**	(–2.94)**
Days ill, past two weeks[a]	–0.173	–0.628	–0.190	–0.563	–0.035	–0.103
	(–1.66)*	(–2.56)**	(–1.96)*	(–2.25)**	(–1.88)*	(–1.70)*
Probability of diarrhea[a]	. . .	. . .	. . .	. . .	–0.937	–1.470
					(–3.93)**	(–4.72)**
Probability of illness[a]	. . .	. . .	. . .	. . .	–0.913	–1.945
					(–3.56)**	(–5.80)**
Recent diarrhea minus average diarrhea	. . .	. . .	–0.047	–0.039	. . .	. . .
			(–1.85)*	(–1.81)*		
Recent days ill minus average days ill	. . .	. . .	–0.006	–0.027	. . .	. . .
			(–0.93)	(–1.71)*		
Birth in hospital[a]	0.964	1.408	0.980	1.309	1.160	0.934
	(1.60)*	(1.75)*	(1.64)*	(1.64)*	(1.75)*	(1.06)*
Vaccination[a]	0.400	1.132	0.425	1.092	0.674	0.987
	(1.82)*	(2.77)**	(1.84)*	(2.63)**	(1.67)*	(1.83)*
Breast-fed exclusively[a]	0.707	1.110	0.108	1.017	1.696	0.258
	(2.61)**	(1.78)*	(2.68)**	(1.61)*	(3.83)**	(3.89)**
Education of mother	0.398	0.095	0.416	0.058	0.236	0.437
	(1.85)*	(1.62)*	(1.91)*	(1.72)*	(1.77)*	(1.85)*
Education of father	0.036	0.165	0.052	0.174	0.208	0.331
	(0.31)	(1.09)	(0.42)	(1.04)	(1.52)	(1.76)*
Mother's height	0.003*	0.0095	0.038	0.094	0.095	0.0035
	(0.53)	(1.00)	(0.56)	(1.05)	(1.34)	(0.03)
Household size	–0.052	–0.072	–0.055	–0.072	–0.036	–0.054
	(–3.58)**	(–3.49)**	(–3.39)**	(–3.64)**	(–2.38)	(–2.67)**
District						
Faisalabad	0.064	0.316	–0.118	0.280	2.7	0.126
	(0.26)	(0.97)	(–0.44)	(0.84)**	(0.87)	(0.57)
Attock	–0.488	–0.340	–0.448	–0.275	–1.209	–0.439
	(–0.99)	(–0.54)	(–0.90)	(0.42)	(1.69)*	(–0.91)
Badin	–0.341	–0.469	–0.356	–0.451	–0.523	–(0.242)
	(–1.52)	(–1.62)*	(–1.58)	(–1.52)	(–1.57)	(–0.90)
Mastung/Kalat	–0.081	–0.486	–0.016	–0.393	–0.265	–0.522
	(–0.25)	(–1.08)	(–0.05)	(–0.81)	(–0.41)	(–1.13)

(continued)

Table 37—Continued

Variable	Model I Z-Scores Weight-for-Height	Model I Z-Scores Height-for-Age	Model II Z-Scores Weight-for-Height	Model II Z-Scores Height-for-Age	Model III Z-Scores Weight-for-Height	Model III Z-Scores Height-for-Age
Age of child, in months	–0.039 (–3.89)**	–0.014 (–1.06)	0.039 (–4.02)**	–0.026 (–1.29)	–0.058 (–4.58)**	–0.007 (–0.45)
Age of child, squared	0.004 (3.05)**	0.003 (0.16)	–0.004 (3.17)**	0.0005 (0.30)	0.0045 (2.60)**	0.004 (1.67)*
Sex of child	0.081 (0.86)	0.042 (0.31)	0.076 (0.81)	0.020 (0.15)	0.179 (1.43)	0.284 (1.18)

Notes: N = 1,078. Figures in parentheses are *t*-values.
[a]Predicted value.
*Significance at the 10 percent level.
**Significance at the 1 percent level.

The predicted logarithms of calories and protein consumed per household have positive coefficients in both equations in Model I, although the former are not significant. This may be due to the insensitivity of this measure to intrafamily distribution. Moreover, the derivative may decline as calorie intakes rise. That is, over the range of intakes observed in the sample, additional household calories may have a smaller impact than they would at lower levels.[57]

Consumption of vitamin A shows a strong influence on short-term nutritional status (weight-for-height). Both measures of illness, however, influence the anthropometric measures of nutrition. The instrumented variables reported in Model I can be considered predictors of the probability of illness or diarrhea. As this probability goes up, nutritional status deteriorates.

The impact of breast-feeding exclusively up to the weaning age is strong and significant. These results underscore the critical role of mother's milk in the development of healthy children. The advantages of breast-feeding include the transfer of immunity. Moreover, where water is not safe to drink, the hygiene of bottle-feeding is an issue. Due to problems associated with measurement of breast-feeding practices (Barrera 1991), however, a variant of the model that excludes the breast-feeding variable was tested.

Parental education is shown to have a positive effect on both long- and short-term nutrition, as well as on the other inputs that enter into the improvement of nutrition. Education of the father, however, did not prove significant. Because education is included in the instrumenting of income (and the education variable remains significant in alternatives to Model I, which include income), the parents' education influences the efficiency of rearing children over and above a pure income effect. Many other recent studies have also shown that mother's education has a strong influence on child nutriture (Behrman and Wolfe 1984; Strauss 1990).

---

[57] This differs from the issue of curvature of the income-calorie relationship explored by Strauss and Thomas (1989), but it is analogous. The coefficient of calories is also sensitive to the exclusion of other nutrients. The magnitude drops appreciably if protein and vitamin A are excluded.

Child rearing is also found to be affected significantly by the size of the household where the child resides. Since family time and resources are always scarce, the ability of parents to provide for any child may be affected by sibling competition. The negative effects of a large household are reflected in the strong negative coefficient of the household-size variable on weight-for-height and height-for-age in Table 37. Since family size may be endogenous yet hard to instrument, an alternative was estimated to verify that the key results were not sensitive to the inclusion of this variable.

The coefficients of age and its quadratic term indicate that a child's age is a major determinant of whether it will suffer from acute malnutrition. However, once a child's growth path deviates from the norm, it may not be able to catch up easily. Thus, height-for-age is less age dependent. Contrary to findings elsewhere in South Asia, gender seems to have no significant effect on nutritional status in the sample children. The same result is reported in the 1985-87 National Nutrition Survey (Pakistan, National Institute of Health 1988).

It is plausible that the impact of vaccination on nutrition is indirect via reduced illness. However, the fact that the coefficient of vaccination is significant may imply that vaccinations against measles and diptheria, for example, reduce the probability of illnesses different from the upper respiratory illnesses that are the most prevalent nondiarrheal diseases in the sample. Birth at the hospital, which is strongly determined by income and proximity (as shown by a strong cluster average) has a positive though slight impact on short-term nutritional status. Because it is more plausible for the variable to be a measure of prenatal care and therefore to explain long-term nutritional status, the variable may be a proxy for other preventive health care.

While this study does not completely explore the dynamic nature of nutrition, it is useful to investigate briefly the impact of a short-term shock on nutritional well-being. To this end, two variables that indicate the deviation caused by a child's morbidity from that child's own pattern of illness were constructed. These variables are the difference between the morbidity of the child in the period under investigation and the average number of illnesses for that child over the year:

$$D' = D_{it} - \bar{D}_i, \text{ and}$$

$$I' = I_{it} - \bar{I}_i, \tag{34}$$

where D' and I' are deviations from individual mean days with diarrhea (D) and other illness (I), respectively. Since $\bar{D}_i$ and $\bar{I}_i$, the means for the year, are removed, individual heterogeneity is controlled. This approach differs from an individual fixed-effects model, however, in that a number of instrumented variables are retained that are considered time invariant, including expected prevalence of disease. This exploration, however, is simpler than the Hausman-Taylor (1981) model or its descendants.

Results given in Model II indicate that a recent episode of diarrhea, controlling for individual heterogeneity, affects child weight-for-height, while other recent illnesses affect height-for-age. These effects are separate from the average incidence of diarrhea over the year. Clearly, the independent effects of being sickly over time versus the effects of recent illness and diarrhea should be distinguished for purposes of identifying measures to alleviate the nutrition problem. Sickly children are more predisposed to illness over time and, therefore, preventive measures would need to be emphasized for such subgroups of children. Short-term measures for alleviating the effects of diarrhea, such as the use of oral rehydration solution (ORS), could be prescribed as needed.

A similar perspective is provided in Model III. In addition to the days of illness and diarrhea in the previous two weeks, a separate variable for the probability of illness or diarrhea was included and instrumented as with the other health measures.[58] When these variables are included, the average number of days ill is interpreted as an indication of the impact of the duration of illness controlling for the number of incidences.

The results indicate that reductions in the number of days ill, conditional on the probability of illness, have an impact on nutrition that is distinct from changes in the frequency of illness and diarrhea. Thus, preventive care appears to offer avenues for reducing malnutrition that are additional to curative methods.

Conclusions and Policy Implications

In recent debates about measures to alleviate malnutrition, two central issues have surfaced: (1) the relative magnitude of the food and health dimensions of the problem, and (2) the use of own resources versus public investments to cope with the problem. Since the process of promoting adequate nutrition is highly complex, any modeling that addresses such issues simultaneously is likely to be useful in identifying the key policy instruments that can be used.

In the rural environment of Pakistan, where 70 percent of the population live, these estimates suggest that at the household level child nutrition responds more strongly *at the margin* to health inputs than to food availability. According to the results presented in this chapter, there is an interdependence between morbidity and poor nutritional status. Modeled simultaneously, diarrhea reduces weight-for-height in children, and other illnesses curtail long-run growth of children.

In order to examine the magnitude of the effects from these policy variables, a simulation based on the parameters of Model I was conducted. The impact of each policy variable was estimated from the direct effects of that input into the production of adequate child nutrition as well as through its indirect effects on other inputs that also affect nutrition. For example, education affects child nutrition through its influence on the nutrition status production function. In addition, it is clear from the results that education also determines the level of inputs such as birth in the hospital, vaccination, and breast-feeding, or the probability of infections.[59]

Although indirect pathways for a few potential changes are explored here, it should be noted that all such changes are *not* derived from adding the individual changes simultaneously.[60]

The critical role of mother's education in achieving nutritional goals in rural areas is highlighted in Table 38. If mothers are educated to at least the primary level, the

---

[58] The introduction of additional instrumented variables required removal of two other instruments, due to restrictions in the computer software.

[59] Education often has an impact on monetary income, although in this rural population, female education at the primary level mainly influences nonpecuniary returns.

[60] The impact of two or more changes on the outcome variable cannot be derived a priori. The total effect can be more or less than the sum, depending on the joint distribution of the policy variables in the community.

Table 38—Simulation of selected policy-relevant variables affecting malnutrition, based on Model I

	Child Wasting			Child Stunting		
Variable/Intervention	Current Level	Projected Level with Intervention	Impact[a]	Current Level	Projected Level with Intervention	Impact[a]
			(percent of children)			
Per capita expenditure (income)	8.7	. . .	. . . . . .	62.3	. . .	. . . . . .
10 percent increase		8.0	–0.7 (8.1)		60.2	–2.1 (3.3)
Days with diarrhea, past weeks	8.7			62.3		
Reduced by one day		6.6	–2.1 (24.1)		52.7	–9.6 (15.4)
Reduced by two days		4.8	–3.9 (55.1)		42.8	–19.5 (31.3)
Days ill, past two weeks	8.7			62.3		
Reduced by one day		6.0	–2.7 (31.0)		46.2	–16.1 (25.8)
Reduced by two days		5.3	–3.4 (39.0)		29.8	–32.5 (52.1)
Education of mother	8.7			62.3		
Education to at least primary level		4.4	–4.3 (49.4)		56.6	–5.7 (9.1)
Education of father	8.7			62.3		
Education to at least primary level		8.3	–0.4 (4.5)		59.1	–3.2 (5.1)
Price of wheat	8.7			62.3		
Reduced by 10 percent		6.9	–1.8 (20.6)		60.2	–2.1 (3.3)
Household size	8.7			62.3		
Reduced by one person		7.7	–1.0 (11.4)		60.0	–2.3 (3.7)
Reduced by two persons		7.4	–1.3 (14.9)		58.9	–3.4 (5.4)

Notes: Figures in parentheses represent the percent reduction from current levels of wasting and stunting. Wasting is indicated by a Z-score of less than –2 standard deviation from median weight-for-height. Stunting is indicated by a Z-score of less than –2 standard deviation from median height-for-age.

[a] Impact is the level of child wasting and stunting with intervention minus the current level.

current prevalence of wasting in children (a short-term indicator of child nutrition) will be reduced by almost one-half. This is six times the overall impact achieved by increasing per capita income by 10 percent. Increasing the educational level of the father also has an effect, but it has less of an impact than mother's education. In part, this reflects the low significance of the education variable in the main equation as well as the fact that far more fathers have already received primary education. Increasing per capita income by 10 percent reduces the original incidence of child wasting by 8.1 percent and stunting by 3.3 percent. These results reflect the indirect effects that increased income has through its association with reduced diarrhea and illness, and increased likelihood of vaccination, birth in a hospital, breast-feeding, and adequate calorie intakes.

Similarly, programs that decrease the occurrence of diarrhea by one day, on average, in any two-week period, dramatically reduce the incidence of child wasting by 2.1 percentage points. (This is down one-fourth from the current level of 8.7 percent; decreasing days with diarrhea by two days reduces wasting by one-half.) Reducing the days a child is ill by one day for any two-week period also reduces child stunting by 16.1 percent, 32.5 percent if illness is reduced by two days. This more-than-proportional improvement reflects the distribution of heights of children in the sample rather than any increasing returns to scale.

The overall assessment of the morbidity-related variables, therefore, clearly demonstrates the consequences of infection and the responsiveness of malnutrition to programs that prevent diarrhea and other illnesses among young children. Public-sector programs designed for curative purposes (for example, clinics and ORS) and preventive purposes (drainage, education campaigns, and so forth) appear to be important inputs for reducing morbidity in the rural areas.

In a similar vein, specific programs such as family planning have clear effects on reducing stunting and wasting in children, although the implied effects are less than the impact of morbidity.

What is the role of price policy in addressing the nutrition problem? The simulation indicates a moderate reduction in prevalence in the short-run nutrition indicator—reduction of child wasting from 8.7 to 6.9 percent with a 10 percent reduction in the price of wheat. The long-term impact—on height-for-age—is, however, far smaller in percentage terms.

While these results do not indicate which steps would be most cost-effective for changing the community covariates that subsequently influence nutritional status, they do indicate the importance of community measures in conjunction with or in addition to household resources. Education—one household asset that has a strong impact on nutrition—is generally achieved through public investment, even if enhanced by income growth.

Since the incidence of diarrhea and illness is strongly affected by community covariates, a clear policy remedy is community-level investments to improve the sanitary environment. To address short-term nutrition problems, an emphasis on income and price policies alone may be less effective than specific programs and investments at the community level. Public health programs that reduce disease or encourage prenatal care are also needed.

In conclusion, these results indicate that in Pakistan, food security alone is not sufficient to improve nutritional status, particularly of children. It is possible that at very low-income levels, such as those prevailing in Sub-Saharan Africa, the marginal impact of additional food calories could be large. However, the effect is likely to be nonlinear, declining with an increase in food availability.

While there are welfare justifications for various food policies that are distinct from nutritional concerns, health and infection in the rural areas of Pakistan are clearly shown to be important factors in nutrition that need to be simultaneously addressed. This may not be the case in every community (Becker, Black, and Brown 1991); the relative response of nutritional status to food and to health should be considered a major component in nutrition policy. This does not argue that a decrease in food availability would not have consequences on the children in the community, but that, at the present levels, household food availability does not appear to be the most binding constraint on adequate nutrition for children. Both food and health inputs are necessary to improve nutrition.

8

CONCLUSIONS AND POLICY IMPLICATIONS

Pakistan's growth in GNP in the last two decades has been impressive. GNP per capita in 1990 was US$380, which is more than double that for 1976 (US$170). Since 70 percent of the population live in rural areas and since agriculture, the largest sector, accounts for 25 percent of GDP, it is to be expected that agriculture's performance will have a strong impact on the lives of the population. Between 1980 and 1990, food production increased by 50 percent, outpacing population growth, which increased by about 32 percent during the same period. It is against this background that this study examines the consequences of these rapid transformations in poverty, household food security, health concerns, nutrition, and various aspects of household and individual welfare. In contrast to the usual snapshots of the population's situation at a given point in time, the repeated (panel) observations of households provide new policy insights into the dynamic dimensions of poverty, food security, and nutrition in the rural populations.

Rural Development Versus Agricultural Development

The in-depth analysis of income and wage formation in rural Pakistan reveals that although households in the sample were totally rural, their sources of livelihood were not strictly agricultural. The three-year panel study of villages in five districts indicates the importance of nonfarm income for both level and distribution of income. Crop earnings represented less than 45 percent of all earnings, including transfers, whereas nonfarm wages and earnings from own enterprises were 41 percent of all income. This diversity of income sources held true for all districts studied. Only 14 percent of households in the entire sample earned less than 20 percent of household income from activities outside of crop cultivation or livestock tending.

Rural income sources varied across the three years, mainly due to various shocks brought about by natural factors such as a hailstorm at harvesttime in one district, flooding in another, and drought in a third. Remittances declined dramatically in the northern district. Thus, components of income shifted over the years.

The diversification of incomes moved in several directions, with both high and low returns. Some farmers undertook artisan activities, which have low status and low capital requirements, while others took up village occupations, including shop ownership, operation of public transport, and various forms of trading.

These findings reinforce the conclusion that rural development is not totally congruent with agricultural development. This does not negate, however, observations from other studies, which indicate that agricultural development strongly influences the demand for rural services and nonfarm production. To be sure, rural nonfarm income is often related to self-employment in business and related activities, including the production of inputs or processing of agricultural output. Nevertheless, strategies for rural development must involve a broader set of policies than development of agriculture per se. These strategies must include education and infrastructure development as well as broadening of credit availability to rural nonfarm enterprises.

Sources of Income Inequality

Of the five sources of rural income—agriculture, nonfarm, livestock, rent, and transfers—agricultural income accounts for the largest share of overall income inequality. Nonfarm income contributes little to total rural inequality. Since landownership is highly skewed in the rural areas, it is not surprising that rental incomes from land increase income inequality. According to the results of this study, both livestock raising and nonfarm income sources help decrease inequality. This implies that if equitable distribution of rural economic growth is an important objective in Pakistan, strategies to encourage the increase of nonfarm income and livestock development would be desirable.

Farm Wage Formation

Although it is occasionally argued that technological change and farm fragmentation have increased the number of households dependent on agricultural wage labor, little evidence for this was found in either the IFPRI panel sample or nationally representative surveys. Moreover, the pay for labor in Pakistani agriculture is similar to that received for urban unskilled labor, and comparatively higher than that in other Asian and African countries. For example, the average agricultural wage laborer in the IFPRI sample could buy 11-17 kilograms of wheat for a day's work. At the same time, unskilled construction workers in Karachi or Lahore were able to buy 15-18 kilograms of flour for their wages. Indian agricultural laborers could buy 8-13 kilograms of wheat (at harvest prices) with their wages, and those in Bangladesh, 6 kilograms.

In general, food has been, and remains, relatively cheap and constant throughout the year. This reflects the extensive subsidy and stabilization policies pursued by the government. At the margin, there is little scope for increasing grain consumption with such policies.

Poverty Measurements

A surge of new indicators for defining poverty in the development literature has enriched the thinking on strategies to alleviate poverty. Sensitive indicators for defining poor versus nonpoor households clearly need to be designed for use in poverty alleviation efforts. How do the poor differ from the nonpoor? Nine different criteria constructed here for assessing the efficiency of definitions indicate that the overlap could be low or high, depending on how data were obtained. Using income as a criterion, this study shows that households with temporary income shortfalls (due to weather or illness, for example) can be considered poor, even if their expenditures reflect their long-term income expectations. A weak overlap indicates potential difficulties in determining whether a household is in poverty or not. This problem is serious for surveys, for example, that cover only a single year, and it is exacerbated by considerable errors in income observations. However, the correlation of asset ownership and consumption (expenditure) is only moderate.

The analysis of alternative indicators shows that there are enormous pitfalls in defining poverty using a single dimension. The repeated observations of households (12 visits in three years) in this study clearly show that it is difficult to unambiguously determine which are the poorest households in a community: some households move in and out of poverty over time; some are excluded when using one indicator but included using another. Instead of attempting to identify the poverty levels of different groups, perhaps one should identify characteristics of the poor—by looking through the statistical correlates of being poor, for example—in order to design programs that take into account the constraints.

Household Coping Strategies: Implications of Income Fluctuations

During the three years covered by the panel data, the relative shares of different income sources were found to fluctuate due to weather and other factors. For example, remittances from abroad declined over the three years. One issue of policy relevance is whether these income shocks are strongly correlated over a district or over a village. If so, it is less likely that traditional social networks will be successful in stabilizing consumption in the face of short-term shocks through sharing mechanisms (coinsurance) or through localized informal credit. The results from this study indicate that, while some income fluctuations are explained by district variables, a far greater share of the variance is explained by village-level variables. Households can reduce their consumption risks through family networks that extend beyond the village as well as through income diversification that reduces income risks.

Moreover, households clearly use savings and credit markets to stabilize consumption. For example, although incomes are seasonal, there are no statistically significant seasonal patterns of total food consumption in any of the sample districts. In the sample in the Sind, there is a pattern of shifting between wheat and rice at their respective harvesttimes, but total calorie intakes are not affected.

Households also save or draw on their savings as a result of transitory income fluctuations. On average, 70 percent of the increase or decrease of income after a shock is either saved or spent, depending on whether the unexpected change in income was a positive or a negative one. Even low-income households manage to save half of transitory income increases, although they save only 10 percent of overall income. Remittances are mostly saved; households put half of marginal remittances from abroad into financial savings (debt reduction, bonds, and bank accounts) and an additional 30 percent into physical property. Nevertheless, more of local remittances than remittances from abroad are used for consumption, reflecting the greater regularity of return from local income sources.

Only about 15 percent of the households used banking networks, indicating the potential for formal-sector resource mobilization. This probability increases with education and declines with distance from a bank. The limited use of formal banks indicates that informal lenders, such as shopkeepers and relatives, are still the main elements of the rural credit market in Pakistan.

Household Food Security

Observations from the 12 visits to households indicate that, in general, the calorie supply of these rural households is moderately high at 2,400 calories per person per day, on average, compared with households in many parts of Asia. There are regional variations, however. During the three-year period, no evidence of seasonal differences in calories consumed was detected, although the composition of grain consumed in one region changed with the seasons. Households coped with seasonal lows through savings, including storage of grains. Households opted to use credit (mostly from informal sources such as relatives and friends) to maintain a fairly constant expenditure level. In these households, the effects from fluctuations in crop production were mitigated by the great diversity in income sources.

Calorie income elasticities in the study ranged from 0.12 to 0.39, on average, and from 0.14 to 0.46 for the poorest income quintile. Food expenditure elasticities, however, are about 1.5-2.0 times the calorie elasticities, which indicates that households opt for a higher-quality and more diversified diet over quantity as income increases. The range of calorie elasticities did not vary substantially between cross-sectional and fixed-effects estimates, which does not lend support to the view that the comparatively large calorie elasticities reported are the result of differences in household tastes and individual preferences.

Despite the relatively high levels of calorie availability in Pakistan, however, the proportion of malnourished children (as indicated by the prevalence of underweight) has remained high. In 1990/91, Pakistan's national survey showed that 41 percent of children 0 to 59 months of age were underweight for their age, 49 percent were stunted, and 8.6 percent were wasted (or extremely thin). Quite similar levels of undernutrition were observed in the sample children in this study. National trend data over the last 14 years show that improvements in nutritional status have been quite slow in relation to improvements in income.

These results indicate that underconsumption is not likely to disappear in the normal course of economic growth. In these households, it would take a 30 percent increase in incomes to achieve a 10 percent rise in calorie intakes. Other concomitant policies need to accompany increases in incomes in order to attain food security. Improved public education, particularly for women, is a critical determinant. A household with the same level of income but with adult women with some education will consume about 150 calories per capita more than similar households where women do not have this education.

Nutrition and Health

The results from this study of growth of rural Pakistani children indicate that converting income into higher calories and, consequently, into growth is hampered by the negative effects of infection in these children. The prevalence of illness and diarrhea is particularly high. The main message from these results, then, is that the interaction between diet and infection is particularly critical in an environment where disease is widespread.

In this light, it is essential to consider the importance of community-level factors—health services, sanitation, village water supplies, and public drainage systems—that are not feasible for a household to provide from its own resources. Public health programs that reduce illness or encourage prenatal care are likely to influence nutrition as well. In this study, education, particularly of females, was found to be strongly correlated with better nutrition in children. In fact, the impact of education was much stronger than that of increasing incomes. Education is achieved generally through public investments.

The quality of the services offered is as important as the actual physical presence of a facility. Government health clinics were available to 80-90 percent of the people in the study villages. Average use of these clinics, however, was very low—only 9-21 percent of the population used them, mainly because medicines and medical supplies were frequently unavailable and equipment was poor. Most people preferred to go to private doctors. The existing health infrastructure will be effective only if adequate recurrent expenditures—particularly for medicines and supplies—are ensured.

The study also found that, contrary to conventional wisdom, girls in these villages were *not* worse off than boys, based on nutritional (anthropometric) indicators. The national sample survey taken during the same period confirmed this finding. The origin of the difference in mortality rates for girls may not lie in caring or feeding practices, but rather in health-seeking behavior, which is found to favor boys in this sample. There was, however, a large difference in schooling and educational attainment between boys and girls, and between adult men and adult women. It is also clear from the study that education of women (especially mothers) in the household is likely to have a large beneficial impact on children's nutrition.

Pakistan's national budget for health expenditures has been less than 1 percent of the GDP for the last 15 years. The implication for policy is clear. To reduce malnutrition in the country, the increase in per capita food supply needs to be matched by a systematic reduction in infection levels, particularly of the preschool-age population. This can be achieved by increasing public investments in health and education.

APPENDIX 1: WAGES, INCOME, AND EXPENDITURE REGRESSIONS

Instrumented income or expenditure variables were employed in various aspects of the analysis. This avoids the possibility of errors in variables (for example, in demand analysis) and allows one to abstract from short-term income shocks in the study of savings.

Under the hypothesis that expenditures reflect a household's long-run earning capacity, household income equations and expenditure equations should indicate the same relationships.[61] To a large degree, this is the case with the results for year 1, reported in Table 39, although it is noteworthy that the coefficients of physical assets, including land, are generally lower in the expenditure equations. Income in the current year is conditional on a level of physical assets, while the expected returns from the asset that influences a household's total expenditures will also incorporate the investment decisions. As such, the coefficients in the income equations can be interpreted as gross returns (minus variable inputs only), whereas the coefficients in the expenditure equations are net returns, which reflect the cost of assets as well. Moreover, income and expenditure instruments do not appear to substitute for each other in that the correlation of predicted expenditures and income, using the same instruments, are as low as 0.65 for Faisalabad and 0.71 for Attock. However, they are above 0.87 for the other three districts.

Additional income instrumenting equations for years 2 and 3 are reported in Table 40. In this as well as the previous table, the sample is restricted to households for which all data are complete in all three years. The fits of the equations are excellent, and most variables are statistically significant despite the relatively small samples resulting from disaggregation by districts. Nevertheless, the coefficients do vary over years.

Few of the coefficients have unexpected signs and fewer still—machinery and tools in the Faisalabad first-year income equation—are significantly negative with a two-tailed test. Since the value of assets—livestock, machinery, and vehicles—is in current rupees, an additional rupee's worth of capital increases incomes in the neighborhood of 10-50 paisa. This is somewhat high, but not implausibly so.

In these equations, human capital is indicated by the highest degree of each individual in the household—a more meaningful measure than the education of the household head who, being the oldest, reflects the low education of an earlier generation and is often retired. As expected, the magnitude of the higher education coefficients exceed the primary school coefficients. Female education often does not increase household income—or expenditures—even at higher levels. This surprising result is, however, consistent with results on labor supply estimated from other data in the survey.

Interyear correlations of predicted income range between 0.62 and 0.94. Only drought-stricken Attock, however, had interyear correlations of predicted incomes below 0.78. Some changes reflect change of assets (right-hand-side variables) rather than changing coefficients.

---

[61] Although the income regressions are useful for smoothing household-level shocks, weather shocks, which are correlated over a district, can bias the returns to assets away from their long-run returns.

Table 39—Income and expenditure functions, year 1

Variable	Attock		Faisalabad		Badin		Dir		Mastung/Kalat	
	Income	Expenditure	Income	Expenditure	Income	Expenditure	Income	Expenditure	Income	Expenditure
Intercept	3,770 (1.57)	6,953 (4.74)**	–3,639 (–0.83)	3,519 (2.46)**	4,111 (2.35)**	4,748 (6.62)**	3,962 (2.04)**	9,075 (9.26)**	5,999 (2.61)**	5,661 (5.21)**
Number of males aged 16 and over	1,951 (2.19)**	1,330 (2.44)**	5,940 (3.94)**	1,432 (2.89)**	2,022 (2.84)**	1,953 (6.71)**	2,684 (3.68)**	818 (2.22)**	938 (0.92)	1,538 (3.18)**
Number of males aged 6-16	–323 (–0.40)	1,667 (3.36)**	–168 (0.16)	2,482 (7.03)**	1,194 (1.90)*	862 (3.34)**	93 (0.17)	1,321 (4.89)**	1,691 (2.09)**	962 (2.52)**
Number of females aged 16 and over	931 (0.97)	2,216 (3.74)**	3,687 (2.09)**	2,004 (3.46)**	362 (0.47)	1,259 (4.00)**	–456 (–0.63)	1,990 (5.42)**	–709 (–0.54)	900 (1.44)
Number of females aged 6-16	–805 (–1.03)	497 (1.03)	1,240 (1.06)	1,627 (4.25)**	331 (0.46)	1,592 (5.40)**	66 (0.11)	1,466 (4.90)**	1,009 (0.64)	34 (0.05)
Number of children 5 or below	1,505 (1.65)*	1,845 (3.31)**	1,175 (1.01)	826 (2.17)**	929 (1.44)	670 (2.53)**	2,287 (3.76)**	1,007 (3.28)**	2,820 (2.99)**	2,217 (4.97)**
Number of males with primary schooling	–847 (–0.71)	448 (0.61)	–560 (–0.23)	1,469 (1.85)*	–196 (–0.14)	–527 (–0.93)	1,298 (0.98)	474 (0.71)	6,140 (2.95)**	2,537 (2.58)**
Number of males with secondary schooling	58 (0.06)	2,177 (3.56)**	–908 (–0.52)	2,111 (3.72)**	a	a	673 (0.74)	1,578 (3.45)**	2,279 (1.69)*	3,341 (5.24)**
Number of males with more than secondary schooling	–1,252 (–0.51)	7,018 (4.62)**	6,233 (1.40)	4,427 (3.03)**	3,785 (1.72)*	–97 (–0.11)	9,124 (4.50)**	4,702 (4.58)**	6,435 (1.41)	3,170 (1.46)
Number of females with primary schooling	1,192 (0.77)	546 (0.57)	–1,328 (–0.51)	1,154 (1.35)	–2,101 (0.54)	–2,314 (–1.44)	4,318 (1.50)	2,163 (1.49)	6,707 (1.85)*	2,584 (1.51)
Number of females with middle schooling or more	3,989 (2.22)**	2,199 (1.99)**	–241 (–0.06)	–2,103 (–1.63)*	b	b	–5,548 (–1.97)**	3,953 (2.75)**	7,758 (1.35)	–1,400 (–0.52)
Rainfed land	254 (6.20)**	74 (2.96)**	. . .	. . .	b	b	182 (1.53)	–38 (0.63)	110 (2.34)**	23 (1.05)
Irrigated land	1,002 (1.04)	–402 (–0.58)	1,919 (7.41)**	722 (8.49)**	403 (5.84)**	113 (0.39)	773 (3.63)**	619 (5.73)**	665 (4.93)**	235 (3.67)**
Acres of orchards	. . .	. . .	6,843 (2.66)**	509 (0.60)	. . .	. . .	1,801 (4.15)**	–34 (–0.15)	4,065 (2.57)**	–66 (0.09)

(continued)

Table 39—Continued

	Attock		Faisalabad		Badin		Dir		Mastung/Kalat	
Variable	**Income**	**Expenditure**	**Income**	**Expenditure**	**Income**	**Expenditure**	**Income**	**Expenditure**	**Income**	**Expenditure**
Value of livestock	0.246	0.103	0.005	0.025	0.348	0.203	0.517	0.095	0.335	0.369
	(2.67)**	(1.84)*	(0.03)	(0.50)	(4.64)**	(4.66)**	(1.70)*	(0.45)	(1.05)	
Value of vehicles	0.069	0.015	0.457	–0.029	c	c	0.086	0.014	0.171	0.016
	(1.77)*	(0.62)	(4.91)**	(–0.97)			(3.07)**	(1.00)	(8.55)	(1.60)*
Value of machinery and tools	0.082	0.076	–0.088	0.022	0.271	0.057	0.075	0.042	0.125	0.232
	(1.55)	(2.30)**	(–0.43)	(0.33)	(5.89)**	(6.55)**	(3.12)**	(3.50)**	(1.27)	(5.04)**
R^2	0.527	0.573	0.673	0.720	0.624	0.748	0.669	0.777	0.747	0.806
N	154	154	144	144	237	237	192	192	217	217

Note: *t*-values are in parentheses.
[a] Aggregated with postsecondary schooling.
[b] Combined with primary schooling due to limited cases.
[c] Aggregated with machinery.
*Significant at the 10 percent level.
**Significant at the 1 percent level.

Table 40— Income instrumenting equations, years 2 and 3

	Attock		Faisalabad		Badin		Dir	
Variable	Year 2	Year 3	Year 2	Year 3	Year 2	Year 3	Year 2	Year 3
Intercept	1,735 (0.73)	20 (0.01)	–6,082 (–1.32)	974 (0.25)	6,707 (3.59)**	5,041 (2.50)**	2,408 (1.03)	3,871 (1.57)
Number of males aged 16 and over	3,532 (3.72)**	1,900 (2.40)**	7,725 (5.15)**	2,804 (2.06)**	5,276 (6.95)**	4,064 (4.95)**	5,821 (6.78)**	3,006 (3.52)**
Number of males aged 6-16	1,414 (1.41)	2,322 (2.65)**	1,306 (0.93)	–225 (0.19)	–430 (–0.56)	–936 (–1.15)	–987 (–1.36)	–827 (–1.02)
Number of females aged 16 and over	–1,666 (1.68)*	318 (0.46)	1,193 (0.72)	3,607 (2.79)**	–63 (–0.08)	686 (0.77)	–1,176 (–1.46)	134 (0.07)
Number of females aged 6-16	470 (0.47)	1,331 (1.58)*	2,248 (1.49)	1,164 (0.86)	815 (0.88)	–482 (–0.49)	843 (1.07)	156 (0.17)
Number of children	1,341 (1.65)*	707 (0.93)	1,689 (1.31)	1,410 (1.25)	107 (0.19)	784 (1.36)	989 (1.49)	1,571 (2.22)**
Number of males with primary schooling	664 (0.54)	388 (0.36)	3,280 (1.19)	–456 (–0.19)	–626 (–0.41)	2,959 (1.85)*	2,256 (1.18)	632 (0.32)
Number of males with secondary schooling	943 (0.84)	1,277 (1.55)	3,980 (1.72)*	1,255 (0.73)	a	a	2,211 (1.46)	–492 (0.26)
Number of males with more than secondary schooling	8,750 (2.24)**	8,797 (4.03)**	–3,609 (–0.50)	7,167 (1.58)**	17,230 (1.92)*	8,726 (0.93)	17,116 (5.10)**	7,359 (3.16)**
Number of females with primary schooling	–83 (–0.04)	987 (0.68)	–2,056 (–0.73)	–5,520 (–2.21)	10,279 (2.55)**	28,770 (2.96)**	–5,173 (–1.18)	–2,669 (–0.79)
Number of females with middle schooling or more	4,902 (2.04)**	565 (0.33)	–3,889 (–0.65)	–444 (–0.10)	. . .	. . .	–372 (–0.09)	12,218 (1.74)*
Rainfed land	12 (0.26)	79 (1.97)**	. . .	. . .	. . .	. . .	–13 (–0.09)	509 (3.37)*
Irrigated land	2,729 (3.38)**	1,419 (1.27)	1,353 (4.75)**	1,077 (4.58)**	513 (8.27)**	452 (7.17)**	1,316 (4.91)**	87 (0.37)
Acres of orchards	. . .	. . .	10,194 (3.51)**	2,080 (1.69)*	. . .	. . .	1,852 (3.42)**	6,064 (6.18)**
Value of livestock	0.111 (0.97)	0.063 (0.73)	–0.058 (–0.27)	0.097 (0.65)	0.196 (3.02)**	0.317 (3.96)**	0.888 (5.13)**	0.444 (2.85)**
Value of vehicles	–0.034 (–0.71)	0.017 (0.50)	0.414 (4.22)**	0.279 (3.28)**	b	b	0.141 (4.70)*	0.139 (3.66)**
Value of machinery and tools	0.213 (3.74)**	0.510 (6.22)	0.076 (0.75)	0.299 (1.79)*	0.329 (7.15)**	0.376 (10.16)**	0.033 (1.00)	0.052 (1.79)*
R^2	0.404	0.545	0.631	0.709	0.694	0.704	0.717	0.603
N	153	153	144	144	237	237	192	192

Note: *t*-values are in parentheses.
[a] Aggregated with postsecondary schooling.
[b] Aggregated with machinery.
*Significant at the 10 percent level.
**Significant at the 1 percent level.

In addition to the relationships reported in Tables 39 and 40, an aggregate income equation was run that included days ill and remittances, both taken as exogenous, at least in the short run. Each additional day of illness for an adult male led to a 57.2 (30.4) rupee reduction of household income in year 1 (standard error in parentheses). In years 2 and 3, those numbers were 68.0 (30.4) and 70.9 (28.1), respectively. These values are larger (between 62 and 89) when district dummy variables are included in the pooled regressions. Nevertheless, they are fairly robust across years and specifications.[62] The value is somewhat higher than unskilled daily wages, but close to average earnings in all wage employment. Female illness did not have a significant relationship with household earnings.

The coefficients of remittances from abroad and domestic remittances or, alternatively, of pooled transfers, were not significant in the pooled regressions. However, in each year, remittances led to a significant reduction in earned income in Dir district. An additional rupee led to reductions between Rs 0.062 and Rs 0.094 of earnings. Similarly, in Mastung/Kalat, a rupee of remittance led to a reduction of Rs 0.071 in the year for which data were collected. The coefficients in regressions in other districts were not significant and sometimes positive. Note, however, that in these districts, fewer remittances were reported; hence, there is relatively little variance in the regressor.

Rural Wage Determination

In order to study the formation of rural wages in Pakistan, a sample-selection-corrected wage function was estimated using 602 observations for which wages were observed. The procedure follows the now well-known technique introduced by Heckman (1979). The first step is to estimate a probit for the probability that an individual works for wages. Conditional on this being the case, the second step estimates the wage function, including in the ordinary least squares regression a transformation of the predicted probability from the first step (called the inverse of the Mills ratio) to correct for sample selection. These equations are indicated in Table 41.

The selection equation indicates the expected negative relationship between land operated and *wage* labor force participation. It is consistent with other aspects of the data used here that this relationship does not hold for Baluchistan, where land quality differences are far more important than the size of the holding. Participation declines with rental income and with the number of other males in the household and increases when some of these males are ill.

The principal motivation for this component of the study is to determine the wage increment due to education. This is significant at all levels of formal education and increases with level of schooling. This is as expected. The increment to wages attributed to primary schooling is slightly higher than that observed for urban males (a 0.12 increase in the logarithm of wages) (Kozel and Alderman 1990); it is comparable to that observed for rural Sri Lanka (Sahn and Alderman 1988). The returns at the postsecondary level are, however, below those for urban areas.

---

[62] First-difference regressions, however, have negative but not significant results; similarly, coefficients in unpooled regressions are significantly negative.

Table 41— Regression explaining rural wage formation for males

Dependent Variable	Probability of Working for Wages		Log Wage	
Constant	–1.55	(0.22)	3.16	(0.27)
Age	0.076	(0.011)	0.012	(0.010)
Age squared	–0.0009	(0.0001)	–0.00012	(0.00011)
Illness of other males in household	0.0313	(0.011)	. . .	. . .
Number of other males 16 years or older	–0.084	(0.024)	–0.00017	(0.017)
Number of adult females	–0.018	(0.029)	–0.021	(0.019
Number of males 10-15 years	–0.026	(0.037)	. . .	. . .
Number of children under 10 years old	0.033	(0.015)	. . .	. . .
Transfer income	–0.00004	(0.00004)	. . .	. . .
Other income (rental and capital)	–0.00032	(0.00009)	. . .	. . .
Land in Punjab	–0.020	(0.004)	. . .	. . .
Land in Sind	–0.052	(0.010)	. . .	. . .
Land in Baluchistan	–0.0017	(0.0015)	. . .	. . .
Sind dummy	–0.173	(0.118)	. . .	. . .
Baluchistan dummy	0.316	(0.008)	0.185	(0.084)
Punjab dummy	. . .	. . .	0.044	(0.065)
Body mass index	. . .	. . .	–35.86	(32.8)
Highest education = primary	. . .	. . .	0.168	(0.062)
Highest education = middle or secondary	. . .	. . .	0.246	(0.055)
Highest education = above secondary	. . .	. . .	0.450	(0.117)
Road distance from village to main market	. . .	. . .	0.0014	(0.0010)
Mills inverse	. . .	. . .	–0.072	(0.096)

Note: Standard errors are in parentheses.

The former observation is noteworthy in that it implies that employers value the basic skills acquired in the primary system. It is sometimes argued that primary education is too rudimentary and the skills acquired are too easily lost to give an advantage to individuals who stop at that level. This may be the case in some economies or some sectors, but does not appear to be the case in rural Pakistan.

The relatively low increments in wages for individuals with higher education reflect the limited opportunities in rural areas. These are, however, not synonymous with private returns. The wage estimates are only for individuals who remain in rural areas. If, as is plausible, more qualified individuals migrate to urban areas, their private returns include the increased earnings obtained in the new environment.

The proportional increment attributable to education indicated in Table 39 compares closely with results estimated from the 1979 Population, Labour Force, and Migration Study (Khan and Irfan 1985). The similarity of the findings, using different data and somewhat different estimation techniques, increases confidence in the reliability of the results.

APPENDIX 2: TESTING FOR BIASED INSTRUMENTS

The use of community averages (excluding data from the household itself) to identify the instruments for health inputs runs the risk that instruments will be biased if unobserved community effects on the demand for health inputs are correlated with community effects that influence the production of adequate nutritional status. This, however, is an empirical point: the village fixed effects that influence one relationship are not necessarily the same as those that influence another; moreover, it may be possible to control for these effects in the estimation.

The available data allow for the use of a Hausman (1978) test for the consistency of the instruments. The test statistic is defined as

$$\text{Hausman} = (\beta-\beta^*)'(V-V^*)^{-1}(\beta-\beta^*),$$

where β^* is a vector of the parameters from a regression in which the nonself village means are included in the instrumenting equations along with other predetermined variables, and is a similar vector from a regression in which the instruments are identified, using standard price and distance variables. The letters V^* and V denote the corresponding variance matrices. The test statistic is distributed as a χ^2 with the number of degrees of freedom equal to the number of elements in β.

The test is based on the assumption that the β vector is unbiased but inefficient, while β^* may or may not be unbiased but will be more efficient. Under the null hypothesis that β^* is unbiased, the expected difference in the two vectors of parameters $(\beta-\beta^*)$ is zero, and the test statistic will be small.

Using Model I, the Hausman test statistic for the height-for-age equation is 9.41, with 20 degrees of freedom, and the corresponding statistic for the weight-for-height equation is 15.18. Rejection of the null hypothesis at the 10 percent level requires a statistic of at least 28.41, and 31.41 at the 5 percent level.

Hausman tests often lack power. That is, they may be unable to indicate a significant difference when one exists. Thus, a similar test was performed using a variant of Model I that excludes the four district dummy variables, which were included to account for common unobserved district factors in the production of nutritional status. When these variables are excluded, the Hausman test statistic, comparing the parameters of the height-for-age equation with and without the nonself village means included in the instrumenting equation, is 266.48, with 16 degrees of freedom. The corresponding statistic in the weight-for-height regression is 287.20. Thus, the test indicates that the method of instrumenting that uses nonself village means may be biased if the equations are mis-specified. This, of course, is not a test of the significance of the district variables but a test of whether the nonself village means are appropriate instruments. Contrasting the two tests also increases confidence that the test can indicate whether the specification used is unbiased, and based on efficiency, which test is preferred.

BIBLIOGRAPHY

Abel, W. 1978. *Agrarkrisen und agrarkenjunktur.* Hamburg and Berlin: Verlag Paul Parey.

Abdel-Fadil, M. 1975. *Development, income distribution, and social change in rural Egypt, 1952-70.* Cambridge, U.K.: Cambridge University Press.

ACC/SCN (Administrative Committee on Coordination/Subcommittee on Nutrition). 1990. *Appropriate uses of anthropometry in children.* ACC/SCN State of the Art Series, Nutrition Policy Discussion Paper 7. Geneva: United Nations.

______. 1993. Second report on the world nutrition situation. Volume 2, *Country trends and methods and statistics.* Geneva: United Nations.

Adams, R. 1991. The economic uses and impact of international remittances in rural Egypt. *Economic Development and Cultural Change* 39 (July): 695-722.

______. Forthcoming. Non-farm income and inequality in rural Pakistan: A decomposition analysis. *Journal of Development Studies.*

Adams, R., and H. Alderman. 1992. Sources of income inequality in rural Pakistan. A decomposition analysis. *Oxford Bulletin of Economics and Statistics* 54 (4): 591-608.

Alderman, H. 1986. *The effects of food prices and income changes on the acquisition of food by low-income households.* An IFPRI Occasional Paper. Washington, D.C.: International Food Policy Research Institute.

______. 1988. *Cooperative dairy development in Karnataka, India: An assessment.* Research Report 64. Washington, D.C.: International Food Policy Research Institute.

______. 1990. *Nutritional status in Ghana and its determinants.* Social Dimensions of Adjustment Working Paper No. 3. Washington, D.C.: World Bank.

______. 1991. Food subsidies and the poor. In *Essays on poverty, equity, and growth,* ed. George Psacharopolous, 172-202. New York: Pergamon Press.

______. 1993. New research on poverty and malnutrition. What are the implications for policy? In *Including the poor,* ed. M. Lipton and J. van der Gaag. New York: World Bank.

Alderman, H., and M. Garcia. 1992. *Food security and health security: Explaining the levels of nutrition in Pakistan.* World Bank Policy Research Working Paper 865. Washington, D.C.: World Bank.

______. Forthcoming. Food security and health security: Explaining the levels of nutritional status in Pakistan. *Economic Development and Cultural Change.*

Alderman, H., and P. Gertler. 1989. *The substitutability of public versus private health care treatment of children in Pakistan.* Living Standards Measurement Study Working Paper 57. Washington, D.C.: World Bank.

Alderman, H., and C. Paxson. 1992. *Do the poor insure? A synthesis of the literature on risk and consumption in developing countries.* World Bank Policy Research Working Paper 1008 and Woodrow Wilson School Discussion Paper 164. Washington, D.C.: World Bank.

Alderman, H., M. G. Chaudhry, and M. Garcia. 1988. *Household food security in Pakistan: The ration shop system.* Working Paper on Food Subsidies 4. Washington, D.C.: International Food Policy Research Institute.

Alderman, H., D. Sahn, and J. Arulpragasam. 1991. Food subsidies and exchange rate distortions in Mozambique. *Food Policy* 16 (October): 395-404.

Alderman, H., J. Behrman, D. Ross, and R. Sabot. 1992. The gender gap in cognitive achievement in a poor rural economy. International Food Policy Research Institute, Washington, D.C. Mimeo.

Allen, L., G. Pelto, A. Chavez, H. Martinez, R. Ely, and C. Capacchione. 1990. Maternal correlates of infant growth in rural Mexico. In *Breast-feeding, nutrition, infection, and infant growth in developed and emerging economies*, ed. S. Atkinson, H. Hanson, and R. Chandra. St. Johns, Newfoundland, Canada: ARTS Biomedical Publishers.

Amjad, R. 1986. Impact of workers' remittances from the Middle East on Pakistan's economy: Some selected issues. *Pakistan Development Review* 25 (4): 757-782.

Anand, S., and C. Harris. 1991. Food and standard of living. An analysis on Sri Lanka data. In *The political economy of hunger*, ed. J. Drèze and A. K. Sen, 297-350. Oxford: Oxford University Press.

Anand, S., and R. Kanbur. 1990. Public policy and basic needs provision: Intervention and achievement in Sri Lanka. In *Hunger and public action*, ed. J. Drèze and A. K. Sen. Oxford: Oxford University Press.

Arrow, K., and F. Hahn. 1971. *General competition analysis.* San Francisco: Holden-Day.

Barrera, A. 1990. The role of maternal schooling and its interaction with public health programs in child health production. *Journal of Development Economics* 32 (1): 69-91.

______. 1991. The interactive effects of mother's schooling and unsupplemented breast-feeding on child health. *Journal of Development Economics* 34 (1): 81-98.

Beaton, G. 1989. Small but healthy: Are we asking the right question? *Human Organization* 48 (1): 30-40.

______. 1990. Nutrition research and human biology: Changing perspectives and interpretations. Pearl Memorial Lecture, Miami, Florida.

Becker, S., R. Black, and K. Brown. 1991. Relative effects of diarrhea, fever, and dietary intake on weight gain in rural Bangladeshi children. *American Journal of Clinical Nutrition* 53 (6): 1499-1503.

Behrman, J. 1991. Nutrition, health, and development. In *Essays on poverty, equity, and growth*, ed. George Psacharopolous, 79-171. New York: Pergamon Press.

Behrman, J., and A. Deolalikar. 1987. Will developing countries improve with income? A case study for rural south India. *Journal of Political Economy* 95 (3): 108-137.

______. 1990. The intrahousehold demand for nutrients in rural South India. *Journal of Human Resources* 25 (4): 665-696.

Behrman, J., and B. Wolfe. 1984. More evidence on nutrition demand: Income seems overrated and women's schooling underemphasized. *Journal of Development Economics* 14 (1): 105-128.

Behrman, J., A. Deolalikar, and B. Wolfe. 1988. Nutrients: Impacts and its determinants. *World Bank Economic Review* 2 (3): 299-320.

Bhalla, S. S. 1979. Measurement errors and the permanent income hypothesis: Evidence from rural India. *American Economic Review* 63 (3): 295-307.

______. 1980. The measurement of permanent income and its application to savings behavior. *Journal of Political Economy* 88 (4): 722-744.

Bollinger, L. 1990. Diffusion and adoption of contraceptive technology in developing countries. University of Pennsylvania, Philadelphia. Mimeo.

Bouis, H., and L. Haddad. 1992. Are estimates of calorie-income elasticities too high? A recalibration of the plausible range. *Journal of Development Economics* 39 (2): 333-364.

Braudel, F. 1981. *The structure of everyday life*, vol.1. *Civilization and capitalism. 15th-18th century*. New York: Harper and Row.

Braun, J. von, and R. Pandya-Lorch, eds. 1991. *Income sources of malnourished people in rural areas: Microlevel information and policy implications*. Working Paper on Commercialization of Agriculture and Nutrition 5. Washington, D.C.: International Food Policy Research Institute.

Burney, N. 1987. Workers' remittances from the Middle East and the effect on Pakistan's economy. *Pakistan Development Review* 26 (Winter): 745-761.

Case, A. 1987. *On the use of spatial autoregressive models in demand analysis*. Woodrow Wilson School Discussion Paper 135. Princeton, N.J., U.S.A.: Princeton University.

Cebu Study Team. 1989. The production of child health: Morbidity and growth differences related to gender of the infant. University of North Carolina, Chapel Hill, N.C., U.S.A. Mimeo.

Chaudhuri, S., and M. Ravallion. Forthcoming. How well do static indicators identify the chronically poor. *Journal of Public Economics*.

Cornwell, C., and P. Rupert. 1988. Efficient estimation with panel data: An empirical comparison of instrumental variables estimators. *Journal of Applied Econometrics* 3 (1): 149-155.

Deaton, A. 1988. Quantity, quality, and spatial variations in price. *American Economic Review* 78 (3): 418-430.

______. 1989. Savings in developing countries: Theory and review. In *Proceedings of the World Bank Annual Conference on Development Economics*, ed. S. Fischer and D. de Tray, 61-96. Washington, D.C.: World Bank.

______. 1990. On risk, insurance and intra-village consumption smoothing. Princeton University, Princeton, N.J., U.S.A. Mimeo.

______. 1991. Savings and liquidity constraints. *Econometrica* 59 (5): 1221-1248.

Deaton, A., and F. Grimard. 1991. *Demand analysis for tax reform in Pakistan.* Woodrow Wilson School Discussion Paper 151. Princeton, N.J., U.S.A.: Princeton University.

Dor, A., P. Gertler, and J. van der Gaag. 1987. Non-price rationing and choice of health care provider in Côte d'Ivoire. *Journal of Health Economics* 6: 291-304.

Dugdale, A. 1985. Family anthropometry: A new strategy for determining community nutrition. *The Lancet* 21: 672-683.

Duncan, G. 1987. A simplified approach to M-estimation with application to two-stage estimators. *Journal of Econometrics* 34 (3): 373-389.

Durnin, J., and J. Womersley. 1974. Body fat assessed from total body density and its estimation from skinfold thickness. *British Journal of Nutrition* 32: 77-97.

Ercelawn. 1984. Income inequality in rural Pakistan: A study of sample villages. *Pakistan Journal of Applied Economics* 3 (1): 1-28.

Foster, J. 1984. On economic poverty: A survey of aggregate measures. In *Advances in econometrics*, vol. 3, ed. R. L. Basman and G. Rhodes, 215-251. Greenwich, Conn., U.S.A.: Jai Press.

______. 1985. Inequality measurement. In *Fair allocation*, ed. H. Peyton Young, in *Proceedings of symposia in applied mathematics*, vol. 33, 31-67. Providence, R.I., U.S.A.: American Mathematical Society.

Gaiha, R. 1988. Income mobility in rural India. *Economic Development and Cultural Change* 36 (2): 279-302.

______. 1989. Are the chronically poor also the poorest in rural India? *Development and Change* 20: 295-322.

Garcia, M. 1988. Determinants of farm earnings: A study of five districts in rural Pakistan. International Food Policy Research Institute, Washington, D.C. Mimeo.

______. 1991. Impact of female sources of income on food demand among rural households in the Philippines. *Quarterly Journal of International Agriculture* 3 (2): 109-121.

Garcia, M., and R. Aggarwal. 1991. Availability and utilization of health and nutrition services in Pakistan: 1986-1989. World Bank, Washington, D.C. Mimeo.

Garcia, M., and E. Kennedy. 1993. Assessing the linkages between body mass index and morbidity in adults: Evidence from four developing countries. In *Functional* *significance of low body mass index*, ed. N. Scrimshaw and B. Schurch. Lausanne, Switzerland: International Dietary Energy Consultative Group.

Gersovitz, M. 1983. Savings and nutrition at low incomes. *Journal of Political Economy* 91 (5): 841-855.

______. 1988. Savings and development. In *Handbook of development economics*, vol. 1, ed. H. Chenery and T. N. Srinivasan, 381-424. Amsterdam: Elsevier.

Gertler, P., and H. Alderman. 1990. Family resources and gender differences in human capital investments: Demand for children's medical care in Pakistan. International Food Policy Research Institute, Washington, D.C. Mimeo.

Gertler, P., L. Locay, and W. Sanderson. 1987. Are user fees regressive? The welfare implications of health care financing proposals in Peru. *Journal of Econometrics* 36 (1): 67-68.

Gillespie, S., and J. Mason. 1990. Nutrition-relevant actions in the eighties: Some experience and lessons from developing countries. Background paper for the ACC/SCN Ad Hoc Group Meeting on Policies to Alleviate Underconsumption and Malnutrition in Deprived Areas, 12-14 November, Geneva.

Glewwe, P. 1986. The distribution of income in Sri Lanka in 1969-70 and 1980-81, a decomposition analysis. *Journal of Development Economics* 24 (2): 255-274.

______. 1988. *The distribution of welfare in Côte d'Ivoire in 1985*. LSMS Working Paper 29. Washington, D.C.: World Bank.

Glewwe, P., and J. van der Gaag. 1990. Identifying the poor in developing countries: Do different definitions matter? *World Development* 18 (6): 803-814.

Gopalan, C. 1988. Stunting: Significance and implication for public health policy. In *Linear growth retardation*, ed. J. Waterlow. New York: Raven Press.

Grilliches, Z., and J. Hausman. 1986. Errors in variables in panel data. *Journal of Econometrics* 31 (1): 93-118.

Grosh, M. 1992. *From platitudes to practice: Targeting social programs in Latin America*. Latin America and the Caribbean Technical Department Report 21. Washington, D.C.: World Bank.

Guilkey, D., B. Popkin, J. Akin, and E. Wong. 1989. Prenatal care and pregnancy outcomes in Cebu, Philippines. *Journal of Development Economics* 30 (2): 241-272.

Habicht, J. P., J. DaVanzo, and W. P. Butz. 1986. Does breast-feeding really save lives or are apparent benefits due to biases? *The American Journal of Epidemiology* 123 (2): 279-290.

Hausman, J. 1978. Specification tests in econometrics. *Econometrica* 46 (1): 69-85.

Hausman, J., and W. Taylor. 1981. Panel data and unobservable individual effects. *Econometrica* 49 (6): 1377-1399.

Hazell, P., and S. Haggblade. 1990. *Rural-urban growth linkages in India*. Policy, Research, and External Affairs Working Paper 430. Washington, D.C.: World Bank.

Heckman, J. 1979. Sample selection bias as a specification error. *Econometrica* 47 (January): 153-161.

Higgins, P., and H. Alderman. 1992. *Labor and women's nutrition. A study of energy expenditure, fertility, and nutritional status in Ghana*. World Bank Policy Research Working Paper 1009. Washington, D.C.: World Bank.

IFPRI/AERC/CAPES/PERI (International Food Policy Research Institute/Applied Economic Research Center/Centre for Applied Economic Studies/Pakistan Economic Research Institute. 1988. Household food security in rural Pakistan: Background and descriptive data from selected districts in Pakistan. International Food Policy Research Institute, Washington, D.C. Mimeo.

Iliffe, J. 1987. *The African poor: A history*. Cambridge, U.K.: Cambridge University Press.

Irfan, M. 1985. Landless in Pakistan: A preliminary investigation. Pakistan Institute of Development Economics, Islamabad. Mimeo.

James, W., A. Ferro-Luzzi, and J. Waterlow. 1988. Definition of chronic energy deficiency in adults. *European Journal of Clinical Nutrition* 42: 969-981.

Kakwani, N. 1980. *Income inequality and poverty*. New York: Oxford University Press.

Khan, S., and M. Irfan. 1985. Rates of returns to education and the determinants of earnings in Pakistan. *Pakistan Development Review* 24 (Autumn): 671-680.

Klennert, K. 1986. Off-farm employment in marginal farm households: A hidden development of parts of Pakistan's rural poor. *Quarterly Journal of International Agriculture* 25 (January): 37-48.

Kozel, V. 1987. Income, consumption, and savings behavior in the Côte d'Ivoire. Ph.D. diss., Massachusetts Institute of Technology, Cambridge, Mass., U.S.A.

Kozel, V., and H. Alderman. 1990. Factors determining work participation and labor supply decisions in Pakistan's urban areas. *Pakistan Development Review* 29 (Spring): 1-18.

Lanjouw, P., and N. Stern. 1991. Poverty in Palanpur. *World Bank Economic Review* 5 (January): 23-56.

Leviatan, N. 1961. Errors in variables and Engel curve analysis. *Econometrica* 29 (3): 336-360.

Lewis, W. A. 1954. Economic growth with unlimited supplies of labour. *Manchester School of Economics and Social Studies* 22 (May): 139-191.

Lipton, M. 1983. Poverty, undernutrition, and hunger. World Bank, Washington, D.C. Mimeo.

Lipton, M., and M. Ravallion. Forthcoming. Poverty and policy. In *Handbook of Development Economics*, vol. 3, ed. J. Behrman and T. N. Srinivasan. Amsterdam: North Holland.

Malik, S. 1989. The source structure and utilization patterns of rural credit in Pakistan: Implications for policy, vols. 1 and 2. International Food Policy Research Institute, Washington, D.C. Mimeo.

______. 1993. Poverty in Pakistan: 1984/85 to 1987/88. In *Including the poor*, ed. M. Lipton and J. van der Gaag. New York: World Bank.

Martorell, R., R. Rivera, and H. Kaplowitz. 1990. Consequences of stunting in early childhood for adult body size in rural Guatemala. In *Long-term consequences of nutrition in infancy and childhood*, ed. International Committee of Pediatricians, Annales Nestlé.

Mason, J., J. P. Habicht, H. Tabatabai, and V. Valverde. 1984. *Nutritional surveillance*. Geneva: World Health Organization.

Mellor, J. 1976. *The new economics of growth: A study for India and the developing world.* Ithaca, N.Y., U.S.A.: Cornell University Press.

Murphy, K. M., and R. H. Topel. 1985. Estimation and inference in two-step econometric models. *Journal of Business & Economic Statistics* 3 (4): 370-379.

Musgrove, P. 1979. Permanent household income and consumption in urban South America. *American Economic Review* 69 (3): 355-368.

Nabi, I., N. Hamid, and S. Zahid. 1986. *The agrarian economy of Pakistan: Issues and policies.* Karachi: Oxford University Press.

NCHS (National Center for Health Statistics). 1976. *Growth charts.* Washington, D.C.: U.S. Department of Health and Human Services.

Noamon, M., and K. Nadvi. 1987. Agrarian transition in Sind: An analysis of interlinked rural factor markets. *Pakistan Development Review* 26 (Winter): 433-444.

Nugent, J., and R. Walther. 1982. Short-run changes in rural income inequality: A decomposition analysis. *Journal of Development Studies* 18 (2): 239-269.

Pakistan, Federal Bureau of Statistics. 1986a. *Household income and expenditure survey, 1984-85.* Karachi: FBS.

______. 1986b. *Labour force survey, 1984-85.* Karachi: FBS.

Pakistan, Government of. 1986. *Rural credit survey of Pakistan 1985.* Lahore: Agricultural Census Organization.

______. 1989. *Economic survey of Pakistan.* Islamabad.

Pakistan, Institute of Population Studies/Institute for Resource Development. 1992. *Demographic and health surveys of Pakistan 1990-91.* Columbia, Md., U.S.A.: Institute of Resource Development/Macro Systems.

Pakistan, National Institute of Health. 1988. *National nutrition survey, 1985-87.* Islamabad, Pakistan: NIH.

Pasha, H., and T. Hasan. 1982. Development ranking of districts in Pakistan. *Pakistan Journal of Applied Economics* 1 (Winter): 157-192.

Paxson, C. 1992. Using weather variability to estimate the response of savings to transitory income in Thailand. *American Economic Review* 81 (1): 15-33.

______. 1993. Consumption and income seasonality in Thailand. *Journal of Political Economy* 101 (1): 39-72.

Payne, P. 1986. Appropriate indicators for project design and evaluation. In *Food aid and well being of children in the developing world.* New York: UNICEF.

Pinckney, T. 1989. *The demand for public storage of wheat in Pakistan.* Research Report 77. Washington, D.C.: International Food Policy Research Institute.

Pinstrup-Andersen, P., and E. Caicedo. 1978. The potential impact of changes in income distribution of food demand and human nutrition. *American Journal of Agricultural Economics* 60 (May): 131-142.

Pitt, M., and M. Rosenzweig. 1985. Health and nutrient consumption across and within farm households. *Review of Economics and Statistics* 67 (May): 212-223.

Pollak, R., and M. Wachter. 1977. The relevance of the household production function and its implications for the allocation of time. *Journal of Political Economy* 83 (2): 255-277.

Prais, S., and H. Houthakker. 1955. *The analysis of family budgets.* Cambridge, U.K.: Cambridge University Press.

Pyatt, G., C. Chen, and J. Fei. 1980. The distribution of income by factor components. *Quarterly Journal of Economics* 95 (3): 451-473.

Ranade, C., D. Jha, and C. Delgado. 1988. Technological change, production costs, and supply response. In *Agricultural price policy for developing countries*, ed. J. Mellor and R. Ahmed, 190-203. Baltimore, Md., U.S.A.: Johns Hopkins University Press for the International Food Policy Research Institute.

Ravallion, M. 1989. Land contingent poverty alleviation schemes. *World Development* 17 (8): 1223-1237.

Ravallion, M., and B. Bidani. 1992. How robust is a poverty profile? World Bank, Washington, D.C. Mimeo.

Reutlinger, S., and M. Selowsky. 1976. *Malnutrition and poverty.* Baltimore, Md., U.S.A.: Johns Hopkins University Press.

Rizvi, N., and S. Chaudhry. 1988. A study of the decisionmaking pattern and women's role in food, health, and education-related behavior—A case study of two villages in Faisalabad District, Punjab. International Food Policy Research Institute, Washington, D.C. Mimeo.

Rosenzweig, M. 1988. Risk, implicit contracts, and the family in rural areas of low-income countries. *Economic Journal* 98 (393): 1148-1170.

Rosenzweig, M., and T. P. Schultz. 1982. Market opportunities, genetic and intrafamily resource distribution: Child survival in India. *American Economic Review* 72 (4): 803-815.

______. 1983. Estimating a household production function: Heterogeneity, the demand for health inputs and their effects on birth weight. *Journal of Political Economy* 91 (5): 723-746.

Sahn, D. 1989. The prevalence and determinants of malnutrition in Côte d'Ivoire. World Bank, Washington, D.C. Mimeo.

Sahn, D., and H. Alderman. 1988. The effects of human capital on wages and the determinants of labor supply in a developing country. *Journal of Development Economics* 29 (2): 157-183.

Schultz, T. P. 1984. Studying the impact of household economic variables and community variables in child mortality. *Population and Development Review* 10 (Supplement): 215-235.

Scrimshaw, N., C. Taylor, and J. Gordon. 1968. *Instructions of nutrition and infection.* Monograph 57. Geneva: World Health Organization.

Sen, A. K. 1981. *Poverty and famines.* Oxford: Oxford University Press.

______. 1992. The political economy of targeting. Paper prepared for The World Bank Conference on Public Expenditures and the Poor: Incidence and Targeting, 17-19 June, Washington, D.C.

Senauer, B., and M. Garcia. 1991. Determinants of nutrition and health status: An analysis with longitudinal data. *Economic Development and Cultural Change* 39 (1): 371-390.

Senauer, B., M. Garcia, and E. Jacinto. 1988. Determinants of intrahousehold allocation of food in the rural Philippines. *American Journal of Agricultural Economics* 70 (1): 170-180.

Strauss, J. 1990. Households, communities, and preschool children's nutrition outcomes: Evidence from rural Côte d'Ivoire. *Economic Development and Cultural Change* 38 (2): 231-262.

Strauss, J., and D. Thomas. 1989. The shape of the expenditure-calorie curve. Rand and Yale University, New Haven, Conn., U.S.A. Mimeo.

Teller, C., and F. Zerfas. 1990. *Cross-country comparisons and intracountry differentials in nutritional status and infant feeding: Presentation from DHS studies in 22 countries.* Chevy Chase, Md., U.S.A.: LTS Corporation.

Thomas, D., J. Strauss, and M. Henriques. 1991a. Child survival, height for age, and household characteristics in Brazil. *Journal of Development Economics* 33 (2): 197-234.

______. 1991b. How does mother's education affect child height? *Journal of Human Resources* 26 (2): 183-211.

Timmer, C. P., W. Falcon, and S. Pearson. 1983. *Food policy analysis*. Baltimore, Md., U.S.A.: Johns Hopkins University Press.

Townsend, R. 1991. Risk and insurance in village India. Discussion Paper. University of Chicago Population Research Center, Chicago.

USAID (U.S. Agency for International Development) (Pakistan). 1987. Primary health care project in Pakistan. Islamabad. Mimeo.

Visaria, P. 1980. *Poverty and living standards in Asia: An overview of the main results and lessons of selected household surveys*. Living Standards Measurement Study Working Paper 2. Washington, D.C.: World Bank.

Walker, T., and J. Ryan. 1990. *Village and household economies in India's semi-arid tropics*. Baltimore, Md., U.S.A.: Johns Hopkins University Press.

WHO (World Health Organization). 1986. Use and interpretation of anthropometric indicators of nutritional status. *Bulletin of the World Health Organization* 64 (6): 929-941.

Wolfe, B., and J. Behrman. 1983. Is income overrated in determining adequate nutrition? *Economic Development and Cultural Change* 31 (3): 525-550.

World Bank. 1980. *World development report 1980*. Washington, D.C.

______. 1991a. *Social indicators*. Washington, D.C.

______. 1991b. *World development report 1991*. Oxford: Oxford University Press for the World Bank.

______. 1992. *World development report 1992*. Oxford: Oxford University Press for the World Bank.

Zaidi, S. 1985. The urban bias in health facilities in Pakistan. *Social Science Medicine* 20 (5): 215-240.

Zeldes, S. 1989a. Consumption and liquidity constraints: An empirical investigation. *Journal of Political Economy* 97 (2): 305-347.

______. 1989b. Optimal consumption with stochastic income: Deviations from certainty equivalence. *Quarterly Journal of Economics* 104 (2): 275-298.

Harold Alderman, formerly a research fellow at IFPRI, is an economist with the World Bank. Marito Garcia has been a research fellow at IFPRI since 1982. He also presently serves as a senior project officer of the United Nations Administrative Committee on Coordination/Sub-Committee on Nutrition (Geneva).

RECENT IFPRI RESEARCH REPORTS (continued)

79 *EFFECTS OF AGRICULTURAL COMMERCIALIZATION ON LAND TENURE, HOUSEHOLD RESOURCE ALLOCATION, AND NUTRITION IN THE PHILIPPINES,* by Howarth E. Bouis and Lawrence J. Haddad, 1990

78 *THE EFFECTS OF SUGARCANE PRODUCTION ON FOOD SECURITY, HEALTH, AND NUTRITION IN KENYA: A LONGITUDINAL ANALYSIS,* by Eileen Kennedy, 1989

77 *THE DEMAND FOR PUBLIC STORAGE OF WHEAT IN PAKISTAN,* by Thomas C. Pinckney, 1989

76 *AGRICULTURAL AND ECONOMIC GROWTH IN ARGENTINA, 1913-84,* by Yair Mundlak, Domingo Cavallo, and Roberto Domenech, 1989

75 *IRRIGATION TECHNOLOGY AND COMMERCIALIZATION OF RICE IN THE GAMBIA: EFFECTS ON INCOME AND NUTRITION,* by Joachim von Braun, Detlev Puetz, and Patrick Webb, 1989

74 *FOOD PRODUCTION IN A LAND-SURPLUS, LABOR-SCARCE ECONOMY: THE ZAIRIAN BASIN,* by Tshikala B. Tshibaka, 1989

73 *NONTRADITIONAL EXPORT CROPS IN GUATEMALA: EFFECTS ON PRODUCTION, INCOME, AND NUTRITION,* by Joachim von Braun, David Hotchkiss, and Maarten Immink, 1989

72 *RICE PRICE FLUCTUATION AND AN APPROACH TO PRICE STABILIZATION IN BANGLADESH,* by Raisuddin Ahmed and Andrew Bernard, 1989

71 *STORAGE, TRADE, AND PRICE POLICY UNDER PRODUCTION INSTABILITY: MAIZE IN KENYA,* by Thomas C. Pinckney, 1988

70 *AGRICULTURE IN THE GATT: AN ANALYSIS OF ALTERNATIVE APPROACHES TO REFORM,* by Joachim Zietz and Alberto Valdés, 1988

69 *CONSEQUENCES OF DEFORESTATION FOR WOMEN'S TIME ALLOCATION, AGRICULTURAL PRODUCTION, AND NUTRITION IN HILL AREAS OF NEPAL,* by Shubh K. Kumar and David Hotchkiss, 1988

68 *COFFEE BOOM, GOVERNMENT EXPENDITURE, AND AGRICULTURAL PRICES: THE COLOMBIAN EXPERIENCE,* by Jorge García García and Gabriel Montes Llamas, 1988

67 *NATURE AND IMPACT OF THE GREEN REVOLUTION IN BANGLADESH,* by Mahabub Hossain, 1988

The International Food Policy Research Institute was established in 1975 to identify and analyze alternative national and international strategies and policies for meeting food needs in the world, with particular emphasis on low-income countries and on the poorer groups in those countries. While the research effort is geared to the precise objective of contributing to the reduction of hunger and malnutrition, the factors involved are many and wide-ranging, requiring analysis of underlying processes and extending beyond a narrowly defined food sector. The Institute's research program reflects worldwide interaction with policymakers, administrators, and others concerned with increasing food production and with improving the equity of its distribution. Research results are published and distributed to officials and others concerned with national and international food and agricultural policy.

The Institute receives support as a constituent of the Consultative Group on International Agricultural Research from a number of donors including Australia, Belgium, Canada, the People's Republic of China, Denmark, the Ford Foundation, France, Germany, India, Italy, Japan, the Netherlands, Norway, the Philippines, Spain, Switzerland, the United Kingdom, the United States, and the World Bank. In addition, a number of other governments and institutions contribute funding to special research projects.

RECENT IFPRI RESEARCH REPORTS

95 *SECTORAL GROWTH IN CHILE: 1962-82,* by Juan Eduardo Coeymans and Yair Mundlak, 1993

94 *FERTILIZER USE ON SMALLHOLDER FARMS IN EASTERN PROVINCE, ZAMBIA,* by Dayanatha Jha and Behjat Hojjati, 1993

93 *ECONOMIC INCENTIVES AND COMPARATIVE ADVANTAGE IN INDONESIAN FOOD CROP PRODUCTION,* by Leonardo A. Gonzales, Faisal Kasryno, Nicostrato D. Perez, and Mark W. Rosegrant, 1993

92 *FAMINE IN ETHIOPIA: POLICY IMPLICATIONS OF COPING FAILURE AT NATIONAL AND HOUSEHOLD LEVELS,* Patrick Webb, Joachim von Braun, and Yisehac Yohannes, 1992

91 *RURAL INFRASTRUCTURE, THE SETTLEMENT SYSTEM, AND DEVELOPMENT OF THE REGIONAL ECONOMY IN SOUTHERN INDIA,* by Sudhir Wanmali, 1992

90 *LABOR IN THE RURAL HOUSEHOLD ECONOMY OF THE ZAIRIAN BASIN,* by Tshikala B. Tshibaka, 1992

89 *GROWTH IN JAPAN'S HORTICULTURAL TRADE WITH DEVELOPING COUNTRIES: AN ECONOMIC ANALYSIS OF THE MARKET,* by Masayoshi Honma, 1991

88 *DROUGHT AND FAMINE RELATIONSHIPS IN SUDAN: POLICY IMPLICATIONS,* by Tesfaye Teklu, Joachim von Braun, and Elsayed Zaki, 1991

87 *INCENTIVES AND CONSTRAINTS IN THE TRANSFORMATION OF PUNJAB AGRICULTURE,* by Anya McGuirk and Yair Mundlak, 1991

86 *THE EFFECTS OF INTERNATIONAL REMITTANCES ON POVERTY, INEQUALITY, AND DEVELOPMENT IN RURAL EGYPT,* by Richard Adams, Jr., 1991

85 *COMMERCIALIZATION OF AGRICULTURE UNDER POPULATION PRESSURE: EFFECTS ON PRODUCTION, CONSUMPTION, AND NUTRITION IN RWANDA,* by Joachim von Braun, Hartwig de Haen, and Juergen Blanken, 1991

84 *EFFECTS OF EXCHANGE RATE AND TRADE POLICIES ON AGRICULTURE IN PAKISTAN,* by Paul Dorosh and Alberto Valdés, 1990

83 *DEVELOPMENTAL IMPACT OF RURAL INFRASTRUCTURE IN BANGLADESH, by Raisuddin* Ahmed and Mahabub Hossain, 1990

82 *AGRICULTURAL GROWTH AND STRUCTURAL CHANGES IN THE PUNJAB ECONOMY: AN INPUT-OUTPUT ANALYSIS,* by G. S. Bhalla, B. K. Chadha, S. P. Kashyap, and R. K. Sharma, 1990

81 *PRODUCTION AND CONSUMPTION OF FOODGRAINS IN INDIA: IMPLICATIONS OF ACCELERATED ECONOMIC GROWTH AND POVERTY ALLEVIATION,* by J. S. Sarma and Vasant P. Gandhi, 1990

80 *HORTICULTURAL EXPORTS OF DEVELOPING COUNTRIES: PAST PERFORMANCES, FUTURE PROSPECTS, AND POLICY ISSUES,* by Nurul Islam, 1990

(continued on inside back cover)

International Food Policy Research Institute
1200 Seventeenth Street, N.W.
Washington, D.C. 20036-3006 USA