

Annex to Chapter 2

2.1: Availability and Use of Household Data

The surveys used are the Household Income and Expenditure Surveys (HIES – for years 1990-91, 92-93, 93-94, 96-97), and Pakistan Integrated Household Survey (PIHS – 1998-99). All HIES up to 1996-97 were conducted independent of the PIHS. The PIHS covers many other topics besides those of consumption and income focused on by the HIES and therefore has a much more wide-ranging household questionnaire, along with a community questionnaire. The PIHS conducted during the 1990s have also been on a smaller sample of households than the HIES.¹ Because of the differences between the sample size as well as questionnaire between the HIES and PIHS surveys, poverty estimates and household characteristics that correlate with poverty were not completely consistent between findings from HIES and PIHS in the past.²

Unlike in previous years, in 1998-99 PIHS is essentially a combination of PIHS and HIES into a single integrated survey, with a sample size comparable to that for the HIES in previous years. However, some other changes have occurred in 1998-99 that has implications for comparability across years. Since a part of the objective of this chapter will be to examine trends in poverty over the years, issues of comparability across surveys are important and merit a discussion.

Issues that Affect Comparability Across Surveys

There exists a high degree of comparability between HIES for all years between 1992-93 and 1996-97, since the same questionnaire was used for all these years, identical sampling techniques used, and sample sizes were also similar.

Comparability between the HIES data from 1990-91 and those from later years is compromised primarily by the fact that the sample size in 1990-91 was substantially smaller than in subsequent years – 6693 households in 1990-91 compared to 14594 in 1992-93. One should thus be cautious about making comparisons between the poverty estimates for 1990-91 and those for subsequent years.

The 1998-99 data, being a combination of HIES and PIHS, offer the unique opportunity of analyzing information on service delivery and human development in a large sample, with concomitant detailed information on household consumption. It also eliminates the possibility of discrepancies and contradictions between finding from separate HIES and PIHS data.³ However, the 1998-99 survey has incorporated some changes that may adversely affect comparability of household consumption expenditures, which determine poverty status, with findings from previous HIES data.

Firstly, in the 1998-99 survey, the household expenditure module has undergone some changes from previous years – expenditures are now reported in less detail, with some relatively minor categories of expenditure being combined into single categories. However these changes are firstly, few in number and secondly, applicable to minor categories of consumption, which should not substantially affect comparability with previous surveys.

¹ The PIHS for 1991, for example, sampled only 4794 households

²For a more detailed discussion on the findings from HIES and PIHS, see Howes and Zaidi (1994)

³ See Howes and Zaidi (1994) for a detailed discussion on past problems with consistency between HIES and PIHS findings

Secondly, a large proportion of the food items consumed by households are reported as fortnightly figures in the 1998-99 PIHS, unlike in previous surveys where monthly consumption figures were reported for all food items. This change in the recall period may affect comparability with previous surveys. In this context, it should be interesting to consider the implications of an ongoing debate on Indian data -- about the effects of changing the recall period for some consumption items from the previously used 30-day period to a combination of 7-day and 30-day periods in the 1999-2000 round of the NSS in India.

Thirdly, although the surveys use the same methodology in sampling, the sampling frame has changed somewhat. The 1998-99 PIHS for rural areas adopted a new sample framework based on the lists of villages from the Housing and Population Census of 1998, whereas HIES used the information from the 1981 Census. The main problem with this appears to be that since only the rural sample framework was changed, if one were to consider the Census as representing the “true” composition of the country’s population, the household survey appears to overestimate the rural population.⁴ This affects the overall estimate of poverty, as well as comparability across years.

Finally, comparing across surveys, it seems that the average household sizes, particularly for households in the lowest expenditure categories, are significantly higher in the 1998-99 PIHS compared to the HIES from 1992-93 to 1996-97. This is hard to explain, since there is no reason to believe in a sharp demographic transition in the space of two years. The fact that this difference exists suggests a systemic difference in techniques of data collection between the different surveys. Obviously, this works to the detriment of comparability of the 1998-99 survey with previous ones. This issue will be explored in greater detail later in this chapter.

While the lack of comparability arising from the factors outlined above remains a problem, the analysis has maintained consistency in methodology for estimating household expenditures and constructing price indices for all the surveys.

2.2: Estimating Expenditure and Poverty

*Measurement of Household Expenditure*⁵

All expenditures for households and across different categories of items are calculated as monthly values. The aggregate household expenditure includes expenditures on food, fuel, housing, other non-durable goods and services (reported as monthly or yearly expenditures), and certain kinds of expenditures on durable goods. Expenditure on consumed items are included whether they were paid for, or received as gifts or payments in kind. Items left out from expenditure estimates are expenses on taxes (including house and property tax) and fines. The only yearly durable expenses included in the expenditure calculation are expenses on services and repair charges of household effects.

The household expenditures thus obtained are then adjusted for price differences. The adjustment factors used here are household level Paasche Indices based on implicit prices computed from the data, normalized by appropriate average price indices; details on how these are constructed are available from the background note. The final step is to normalize the household level Paasche

⁴ Share of rural areas in total population is 71% according to the 1998-99 PIHS and 67% according to the 1998 Population Census

⁵ See the background note “A Note on Poverty Estimates for Pakistan in the 1990s: Issues and Preliminary Findings from HIES Data” (2001) for a detailed description of the expenditure categories.

indices by average price indices, yielding two kinds of household-specific price indices – one adjusts for price differences across the entire country, the other for intra-region (within urban or rural regions) price differences. The former are used to deflate household-level expenditure estimates to make them comparable across all households. The latter, on the other hand, are used to deflate household expenditures which can then be compared with separate urban and rural poverty lines to determine whether a household is poor or not.

It is important to note that the price indices just described take into account only food prices. Household expenditures adjusted by these price indices thus implicitly assume that costs of living are exactly proportional to the relative food prices faced by the household. This may be problematic; in particular if there is reason to believe that relative costs of certain items like the housing in urban areas vis-à-vis rural areas may be higher than that of food items. But in practice, calculating implicit prices of non-food items is even more problematic, because of factors like non-availability of quantity information and very high heterogeneity in quality. On account of these difficulties, only food prices are used to compute the price indices, which is a standard practice in poverty analysis.

In order to measure welfare at individual level and to estimate poverty rates, it is also necessary to adjust household consumption expenditure by household composition – for which household expenditure is corrected by the per adult equivalent in the household, which is calculated by simply weighting all household members younger than 18 as 0.8, and all other household members as 1. While this may appear as oversimplifying the problem of adjusting for the composition of a household, using a more complex equivalence scale, for instance one that differentiates between sex and various age categories, is even more problematic. This is because such scales are generally based on calorie requirements, and are therefore applicable only to food consumption, and not to the vast array of other items that enter into household consumption.⁶

Adjusting consumption expenditure for household economies of scale: an investigation

There are also sound arguments for adjusting household expenditures for household size, to allow for economies of scale in consumption. The expenditure and poverty estimates in this report are however calculated *without* such correction. While ignoring the scale factor may lead to understating the welfare of people who live in large households, making such adjustment is also problematic, primarily because it is hard to define the precise adjustment applicable for Pakistan. Moreover, such adjustment will also affect the comparability of poverty estimates for the years since 1992-93 with estimates from previous years, which had been conducted by previous reports without taking the scale effect into account.

However, it is important to investigate, at least in a rough sense, whether poverty trends during the 1990s are sensitive to reasonable scale adjustments. This is all the more important, given the concern, outlined later in this Annex, about the comparability of household sizes in the 1998-99 survey with those from the previous ones. To investigate the effect of scale adjustment, a somewhat arbitrary method is adopted, used in related literature for developing countries.

According to this method, the number of equivalent adults is determined by the formula: $AE = (A + s.C)^s$; where A is the number of adults, C is the number of children in the household, the parameter s is the cost of a child relative to that of an adult, and equal to 0.8 as mentioned above.

⁶ Identical equivalence scales have been used for previous poverty analysis with data from Pakistan, including the Pakistan Poverty Assessment (1995) and Poverty in the 1990s, Federal Bureau of Statistics (draft Report, 2001)

The other parameter, t , which lies between 0 and 1, controls the extent of economies of scale. When t is set to unity, the expenditure measure does not adjust for household size.

If economies of scale are thought of as arising from the existence of shared public goods in the household, then t will be high when most goods are private, and low when a substantial fraction of household expenditure is on shared goods. Since households in poor economies spend a large proportion of their budget on food (around 50% for Pakistan), and since food is an essentially private good, economies of scale must be limited, and t should be set at or close to 1.

For the purpose of this analysis, t is set between 0.8 and 0.9. Table A-2.1 compares head-count poverty measures (using poverty lines specified in the next section, *with* necessary adjustments for the value of the scale parameter t) with $t = 0.8, 0.9$ and 1. As the table shows, poverty estimates tend to be lower when t is set at less than unity; however, in all other respects (i.e. across sectors, as well as across periods), the pattern of change is very similar for all tested values of t . Figure A-2.1 also shows this clearly for trends in overall poverty – the movement in headcount rate over the years is very similar for different values of the parameter t for scale adjustment in household consumption. The fact that comparative trends across time, as well as patterns across regions quite robust to such scale adjustment, suggests that analysis using unadjusted poverty estimates, which is used throughout this report, is a reasonable methodology to adopt. That said, the issue of economies of scale in household consumption is one that merits rigorous analysis – far beyond the rough exercise conducted here – in the course of future poverty work in Pakistan.

Figure A-2.1: Trends in Headcount with & without Economies of Scale in Consumption

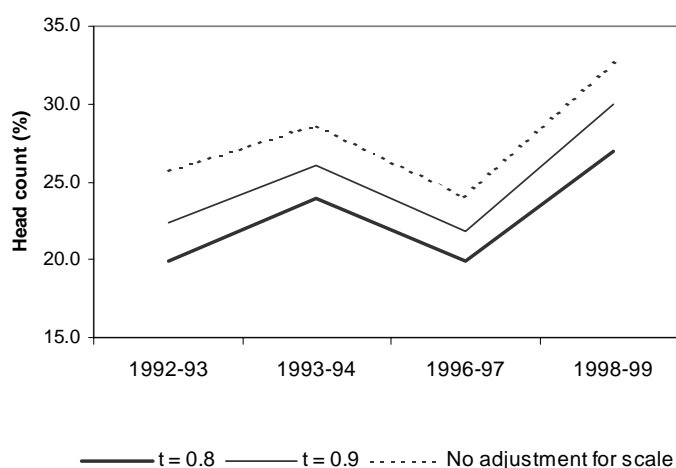


Table A-2.1: Headcount Poverty with Different Household Scale Adjustments

	1992-93	1993-94	1996-97	1998-99
Head Count (s=0.8, t=0.8)				
Urban	15.1	13.6	12.4	19.1
Rural	21.7	28.2	23.2	29.9
Overall	19.9	23.9	19.9	26.9
Head Count (s=0.8, t=0.9)				
Urban	17.9	15.4	14.9	21.9
Rural	24.2	30.6	24.8	33.2
Overall	22.4	26.1	21.8	30.0
Head Count (s=0.8, t=1)				
Urban	20.8	17.2	16.9	24.2
Rural	27.7	33.4	27.1	35.9
Overall	25.7	28.6	24.0	32.6

*Poverty Lines*⁷

The Poverty Lines for every year are the inflation-adjusted "basic needs" poverty lines, which in turn was based on some modifications (primarily adjustments for prices) of the basic needs poverty line developed by Ahmad (1993). The poverty line was fixed at the 1990-91 level, and updated for every successive year using Consumer Price Indices (CPIs) for Pakistan. Since the household expenditures were adjusted by spatial price indices to account for within-region price differences (as described above), poverty lines were not adjusted for price differences within each region (rural/urban).

Most of the poverty lines used for analyzing poverty in Pakistan in the past have relied on calorie-based poverty lines. Even in so-called basic needs approaches, the practice has been to define the minimum bundle exclusively by the expenditure (including non-food) that is expected to *induce* the minimum calorie intake. As Gazdar et al point out, there are 3 standard defenses to this approach: First, calorific intake is the most important human need (Ercelawn, 1992). But even so, the question is, are other needs "unimportant" enough to ignore? Second, calorific need is a good proxy: if a household consumes more than the cost of the minimum bundle of calories it is able to satisfy all its basic needs not just its calorific ones. This would be an attractive argument were it to be supported by evidence, but it is not. Given the diversity of expenditure patterns observed, there seems little reason to accept this argument in terms of actual calorific intake. Third, non-calorific needs hard to specify, or specified arbitrarily, leaving one with no choice but to look at expenditure on calories and to set basic non-food expenditure requirements on this basis (for example, equal to the average non-food expenditure of the poor). This is a compelling argument for many countries, but fortunately not for Pakistan, where a "basic needs" poverty line has been specified.

An alternative route to the calorific one is to take the poverty line as the cost of achieving a minimum bundle of basic needs, i.e. the money value of a bundle of commodities that represents a minimally acceptable level of living, *selected a priori*. To do this requires a great deal of intimate knowledge of the country concerned. Even then, the final line decided on will still be to some extent arbitrary, and can better be thought of as representing a social judgment than an actual threshold.

Although this procedure of specifying a bundle of basic needs has been little used in developing countries, it does have a long history in developed countries. Examples include the classic studies early this century by Bowley and others in the U.K. (see Atkinson, 1987, and Barr, 1987, for references). Pakistan is one of the few developing countries for which this exercise has been undertaken. In a recent paper, Ahmad (1993) describes the process he used to choose a poverty line:

The proposed basic needs package consists of food, clothing, housing, health, education, transport, social interaction and recreational facilities. ... All possible componential needs were identified. Discussions were held with professional economists in Federal Government, Provincial Governments, Research Institutes and Universities. A checklist thus prepared was rechecked with heads of different families. A team of economists was constituted to arrive at the quantum and value of each componential item of various basic needs separately in the rural and urban areas. These were rechecked with the consumers in different areas.

⁷ This section is drawn significantly from Gazdar et al (1994).

While there is subjectivity in this process, that is true for any poverty line measure. Arguably, this element of subjectivity is not inferior to the subjective judgment that anyone who is able to achieve minimum calorie needs is also able to achieve the minimum basic needs.

Using this method, Ahmad's poverty line for a family of 2 adults & 4 children (91-92 prices) came to, for rural and urban regions respectively, Rs. 300 per capita out of which Rs. 150 allocated to food needs; and Rs. 419 per capita out of which Rs. 212 allocated to food needs. Adjustments to this poverty line were made by Gazdar et al (1994) using HIES (90-91) consisted of two main steps:

- (a) Reducing the urban-rural food price differential, using cost-of-living price deflator: The original urban-rural food differential of Rs. 212 to 150 were considered to be too large. Household surveys indicate a urban-rural price differential of only around 10%. Unfortunately, the physical bundle of goods on which the Ahmad line is based was not available, so a good-by-good repricing was not possible. However, the rural food minimum of Rs 150 seemed the more reasonable of the two figures, so these were retained. Using the urban-rural cost-of-living food deflator from the HIES (90-91) gives an equivalent urban expenditure of Rs 161. Using the most recent PIHS/HIES (98-99), the food price differential is very close (9.6%), yielding an urban expenditure (for Rs 150 rural) of around Rs. 164. The figure of Rs. 161 thus seems very reasonable.
- (b) Adjusting housing expenditures: Ahmad's allocation of only Rs 11 to housing rent in rural areas, and of six times as much as that (Rs 67) in urban areas is felt to be an underestimate of housing needs in rural areas. Unfortunately, in the absence of price information on housing expenditure, any adjustments must be crude. Gazdar et al ignore distinctions within categories of housing, and assume that the difference between the two housing expenditure levels is due to differences in housing costs. Regressions (using HIES 1990-91) are used to estimate *expected* rural and urban housing expenditure given non-housing expenditure equal to the *minimum non-housing expenditure* required, Rs. 265 and 280 respectively. This gives new rural and urban minimum housing requirements of 32 and 54 Rs respectively.

With these adjustments, rural poverty line falls to Rs 296 per capita; the urban line falls to Rs 334 for 1990-91. Converting these into per equivalent adult terms, using $s=0.8$ and $t=1$ (see previous subsection) yields the poverty lines described in Table A-2.2.

Table A-2.2: Poverty Lines Per Equivalent Adult (Current Rs.)
(Using $s=0.8$, $t=1$)

	1990-91	1992-93	1993-94	1996-97	1998-99
Urban	346	424	472	655	767
Rural	307	376	418	581	680

In the opinion of Gazdar et al (1994), which this report largely shares, the work of Ahmad points a way forward for poverty analysis in Pakistan. One can argue both with the execution of the method and with the numbers that arrived at. However, the basic principles of trying explicitly to take into account a variety of needs in fixing a poverty line, and updating it for only price changes over the years is one that should be endorsed. In Pakistan, as shown later, even among the poor, expenditure on food comes to little more than 50% of total expenditure. Correspondingly, the motivation to define poverty in terms broader than calories is strong.

The poverty lines derived here also turn out to be sensible in terms of calorie equivalence, as well as in terms of the pattern of expenditure of the poor. Regression analysis reveals that the rural poverty line corresponds to a per capita calorie intake of 2250 (for a family of two adults and four children) and that the urban poverty line corresponds to calorie intake of 1950 calories. First, these figures are in the range of accepted calorific requirements (the most common figure is 2550 using the GoP equivalence scales which corresponds to about 2000 per capita). Second, at the poverty line the urban calorie intake is below the rural, which is indicative of the taste for expensive calories in urban areas. The analysis controls for differences in food prices, but not for differences in taste.

Any allocation of expenditure by basic needs must display rough conformity with the allocation of expenditure at the poverty line to be credible. Expenditure shares for the three major categories of food, housing and other from the 1990-91 HIES for urban and rural households 10% on either side of the poverty line is compared with expenditure shares implied by the construction of the basic needs poverty line. For urban areas, the actual and poverty-line shares are almost identical: the largest difference is only .3 percentage points. The discrepancies are larger in rural areas, but the largest difference is only 3.5 percentage points. One should not expect perfectly-matching shares. Indeed, if one is only allowing the poverty line to vary with prices, one could achieve this only by coincidence. But the very close match found is reassuring.

Finally, the poverty estimates arrived at using the poverty lines described above correspond closely to those calculated by the Federal Bureau of Statistics (FBS) in their recent report. The Table below illustrates this, with estimates from this report listed along with the *FBS estimates in parentheses*. The close match between the two sets of numbers shows that the broad story of poverty trends told in this report remains unchanged if one were to use the FBS estimates instead.

Table A-2.3: Poverty Estimates – World Bank and FBS (Govt. of Pakistan)

	1990-91	1992-93	1993-94	1996-97	1998-99
Head Count					
Urban	28.0	20.8 (20.7)	17.2 (16.3)	16.9 (16.1)	24.2 (22.4)
Rural	36.9	27.7 (28.9)	33.4 (34.7)	27.1 (30.7)	35.9 (36.3)
Overall	34.0	25.7 (26.6)	28.6 (29.3)	24.0 (26.3)	32.6 (32.2)
Poverty Gap					
Urban	5.7	3.6 (3.6)	3.0 (2.9)	2.7 (2.5)	5.0 (4.5)
Rural	7.8	4.8 (4.9)	6.4 (6.6)	4.9 (5.4)	7.9 (7.9)
Overall	7.1	4.5 (4.5)	5.4 (5.5)	4.3 (4.5)	7.0 (6.9)

2.3: Important Caveats Regarding Comparison Across Surveys

Caveats on Interpreting Household Survey Data for Balochistan: The poverty estimates for rural Balochistan in 1998-99 are not only out of trend with those from previous years, but also seem inconsistent with other important indicators of well-being, where Balochistan scores well below the national averages. Poverty measurements for rural Balochistan are probably undermined by

both sampling and non-sampling errors. Balochistan is a vast territory, with a highly dispersed population that makes it difficult to construct representative surveys, and increases the likelihood of sampling errors for any survey year. Fluctuations in poverty estimates may also be caused by seasonal migratory movements and agricultural variations, and the dependence of certain areas on highly volatile illegal sources of income. Further, the FBS report on poverty points out some likely problems specific to the survey data for 1998-99. First, comparing the 1998-99 survey to the 1990 agricultural census, it appears that the former substantially underestimated the proportion of households who derive their livelihoods from agriculture. This may crucially underestimate poverty. Second, analysis of the HIES data for 1996-97 reveals that households interviewed between September and December appear substantially better off. If this is the result of large seasonal variations in consumptions, the fact that more than 65 percent of the interviews in Balochistan for the 1998-99 survey were carried out between September and December, would likely underestimate the rural poverty rates for that year. Whatever the precise reasons, in considering a combination of one or more of the above factors, one should treat expenditure-based poverty comparisons between Balochistan and other provinces with skepticism. Especially for 1998-99. It is important to further examine the possible problems affecting Balochistan data, in order to improve sampling and data collection techniques of future household surveys.

Secondly, as mentioned before, the average household sizes reported in the data for 1998-99 turns out to be substantially higher than those in HIES for 1992-93, 1993-94 and 1996-97. The gap between 1998-99 and other surveys is found to be especially high for lower expenditure deciles in rural areas (Table A-2.3), and negligible for urban areas. From the last column of Table A-2.4, it is possible to see that the average rural household size is considerably higher in 1998-99 for all provinces, with the sole exception of Punjab. In case of rural Sindh and Balochistan, the average household size in 1998-99 is 11 and 30 percent higher respectively, than the maximum average household size over the three preceding survey years.

Table A-2.4: Average Household Sizes Across Surveys, by Per Capita Expenditure Deciles for Rural Regions

Per Capita Exp Deciles	1992-93	1993-94	1996-97	1998-99
1	8.4	8.2	8.5	9.1
2	8.0	7.9	7.5	8.5
3	7.8	7.6	7.1	7.9
4	7.3	7.4	7.1	8.0
5	6.9	6.9	6.6	7.6
6	6.6	6.6	6.5	6.9
7	6.2	6.3	5.8	6.5
8	5.9	5.7	5.4	6.1
9	5.0	5.3	5.0	5.6
10	4.0	4.1	4.2	4.7
Total	6.3	6.3	6.1	6.8

The observation that the 1998-99 survey reveals substantially greater household sizes for rural areas should be considered against the fact that the surveys between 1992-93 and 1996-97 do not reveal any pattern of household sizes increasing over time for rural areas (Table A-2.4). This

seems to indicate that an explanation for the greater household sizes in 1998-99 would lie in a direction other than an actual demographic change in rural Pakistan.

Further discussion on this issue can be found in the report "Poverty in the 1990s," which is based on PIHS data, prepared by the FBS. They report that HIES and PIHS in the 1990s have two different household size trends, and that the difference does not reflect a genuine increase in household size. Since the definition of the household members in the two surveys is exactly the same, the main reason for the substantial differences seem to lie in the field collection techniques. One factor mentioned is that while HIES data were collected by single male enumerators, interviewing mainly male household members, for PIHS there were both male and female enumerators. Moreover, the report finds that in some cases, such as in rural Sindh in 1996-97, HIES data collection seems to have followed unwritten rules – there is no household with servants or non relative members in the 1996-97 data, and there are indications that the category of other relative members (relatives who are not children, siblings or parents) is also underestimated.

From what is known so far about field methodologies, it appears that the PIHS data of 1998-99 measures the household sizes better than do the surveys between 1992-93 and 1996-97. From Table A-2.4 it also appears that the HIES for 1992-93 to 1996-97 tend to underestimate the household sizes of relatively poorly off households more than that of richer households. In that case, the data for the earlier years should be regarded as somewhat underestimating the incidence of poverty, with the data for 1998-99 yielding estimates that better reflect the poverty picture. Moreover, the aforementioned PIHS report points out that the 1998 population census is an independent source of information to assess if the survey is representative; whereas the PIHS data on household structure and size are very similar to the findings of the Census, the HIES data in 1996-97 appear to be out of trend.

2.4: Methodology for Growth-Inequality Decomposition of Poverty Changes

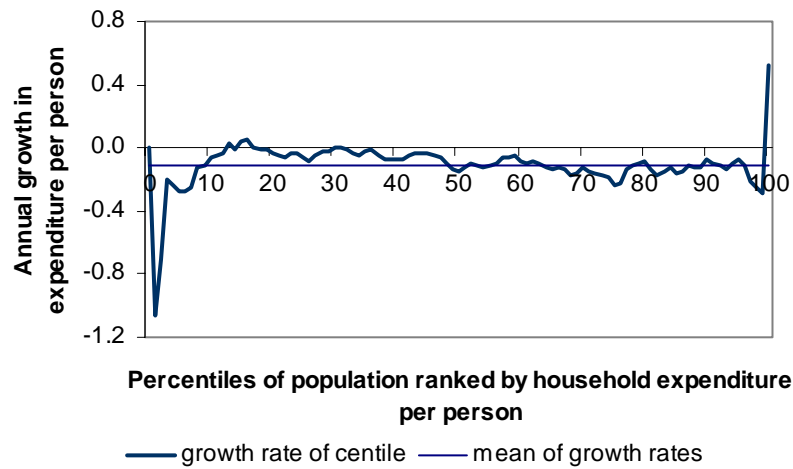
Following the method developed by Ravallion and Datt (1992), change in poverty estimates between two periods can be decomposed between so-called growth redistribution effects. The growth component measures how much of the change in poverty measures is due to the variation in mean per equivalent adult consumption expenditure over time, holding the distribution of per equivalent adult expenditure constant. On the other hand, the redistribution component assesses how much of the variation in poverty measures is due to a change in the distribution of expenditure, provided that there was no growth in the mean expenditure.

Suppose one is interested in decomposing the poverty change between periods t_0 and t_1 . Let the *mean per equivalent adult expenditure*, from the household data for the relevant years, for the years t_0 and t_1 be m_0 and m_1 respectively. In practice, the growth effect on poverty is calculated by multiplying the *vector of per equivalent adult expenditure* of year t_0 by (m_1/m_0) . This yields an expenditure vector with the distribution of year t_0 but with mean m_1 . Poverty measures are then estimated on this adjusted data for year t_0 . The growth effect is simply the residual from subtracting these estimates from the actual poverty estimates for year t_0 (using the actual expenditure data).

The redistribution component is estimated analogously. First the *vector of per equivalent adult expenditure* of year t_1 is multiplied by (m_0/m_1) . This yields an expenditure vector with the mean per equivalent adult expenditure of m_0 but with the distribution of year t_1 . Poverty measures are then estimated on this adjusted data for year t_1 . The redistribution effect is simply the residual from subtracting these estimates from the actual poverty estimates for year t_0 .

2.5: Growth Incidence Analysis for Pakistan: 1990-91 to 1998-99

Figure A-2.2: Growth Incidence Curve: 90-91:98-99



2.6: Measurement of Vulnerability

Definition of the Vulnerability Measure: Consider a time horizon of three periods and let the initial period be t . We need to find the probability that a household's expenditure level will fall below the poverty line at least once within the following three periods. This probability is given by: $V_{it}(T, P_{line}) = P(\text{At least one period of poverty}) = [1 - P(\text{No periods of poverty})] = [1 - [(1 - P(\text{poor in first period})) * (1 - P(\text{poor in second period} | \text{not poor in first period})) * (1 - P(\text{poor in third period} | \text{not poor in first two periods}))]]]$

A household i is then classified as vulnerable at time t if the vulnerability measure, V_{it} , exceeds some threshold value V_{thresh} . V_{it} is obtained by conditioning future probabilities of poverty on outcomes in previous periods. In order to compute the probabilities for the vulnerability index, we estimate expenditures using household fixed-effects and the rainfall shock. This allows us to directly estimate the change in expenditure due to the rainfall shock. We allow for persistence in this shock so that the total variation in time t expenditures is the sum of variation due to past shocks and variation due to the time t shock. By using estimated consumption we are also able to roughly correct for measurement error in the data. To account for heteroskedasticity in observed expenditure, we ranked all households by mean absolute deviation in estimated expenditure, grouped households into deciles and computed the variance of estimated expenditure, as well as the variance of consumption due to the exogenous shock separately for each decile.

It is important to note that the measure we develop does not require panel data. The panel allows us to check the validity of our measure by comparing estimated vulnerability levels against the occurrence of episodes of poverty over the 5 years of the panel. However, we estimate vulnerability at the cohort level by treating the panel as a series of cross sections and find that our cohort based measure tracks actual transitions extremely well and is robust to changes in the time horizon and the poverty line. This greatly enhances the usefulness of the measure for analyzing differentials in the intensity of vulnerability, as well as in its causative factors, in sub-populations of interest. We intend to use the Household Income and Expenditure Survey series to estimate

cohort vulnerability in future work. Given the costs and difficulties inherent in conducting panel surveys, much of the data available for developing countries is in the form of repeated cross-sections. It is thus of enormous interest to see how reasonably a measure of vulnerability performs when panel data is not available.

*Estimating Vulnerability*⁸

The dependent variable in the regression used is the log of per capita expenditure. Explanatory variables included rainfall shock variables for the current year (deviation of year t rainfall from its time mean), rainfall shock variables for the past year, past rainfall shock variables interacted with time-varying agricultural assets (land, livestock, and vehicles), and a household fixed effect. The analysis constructed 5 rainfall “seasons” from the monthly rainfall data. The first is the deviation in rainfall over the winter season prior to the agricultural year which begins roughly in June (the start of the Kharif season). The remaining four capture rainfall during the Kharif planting period, the Kharif harvest period, the Rabi planting period, and the Rabi harvest period.

The current rainfall shock is found to be jointly significant. Rainfall during the planting period has a positive effect on expenditures, but rainfall during the harvest phase of the season, has a strong negative effect. Last year’s rainfall shock is also jointly significant, and varies with asset ownership. This implies some persistence in the rainfall shock. Table A-2.5 provides estimated expenditures from the regression.

Tables A-2.6a and A-2.6b show that the proportion of households classified as vulnerable using the measure used here matches closely with households that *actually* experienced an episode of poverty over the 5 years of the panel. This correspondence remains regardless of the poverty line we use. Tables A-2.7a and b, and A-2.8 a and b further corroborate that individual households are correctly classified between 75 and 80 percent of the time. Finally, Tables 2.9a and b show that the measure seems to work equally well when when the panel is treated as a repeated cross-section, cohort means are formed, and cohort means are used to estimate expenditures and to construct the vulnerability estimate.

Table A-2.5: Decomposition of estimated adult equivalent real expenditure by year

	Measured expenditures	Estimated expenditures
Year 1 (1986-87)	2878.6 (1401.5)	2781.7 (1217.2)
Year 2 (1987-88)	2678.0 (1205.3)	2744.5 (1209.3)
Year 3 (1988-89)	2478.6 (912.3)	2828.1 (1082.6)
Year 4 (1989-90)	3087.1 (2228.7)	2999.9 (1306.7)
Year 5 (1990-91)	3119.4 (1339.8)	2893.4 (1034.9)
Five-year mean	2836.6 (1490.2)	2845.3 (1178.6)

Standard deviations are in parentheses.

**Table A-2.6a: Fraction of vulnerable households
(Time horizon = two years, average vulnerability over 5 years)**

	Proportion of households classified as vulnerable projecting 2 years ahead	Proportion of households that actually experienced an episode of poverty looking two periods ahead
Poverty line = 2580 Rs.	0.56	0.57
Poverty line = 2400 Rs.	0.48	0.46
Poverty line = 2200 Rs.	0.38	0.36
Poverty line = 2000 Rs.	0.29	0.26

⁸ All analysis in this section is based on IFPRI data

Table A-2.6b: Fraction of vulnerable households
(Time horizon = three years, average vulnerability over 5 years)

	Proportion of households classified as vulnerable projecting 2 years ahead	Proportion of households that actually experienced an episode of poverty looking two periods ahead
Poverty line = 2580 Rs.	0.59	0.61
Poverty line = 2400 Rs.	0.51	0.51
Poverty line = 2200 Rs.	0.42	0.40
Poverty line = 2000 Rs.	0.32	0.29

Table A-2.7a: Comparing household vulnerability with an actual episode of poverty
(time Horizon = 2 periods)

Percentage vulnerable households					
	Vulnerable and episode of poverty	Not vulnerable and no episode of poverty	Episode of poverty but not classified as vulnerable	Classified as vulnerable but no episode of poverty	Total for which vulnerability status and actual transitions agree
Poverty line = 2580 Rs.	43.3	35.2	13.0	8.5	78.5
Poverty line = 2400 Rs.	34.1	44.3	12.1	9.5	78.4
Poverty line = 2200 Rs.	25.2	54.2	10.7	9.9	79.4
Poverty line = 2000 Rs.	16.9	64.9	9.1	9.7	81.2

Table A-2.7b: Comparing household vulnerability with an actual episode of poverty
(time horizon = 3 periods)

Percentage vulnerable households					
	Vulnerable and episode of poverty	Not vulnerable and no episode of poverty	Episode of poverty but not classified as vulnerable	Classified as vulnerable but no episode of poverty	Total for which vulnerability status and actual transitions agree
Poverty line = 2580 Rs.	43.6	32.8	17.1	6.6	76.3
Poverty line = 2400 Rs.	34.7	40.9	16.3	8.1	75.6
Poverty line = 2200 Rs.	25.4	51.3	14.2	9.2	76.7
Poverty line = 2000 Rs.	18.3	61.9	11.1	8.7	80.2

Table A-2.8a: Comparing *ex-post* outcomes and *ex-ante* predictions by V_{it}
(Pline: 2580 Rps; TimeHorizon=2—using data for years 1,2 and 3)

	Number of observations	Percentage of observations for which vulnerability status and actual transitions agree
$V_{it} \leq 0.2$	697	.80
$0.2 < V_{it} \leq 0.4$	249	.64
$0.4 < V_{it} \leq 0.6$	254	.51
$0.6 < V_{it} \leq 0.8$	255	.69
$0.8 < V_{it} \leq 1$	777	.94

Table A-2.8b: Comparing *ex-post* outcomes and *ex-ante* predictions by V_{it}
(Pline: 2000 Rs; TimeHorizon=2; using data for years 1,2 and 3)

	Number of observations	Percentage of observations for which vulnerability status and actual transitions agree
$V_{it} \leq 0.2$	1204	.91
$0.2 < V_{it} \leq 0.4$	326	.81
$0.4 < V_{it} \leq 0.6$	221	.53
$0.6 < V_{it} \leq 0.8$	212	.57
$0.8 < V_{it} \leq 1$	269	.82

**Table A-2.9a: Fraction of vulnerable households based on cohort estimates
(Time horizon = two years, average vulnerability over 5 years)**

	Proportion of households classified as vulnerable projecting 2 years ahead	Proportion of households that actually experienced an episode of poverty looking two periods ahead
Poverty line = 2580 Rs.	0.54	0.57
Poverty line = 2400 Rs.	0.47	0.46
Poverty line = 2200 Rs.	0.35	0.36
Poverty line = 2000 Rs.	0.25	0.26

Table A-2.9b: Fraction of vulnerable households based on cohort estimates (Time horizon = three years, average vulnerability over 5 years)

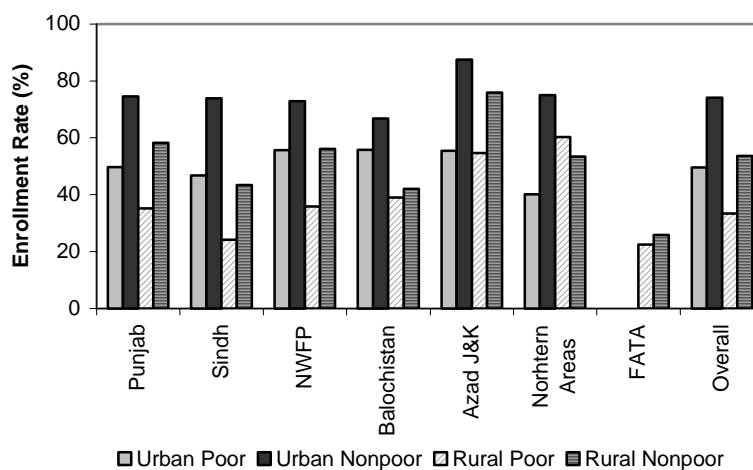
	Proportion of households classified as vulnerable projecting 2 years ahead	Proportion of households that actually experienced an episode of poverty looking two periods ahead
Poverty line = 2580 Rs.	0.56	0.61
Poverty line = 2400 Rs.	0.49	0.51
Poverty line = 2200 Rs.	0.39	0.40
Poverty line = 2000 Rs.	0.27	0.29

2.7: Poverty and Human Development

Table A-2.10: Effect of Scale Adjustment in Consumption on Demographics of Poverty

	Average Household Size			Average Dependency Ratio		
	Poor	Nonpoor	Overall	Poor	Nonpoor	Overall
Scale factor: $t = 0.8$	8.9	8.3	8.5	1.6	1.2	1.3
Scale factor : $t = 0.9$	9.5	8.1	8.5	1.6	1.2	1.3
No adjustment for scale	9.8	7.9	8.5	1.5	1.2	1.3

Figure A-2.3: Net Primary Enrollment Rates in 1998-99: Poor & Nonpoor



Source: PIHS (1998-99)