Consumption Vulnerability and Dynamic Poverty in the North-West Frontier Province, Pakistan

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Abstract

This paper quantitatively investigates vulnerability to risk as a characteristic of dynamic poverty in low income countries. A household is defined as vulnerable to consumption risk if it has to drastically reduce its consumption level when hit by a negative income shock. To empirically operationalize the definition, descriptive analyses based on transition matrix are combined with regression models with consumption change as a dependent variable. The paper employs a two-period panel dataset collected from the North-West Frontier Province, Pakistan. To minimize possible biases due to measurement errors and endogeneity, which are likely to be severe in that kind of datasets, qualitative information on households' subjective assessment on risk is utilized to instrumentalize observed consumption and income changes. Empirical results show that, first, sample households are subject to high transient poverty in terms of income but the income variability is transferred to consumption variability only partially due to *ex post* risk-coping mechanisms; second, several households, who are excluded from these mechanisms, are prone to high risk of a substantial fall in consumption and a drastic cut in children's school enrollment; third, households are more vulnerable to consumption poverty when they are hit by shocks in outside employment than by shocks in self-employment; fourth, the dynamically vulnerable group includes households led by the aged, with less land, and without regular remittance receipt.

Keywords: poverty, vulnerability, risk, consumption smoothing, human capital.

JEL classification codes: I32, Q12.

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1 Introduction

This paper quantitatively investigates vulnerability to risk as a characteristic of dynamic poverty in low income countries. Unlike recent studies that associate vulnerability with the excessive sensitivity of consumption to income shocks or measure vulnerability by the probability of experiencing poverty in the near future, we define a household to be vulnerable to consumption risk if it has to drastically reduce its consumption level when hit by a negative income shock. Our definition attempts to follow more closely what is meant by "vulnerability" in the non-technical literature — Chambers (1989) described "vulnerability" as "defenselessness, insecurity, and exposure to risk, shocks, and stress" (p.1), while the World Bank (2000) described it as "the likelihood that a shock will result in a decline in well-being" (p.139).

To empirically operationalize our definition, descriptive analyses based on transition matrix are combined with regression models with consumption change as a dependent variable. Through these analyses, we address the following questions. How vulnerable to risk are low income households? Are the ill effects different according to the sources of shocks? Do they need to cut consumption when their income drops? How secure are their household assets and human capital? Which attributes of households are associated with the vulnerability? It is expected that, by investigating poverty from a dynamic perspective with vulnerability as a key word, useful insights would be obtained for poverty eradication policies.

The empirical analysis is applied to a two-period panel dataset collected from rural areas of the North-West Frontier Province (NWFP), Pakistan. To minimize possible biases due to measurement errors and endogeneity, which are likely to be severe in that kind of datasets, qualitative information on households' subjective assessment on risk is utilized to instrumentalize observed consumption and income changes. Pakistan belongs to South Asia where more than 500 million people or about 40% are estimated to live below the poverty line (World Bank, 2000). Economic development in South Asia in general is characterized by a moderate success in economic growth with a substantial failure in human development in terms of basic health and education or gender equality (Drèze and Sen, 1995). This characteristic applies the most to the case of NWFP. Furthermore, NWFP is a land-scarce province with limited scope for agriculture-led sustained growth and agriculture is more risky than other parts of Pakistan. These characteristics make the NWFP case study an interesting one to investigate the dynamics of poverty.

Earlier works on the dynamics of poverty with a motivation similar to this paper's include Amartya Sen's classic monograph, *Poverty and Famines* (Sen, 1981). Based on historical analysis of Great Bengal Famine of 1943, he demonstrated that landless agricultural laborers were more vulnerable to famines-related sufferings than landless sharecroppers, even when their *average* standard of living was similar, because their food entitlement was different. The World Bank's *World Development Report* emphasized the importance of distinguishing transient poverty from chronic poverty in its 1990 edition (World Bank, 1990), although it is not as explicit as in its 2000/2001 edition where "security against risk" is listed as one of the three core concepts of poverty eradication policies (World Bank, 2000). The more explicit discussion on dynamic poverty partly reflects the accumulation of new empirical studies from developing countries.[1] It also reflects the advance in theoretical modeling of household behavior under risk and in econometric analysis based on such models,[2] which found that poor households are likely to suffer not only from low income and consumption on average but also from fluctuations of their welfare level.

With this background, the quantitative literature on vulnerability to risk has expanded recently. Several authors have attempted to measure "vulnerability" by the level of variability of welfare indicators, usually per-capita real consumption (Jalan and Ravallion, 1999; Glewwe and Hall, 1998). Households are defined vulnerable to risk when their consumption shows excess sensitivity to income shocks due to insufficient insurance measures. Although this line of research investigates issues closely related with the vulnerability defined here, an important difference is that this paper treats the positive and negative shocks separately and finds vulnerability only when a household hit by a *negative* shock *reduces* its welfare level drastically.[3]

A related approach treats "vulnerability" as synonym for transient or stochastic poverty. For example, Morduch (1994) regarded households as vulnerable when their expected welfare status is above the poverty line but they are stochastically under the poverty line. Based on this idea, Chaudhuri (2000) proposed a measure of "vulnerability to poverty" defined as the

[1]For example, newly collected household data like the World Bank's "Living Standards Measurement Study (Grosh and Glewwe, 2000) have facilitated such empirical works.

[2]Among important works, Townsend (1994) applied an intra-village full risk-sharing model to Indian household data, and Udry (1994) proposed a model of state-contingent loans, which was applied to Nigerian households. Both of them found that low income households have means to smooth consumption *ex post* but the degree of consumption smoothing is less than the socially efficient level.

[3]In the existing literature on the poor's vulnerability to risk, Kochar (1995, 1999) explicitly distinguished the impacts of negative and positive shocks.

probability of experiencing poverty in the near future, which is estimable from cross-section or panel datasets. Similar measures were estimated for Pakistan (Mansuri and Healy, 2001) and Indonesia (Pritchett et al., 2000; Chaudhuri et al., 2002). Although these measures of vulnerability are useful in assessing the poverty status of households, it should be noticed that they do not account for the depth of poverty below the poverty line. Because of this shortcoming, they may not be a good indicator of vulnerability to risk. For instance, when the variability of welfare becomes larger (mean-spreading risk), Chaudhuri's (2000) vulnerability measure becomes smaller for households whose average welfare status is below the poverty line, although the welfare level of such households is likely to decline because of the increase in risk.[4] In contrast, our definition could be applied both to households whose expected welfare level is above and below the poverty line, and our regression exercise accounts for the depth of welfare decline continuously.

The paper is organized as follows. Section 2 describes a micro panel dataset used in this paper. Section 3 shows empirical results based on poverty transition matrix. Section 4 presents estimation results of regression models with variables representing consumption changes on the left hand side. The final section summarizes the paper.

2 Data

This paper employs a panel dataset compiled from sample household surveys implemented in 1996 and 1999 in three villages in Peshawar District, the North-West Frontier Province (NWFP), Pakistan. NWFP is one of the four provinces of Pakistan. Compared with Punjab, which is the center of agriculture and related industries, and Sind, where a metropolitan city of Karachi is located, NWFP could be characterized as an economically backward province. The share of manufacturing industries in labor force in the province is much smaller than those in Punjab and Sind. Electricity consumption per capita was only half the level enjoyed in Punjab and Sind. NWFP's economy is more dependent on service sectors and remittances than on commodity sectors including agriculture and manufacturing industries. In terms of

[4]Ravallion's (1988) approach of decomposing total poverty into "chronic" and "transient" poverty is useful in understanding this puzzle. He defined "total poverty" as the expected value of poverty measures, "chronic poverty" as the poverty measures corresponding to the expected value of consumption, and "transient poverty" as the residual. If there is no consumption risk, the total poverty becomes equivalent to the chronic poverty so that the transient poverty becomes zero. As Ravallion (1988) demonstrated, not all poverty measures respond positively to the increase in consumption variance. The most popular measure of headcount index misleadingly predicts that transient poverty decreases with risk when the poverty line is more than the mode welfare. Chaudhuri's (2000) measure of vulnerability is a sophisticated version of Ravallion's "total poverty" applied to the headcount index.

income poverty, estimates for headcount index in rural NWFP vary in the range from 20% to 40% in 1990/91 (World Bank, 1995).

Since NWFP is relatively a land-scarce province with limited scope for agriculture-led sustained growth, human capital is expected to play a more important role in poverty eradication. In terms of human development, the backwardness of NWFP is strengthened. Literacy rates in NWFP, especially of females, are much lower than in Sind and Punjab. NWFP is lagging behind Punjab and Sind in infant mortality rates also. This disparity, i.e., human development poverty is more serious than income/consumption poverty, is a notorious characteristic of South Asian economy (Drèze and Sen, 1995). We focus on rural NWFP because this is the region where this disparity applies the most.

Details of the 1996 household survey are given in Kurosaki and Hussain (1999) and those of the 1999 household survey are given in Kurosaki and Khan (2001). The reference period for each survey is fiscal years 1995/96 and 1998/99 respectively.[5] In choosing sample villages in 1996, we controlled village size, socio-historical background, and tenancy structure. At the same time, to ensure that the cross section data thus generated would provide dynamic implications, we carefully chose villages with different levels of economic development. The first criterion was agricultural technology — one of the three sample villages was rain-fed, another semi-irrigated, and the other fully-irrigated. Another criterion was that the selected villages be located along the rural-urban continuum so that it would be possible to decipher the subsistence versus market orientation of farming communities in the study area.

Table 1 summarizes characteristics of the sample villages and households. Village A is rain-fed and is located some distance far from main roads. This village serves as an example of the least developed villages. Village C is fully irrigated and is located close to a national highway, and serves as an example of the most developed villages. Village B is in between. Sample households in each village were selected randomly from each type of households classified by their farm operating status: non-farm households (with no operated land for cropping)[6] and farm households that include owner, owner-cum-tenant, and pure tenant farm households. The variation in land ownership and management enables us to decipher the effects of land assets on household welfare.

Out of 355 households surveyed in 1996, we were able to resurvey 304 households in

[5] Pakistan's fiscal year as well as her agricultural year is a period from July 1 to June 30.

[6] "Non-farm" households were identified by the land operation status. Therefore, several households who did not operate any land but worked as farm laborers for wage or kept livestock are classified as "non-farm" households.

1999. Among the resurveyed, three have been divided into multiple households[7] and two have incomplete information on consumption. Therefore, a balanced panel of 299 households with two periods is employed in this paper. Since the initial samples were almost equally distributed among the three villages, the smallest sample size in Village A implies that the attrition rate is the highest there. The most frequent reason for attrition was migration. Some households have migrated out from the village and others have sent their all adult males for work in foreign countries or in Pakistani cities. As shown in Appendix 2, attrition occurred more for households living in Village A and whose heads were more educated. Education and risky environments are thus associated with higher propensity to migrate.

Average household sizes are larger in Village A than in Villages B and C, reflecting the stronger prevalence of extended family system in the village. Average landholding sizes are also larger in Village A than in Villages B and C. Since the productivity of purely rainfed land is substantially lower than that of irrigated land, effective landholding sizes are comparable among the three villages.

In the analyses below, the welfare of individual i in year t is measured by real consumption per capita (y_{it}). Household consumption is the sum of annual expenditures on individual food and non-food items. In the survey, information on the expenditure on non-food items, quantity of food items consumed, their prices, the share met by domestic production was collected. To convert it into real consumption per capita, the household consumption was divided by the household size and by the consumer price index.[8]

Real household income per capita (x_{it}) is the most important determinant of y_{it}. The household income is defined as the sum of the income from: self-employed activities; wage, salary, and allowances from employed household members; net transfer receipt (public and private); net remittances receipt; and other unearned income. The income from self-employed activities in agriculture includes the value of farm produce consumed by the same household. In other words, it is defined as the sum of gross values of total farm produce minus the sum

[7]In the survey, a household is defined as a unit of coresidence and sharing consumption. A typical joint family in the region, where married sons live together with the household head who owns their family land along with their wives and children, is treated as one household, as long as they share kitchen. When the household head dies or becomes older, the land may be distributed among sons, who start to live separately on that occasion. In our survey when we encounter such cases, each family of each son is counted as one household.

[8]The actual number of household members was used as a measure of household size. Alternatively, we can estimate the household size in terms of equivalence scale that reflects difference in sex/age structure and corrects for scale economy. This is left for further study. Non-adjustment for scale economy could lead to an overestimate of poverty for large households, on which see Lanjouw and Ravallion (1995) for the case of Pakistan.

of actually-paid expenses (intermediate goods, hired labor, hired machinery, hired capital, and rented land). The total household income is divided by the same price deflator and by the same household size to obtain x_{it}. Average income and consumption per capita are the lowest in Village A and the highest in Village C (Table 1), confirming our survey design that different levels of economic development were represented in village selection.

In any household survey where self-employment agriculture is important, estimating household income and consumption is subject to measurement errors, although we did our best to minimize them (Grosh and Glewwe, 2000). In our survey, a series of questions on households' adjustment to risk were also asked to the household head in the 1999 survey, such as (i) any good/bad economic year(s) in the past three years due to unanticipated shocks, (ii) associated reasons/factors thereof, and (iii) possible adjustments they had to or could make to cope with the risk, such as consumption adjustments, food storage, accumulation/decumulation of productive assets (land and livestock), gold and jewelry management, mutual help, adjustment of children's schooling, etc. This part of the questionnaire provides us with qualitative information on households' subjective assessment on risk, which can be used as an independent check for changes in income and consumption. Although the information is in the form of zero-one dummies, we found that the subjective assessment on income shock corresponds well to the direction of observed income changes and that on adjustment corresponds well to the direction of observed consumption and asset changes. Because of this reason, we use them as instrumental variables for observed consumption/income changes (Section 4).

During the three years since the first survey, Pakistan's economy suffered from macroeconomic stagnation. The GDP growth rate was slowed down; inflation was accelerated, especially the prices of essential items. NWFP economy was affected the most severely among the four provinces by economic turmoil after Pakistan's nuclear test in May 1998. Reflecting these macroeconomic shocks, the general living standard stagnated in the study villages during the period of this study.

3 Characterizing the Vulnerability to Risk

This section analyzes the characteristics of risk vulnerability using poverty transition matrix. Individual welfare indicator y_{it} fluctuates around its expected value due to shocks such as weather, diseases/injuries, macroeconomic fluctuations, etc. When a panel dataset is

available that contains information on y_{it} for $t \geq 2$ and a poverty line of z is given, we can categorize individuals according to their poverty status. For example, three categories of "chronically poor" ($y_{it} < z$ for all t), "transiently poor" ($y_{it} < z$ for some t and $y_{it} \geq z$ for some t), and "always non-poor" ($y_{it} \geq z$ for all t) can be identified. When we have a two-period panel dataset surveyed before and after an important event such as famines, it is useful to identify a category "impoverished" ($y_{i1} \geq z$ and $y_{i2} < z$) and a category "escaping poverty" ($y_{i1} < z$ and $y_{i2} \geq z$).

A number of studies investigated the dynamics of poverty using this framework (Sen, 1981; Walker and Ryan, 1990; Baulch and Hoddinott, 2000). One shortcoming of this approach is that it might be too sensitive to the specific choice of poverty line. Since the identification of poverty line is inevitably arbitrary (Sen, 1981), we need to check the robustness of category-based analysis to the choice of poverty line. Ravallion et al. (1995) extended a stochastic dominance approach to the dynamic case. Jalan and Ravallion (1998) adopted a finer categorization using intermediary boundaries such as $0.75z$ or $1.25z$. We follow the latter approach in this paper.

Table 2 shows a transition matrix of consumption poverty estimated from our data with five categories of poverty status in each year. The poverty line used is z=7,140 Rs. (approximately 185 US$ in 1996), which is obtained from World Bank (1995) adjusted for rural CPI. Pakistan Rupees in the empirical section of this paper are all in 1996 values. Each cell in the table shows the number of households belonging to each category. Diagonal cells correspond to those households whose poverty status did not change, where 106 households are included. The number of households in cells below the diagonal is 98 and that in cells above the diagonal is 95. Therefore, overall consumption poverty did not experience a big change. Individually, however, the household mobility is indeed high.[9]

Out of the total 299 panel households, 31 (10.3%) are in the four cells in the southeast corner where $y_{it} \geq z, t = 1, 2$. We call them "always non-poor" households. On the contrary, the four cells in the northwest corner where $y_{it} < 0.75z, t = 1, 2$, contains 104 households (34.8%). We call them "always poor" households in the analysis below. Another group of interest is those households in six southwest cells where $y_{i1} \geq 0.75z, y_{i2} < 0.75z$, where 58 households (19.4%) are included. This is a group which experienced a rapid decline in welfare

[9]Nevertheless, the hypothesis of an independent Markov process was rejected at 1% level (χ^2 test of independence in two-way contingency tables yielded a test statistic of 65.5, whereas the 1% critical value for a χ^2 variable with sixteen degrees of freedom is 32.0). Therefore, there exists a tendency to remain in the same status although the transition to other statuses is frequent.

and called "impoverished" in the analysis below. It is expected that vulnerable households according to our definition are concentrated in this group.

Table 3 examines the difference in consumption changes among these groups in more details. The overall change in consumption is small both for food and non-food expenditure. This general pattern is applied to "always non-poor" and "always poor" households. In contrast, the total consumption of "impoverished" households declined by 44% or about 3000 Rs., of which two thirds were attributable to reduction in food consumption. The welfare decline of this group was thus substantial.

Did they need to reduce consumption substantially because they were hit by an abnormally large income shock? Table 4 shows that their income indeed declined by more than 3000 Rs. or by 38%. In this sense, the "impoverished" group is indeed a "vulnerable group." However, the absolute amount of income decline for "always non-poor" households was much larger than this. "Always poor" households also experienced a substantial income decline of 23%. Therefore, what distinguishes "impoverished" households from others is not the level of an income decline but the availability of *ex post* consumption smoothing measures given an income decline. In other words, the lack or insufficiency of consumption smoothing measures is necessary for vulnerability.

To investigate the nature of vulnerability further, Tables 5 and 6 are compiled. Changes in household assets are summarized in Table 5, in the order of liquidity. In case of farmland, only non-family transactions are included since inheritance transactions may be less responsive to risk. Monetary assets are shown in net terms, with its negative value indicating a net debt. Overall, the households increased their net debt by 1081 Rs. or by 12.3%. The majority of these credit transactions are informal (Kurosaki and Khan, 2001). They also decumulated livestock assets substantially. Although small for the total households, farmland was also decumulated. These figures show that the sample households used physical and monetary assets to smooth consumption, faced with a substantial decline in income. The total asset value declined by 3.6% as a result.

The "impoverished" group shows an interesting deviation from the general pattern in Table 5. This group was a net debtor in 1996 but turned into a net creditor in 1999 with a change of +21,500 Rs. This does not imply an improvement in their welfare. On the contrary, what happened to these households is that they were forced to repay loans and not able to borrow further when they needed. The perverse situation for this group is well evidenced by its level of land sales. They needed to sell out 26% of their farmland to survive. Since

farmland is the source of social status as well as the source of income, land sale markets are not very active in the study area. Therefore, we could conclude that "impoverished" households were those who had to transfer income shocks to consumption reduction directly mainly because they were more constrained in credit access. The importance of informal credit in consumption smoothing in Pakistan was also addressed by Alderman (1996).

The welfare decline that occurred to "impoverished" households was not completely transient. Decline in assets could be replenished when they are blessed with a good economic shock in the future. Decline in human capital accumulation may not be replenished because human capital investment such as education has to be implemented in time. Table 6 gives an evidence that the "impoverished" households indeed reduced their education investment substantially. The table shows the level and change of school enrollment for children belonging to the age cohort of six and seven in 1996. In Pakistan, the official starting age of primary education is five or six but many children enter school later than this.[10] If the number of late entry children is larger than the number of dropouts in the three years, the enrollment increases. As Table 6 shows, the dropouts dominate marginally as a whole — the enrollment ratio declined by 5.9 percentage points. The decline is due to a rapid decline in female education since the enrollment ratio of boys increased during the same period.

In contrast, the enrollment ratio dropped both for boys and girls in "impoverished" households. In 1996, they sent their boys as often as the "always non-poor" households; in 1999, the gap appeared because the former called back boys from school whereas the latter now sent all the boys to school. In 1996, girls of the "impoverished" group went to school as often as those of the "always poor" group; in 1999, none of the girls were found at school. Our data thus suggest that the adjustment cost of dynamic poverty goes more to girls than to boys. According to Kurosaki's (2001) estimates, private returns to education are not discernible for girls whereas boys' education are associated with significantly positive returns. This could be a reason for households' strategy to give priority to male education when they are hit by a bad economic shock. The gender contrast in the study area is sharper than other developing countries. Since female primary education is associated with high social rates of return due to its positive impact on health and education for the next generation, this is a worrying situation. Development policies that provide safety nets and increase private returns to female education are called for.

[10] See Sawada and Lokshin (2001) for an econometric analysis of children's enrollment and household decision making in Pakistan.

4 Determinants of Consumption Vulnerability

Descriptive analyses based on transition matrix in the previous section found that there is a group of households whose consumption experienced a rapid decline when hit by negative income shocks, with a drastic reduction in households assets (current physical capital) and in children's enrollment (future human capital). This section investigates how income changes are transmitted to consumption changes through regression analyses. On the one hand, it complements the previous section by investigating further the nature of consumption vulnerability and by examining the household attributes associated with such vulnerability. On the other hand, the regression models in this section attempt to minimize bias from measurement errors and endogeneity, which were not discussed in the previous section.

First, re-examining Table 4 with emphasis on individual income sources, we can find that "impoverished" households experienced a more significant decline in non-farm income than in farm income. This could suggest that households in the study region are more able to cope with farm income risk than with non-farm income risk, since the former has been risky for generations so that households have accumulated ways to deal with it whereas the latter is increasing its importance only recently. One problem of this interpretation is that both income and consumption changes are measured with errors and subject to simultaneity bias.

To give another evidence, which is less prone to these problems, a probit model is estimated in which households reporting a specific welfare decline are associated with dummy variables corresponding to the subjective assessment for negative and unanticipated economic shock differentiated by its reasons/factors. To concentrate on the vulnerable households described in the previous section, we adopt as the dependent variable the probability of a household replying that they had to reduce food consumption or to reduce children's enrollment due to the negative shocks.

Estimation results are reported in Table 7. Except for negative shocks in non-farm self-employment, all the six shocks were associated with households' vulnerability at 1% level of significance. This is because those households with non-farm self-employment business belong to a relatively well-off section of the sample households. They seem to have sufficient assets for their consumption to be isolated from income shocks. Among the six types of negative shocks, the marginal effect on the probability of being vulnerable is higher for shocks related with outside employment (low wages, lost jobs, and declined remittances). This supports our view that households are more able to cope with farm income risk than

with non-farm, outside employment risk, which are a relatively newcomer to the village economy.

Second, given these characteristics of the nature of vulnerability, we would like to investigate what kind of households' initial attributes are associated with this vulnerability. Let Z_i denote household attributes in 1996, such as village characteristics, demographic variables (household size, dependency ratio, dummy for female headed household, and age of household head), income sources (dummy for having household members engaged in non-farm full-time work and dummy for having family members who regularly remit to the household), land ownership (ownership dummy and the land asset value), and education. All these variables are endogenous to household decisions in the long run, but treated as exogenous in the following analysis since they are predetermined for the status in 1999 and we could not find good instrumental variables for them in our dataset.

As a preliminary analysis, the same probability for Table 7 was regressed on Z_i. Although many of the variables had expected signs, the regression model on the whole was not statistically significant (not reported). This could be due to the qualitative nature of the dependent variable. Both consumption changes (Δy_i) and income changes (Δx_i) occur continuously, whose information is lost in the probit analysis.

Therefore, we estimate a model of consumption smoothing with variable coefficients depending on household attributes in 1996, namely,

$$\Delta y_i = \alpha_v + b_1 Z_i(1 - D_i)\Delta x_i + b_2 Z_i D_i \Delta x_i + u_i, \tag{1}$$

where $D_i = 1$ if $\Delta x_i < 0$, u_i is an i.i.d. error term with zero mean, and α_v, b_1, and b_2 are parameters to be estimated. Parameters α_v control village-fixed effects. Our concern is on b_2 because it shows what kind of households were insulated from income declines and what kind of households were not. The focus on b_2 corresponds to the definition of vulnerability adopted in this paper and distinguishes this paper from the existing studies on consumption smoothing.[11]

The model was estimated by a two-stage weighted least squares method. To minimize possible biases due to measurement errors and endogeneity, which are likely to be severe in two-period panel datasets, both consumption changes in the left hand side and income

[11] In the literature, variable coefficient models differentiating positive and negative *anticipated* shocks are popular because their contrast gives a useful test for credit constraints on consumption smoothing (e.g., Garcia et al., 1997; Jacoby and Skoufias, 1997). Our model attempts to differentiate positive and negative *unanticipated* shocks because this asymmetry is an important aspect of vulnerability. Kochar (1995, 1999) also distinguished the impacts of negative and positive unanticipated shocks explicitly.

changes in the right hand side are instrumentalized in the first stage. Δy_i (either total consumption or food consumption per capita) were instrumentalized by Z_i and dummy variables for "Adjustment to the positive shock if any" and "Adjustment to the negative shock if any." Δx_i is instrumentalized by Z_i and dummy variables for "Reasons/factors for unanticipated positive shock" and "Reasons/factors for unanticipated negative shock." We expect that dummies for subjective assessment on risk predict the direction of consumption or income changes well whereas household attributes in 1996 predict the magnitude of the changes well. In the second stage, a weighted least squares method was used with the household size as a weight because the focus is on the individual welfare. The standard errors are calculated using Huber-White's heteroscedasticity robust formula.

Equation (1) nests a model of village-level consumption smoothing such as a model estimated by Townsend (1994). The nested model corresponds to the case that all the elements of b_1 and b_2 are constrained to be zero except for the intercept b_0, which is the same regardless of D_i. The village dummies then control for macro shocks and Δx_i captures idiosyncratic shocks that occur to the household. The constrained version yielded the estimates for the excess sensitivity parameter $\hat{b}_0$ on Δx_i at 0.065 for total consumption and 0.057 for food consumption, both of which are not statistically significant at 10% level. The insignificance of the parameter suggests that households on average have several means to smooth consumption effectively *ex post*.

However, the analyses so far suggest that households are heterogeneous in their ability to cope with income risk. Allowing heterogeneous impacts according to household attributes and differentiated impacts depending on the sign of income changes, we obtain estimation results reported in Table 8.[12]

Dependency ratio has a significantly negative coefficient both in b_1 and b_2 and both for total and food consumption. This seems to indicate that households with more dependent members could not change consumption much when income changes. The magnitude of the coefficient is larger for b_1 than for b_2, suggesting that minimizing consumption adjustment to income shock is more difficult when hit by a negative shock. In this sense, households with many dependent members are vulnerable. Other household attributes are not significant in b_1 (coefficients on Δx_i when $\Delta x_i > 0$). When $\Delta x_i < 0$, b_2 is significantly positive for age

[12] A dummy for female-headed households was not included because only 1% of the samples belong to this category. When included, it had a significantly positive coefficient in b_2, suggesting that female-headed households are more vulnerable.

and education of household heads. Therefore, the welfare of these households declines more when hit by negative shocks. Our observations in the field survey in the villages also supports that aged households are indeed vulnerable to welfare declines if their family network is not strong. In the regression, the coefficient on household size is significantly negative, indicating that larger households are more able to isolate consumption from income shocks. Therefore, we can conclude that aged and isolated households are very vulnerable.

The sign of education is somewhat puzzling. The existing literature usually finds that more educated households are more able to smooth consumption. Based on our field observations, this could be due to a fact that households with educated heads are on average richer than others so that they have a room to reduce consumption expenditure when hit by a negative shock without reducing the core components of consumption. The education variable became non-significant when additional variable of consumption level in 1996 was added in the regression, which support this interpretation.[13]

Other variables for income sources and land assets had a negative sign as expected. Therefore, households endowed with stable non-farm employment, remittance sources, and land assets are relatively more insulated from the perverse impacts of income declines. However, the coefficient on non-farm employment was not significant, probably because of additional risk associated with these jobs (see the discussion above on Table 7). The coefficient on land ownership dummy was highly significant both on total consumption changes and on food consumption changes, whereas that on land asset value was significant only on food consumption changes. This shows that a threshold effect of having any land is more important in smoothing consumption than a marginal effect of having additional land. The negative coefficient on regular remittance receipt suggests that remittances are important in coping with risk *ex post* (Alderman, 1996; Lucas and Stark, 1985).[14]

To examine whether or not the results in Table 8 were subject to a serious attrition bias, a probit model for sample selection was estimated in which the probability of successful resurvey was regressed on households' initial attributes (Appendix 2). The inclusion of an inverse Mills ratio to the models did not change the magnitudes and significance of coefficients in Table 8 and the coefficient on the inverse Mills ratio was not statistically significant at

[13]The consumption level in 1996 is not included in Z_i of Table 8 since it is endogenously determined by the same Z_i which are already included.

[14]Although it is significant only at 10% level in the total consumption equation and at 15% in the food consumption equation, it became significant at 1 to 5% levels when the dummy for non-farm full-time employees was deleted from the regression.

10%. Therefore, the attrition bias may not be serious in our case.

5 Conclusions

This paper empirically investigated vulnerability to risk as a characteristic of dynamic poverty in rural areas of the North-West Frontier Province, Pakistan, an area with high incidence of income poverty and low human development. Based on a two-period panel dataset, a household was defined as vulnerable to consumption risk if it had to drastically reduce its consumption level when hit by a negative income shock. To minimize possible biases due to measurement errors and endogeneity, which are likely to be severe in that kind of datasets, qualitative information on households' subjective assessment on risk is utilized to instrumentalize observed consumption and income changes.

Descriptive analyses based on transition matrix showed that, first, sample households are subject to high transient poverty in terms of income but the income variability is transferred to consumption variability only partially due to *ex post* risk-coping mechanisms; second, several households, who are excluded from these mechanisms, are prone to high risk of a substantial fall in consumption, a loss of land assets, and a drastic cut in children's school enrollment. Regression analyses with consumption change as a dependent variable showed that, first, households are more vulnerable to consumption poverty when they are hit by shocks in outside employment than by shocks in self-employment; second, the dynamically vulnerable group includes households led by the aged, with less land, and without regular remittance receipt.

Therefore, we could conclude that remittances, labor markets, credit access, and household assets are important determinants of households' vulnerability to consumption risk. The results suggest that these vulnerable households should be the target of poverty eradication and safety net policies. Without effective protection and promotion by public policies, these vulnerable households may not be able to come out of the poverty trap with low level of human and physical capital. Specific policies to achieve these tasks are beyond the scope of this paper. This paper's perspective is descriptive without formally modeling household and market behavior that generates the vulnerability of these households found in this paper. Theoretically modeling these aspects and empirically specifying the model to simulate possible impacts of any policy is left for further research.

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Table 1. Sample Villages and the Panel Data (NWFP, Pakistan)

	Village A	Village B	Village C
1. Village Characteristics			
Agriculture	Rainfed	Rain/irrig.	Irrigated
Distance to main roads (km)	10	4	1
Population (1998 Census)	2,858	3,831	7,575
Adult literacy rates (1998 Census)	25.8	19.9	37.5
2. Characteristics of Panel Households			
Number of sample households	83	111	105
Average household size			
in 1996	10.75	8.41	8.95
in 1999	11.13	7.86	9.30
Average farmland owned			
in 1996 (ha)	2.231	0.516	0.578
in 1999 (ha)	2.258	0.517	0.595
Average per capita income			
in 1996 (nominal US$)	194.4	231.2	336.6
in 1999 (nominal US$)	147.8	164.7	211.6
Average per capita consumption			
in 1996 (nominal US$)	134.4	157.0	200.8
in 1999 (nominal US$)	133.5	143.1	198.3

Notes: (1) "Average per capita income (consumption)" are averages based on individuals. They were calculated as household averages with household size as weights.
(2) "Average farmland owned" is an average over all the sample households.

Table 2. Transition Matrix of Consumption Poverty

	Status in 1999					
Status in 1996	$y_{it} < 0.5z$	$0.5z \le y_{it} < 0.75z$	$0.75z \le y_{it} < z$	$z \le y_{it} < 1.25z$	$1.25z \le y_{it}$	Total
Number of households						
$y_{it} < 0.5z$	19	26	11	1	1	58
$0.5z \le y_{it} < 0.75z$	15	44	18	11	10	98
$0.75z \le y_{it} < z$	7	26	23	5	5	66
$z \le y_{it} < 1.25z$	2	8	16	6	7	39
$1.25z \le y_{it}$	3	12	5	4	14	38
Total	46	116	73	27	37	299
Transition probability (%)						
$y_{it} < 0.5z$	32.8	44.8	19.0	1.7	1.7	100.0
$0.5z \le y_{it} < 0.75z$	15.3	44.9	18.4	11.2	10.2	100.0
$0.75z \le y_{it} < z$	10.6	39.4	34.8	7.6	7.6	100.0
$z \le y_{it} < 1.25z$	5.1	20.5	41.0	15.4	17.9	100.0
$1.25z \le y_{it}$	7.9	31.6	13.2	10.5	36.8	100.0

Table 3. Changes in Real Consumption Expenditure Per Capita

	Total consumption	of which: Food	of which: Non-food
In 1996 Rs.			
All the sample households	40	287	-247
"Always poor" households	169	329	-160
"Impoverished" households	-3324	-2087	-1237
"Always non-poor" households	958	910	48
In % change			
All the sample households	0.7	6.6	-16.0
"Always poor" households	4.5	11.5	-17.4
"Impoverished" households	-44.1	-38.6	-57.8
"Always non-poor" households	9.0	12.0	1.6

Notes: Since there are 106 households other than "Always poor" (104 households), "Impoverished" (58 households), and "Always non-poor" (31 households), the weighted average of the three categories is not equal to the figures reported for "All the sample households."

Table 4. Changes in Real Household Income Per Capita

	Total income	of which: Crop S.E.	Livestock S.E.	Farm wage	Non-farm S.E.	Non-farm wage	Unearned income
In 1996 Rs.							
All the sample	-1920	133	-446	-147	-897	-820	257
"Always poor"	-1229	102	-280	-279	-304	-844	376
"Impoverished"	-3248	127	-546	-112	-2063	-995	341
"Always non-poor"	-5386	718	-1797	607	-2236	-1823	-854
In % change							
All the sample	-22.8	14.0	-47.2	-27.0	-38.9	-28.3	32.2
"Always poor"	-23.0	29.6	-54.7	-40.2	-33.8	-30.4	288.1
"Impoverished"	-37.8	22.0	-68.3	-21.8	-64.2	-36.9	42.4
"Always non-poor"	-28.4	26.2	-58.0	1078.2	-35.0	-44.6	-32.6

Note: "S.E." is short for self-employment income.

Table 5. Changes in Real Household Assets

	Total	of which:		
		Monetary	Livestock	Farmland
In 1996 Rs.				
All the sample	-13005	-1081	-5269	-6654
"Always poor"	-4707	-1848	-3408	549
"Impoverished"	-57516	15109	-3906	-68719
"Always non-poor"	-107946	-57817	-13596	-36533
In % change				
All the sample	-3.6	12.3	-37.2	-1.9
"Always poor"	-2.0	20.6	-29.2	0.2
"Impoverished"	-29.3	-120.2	-37.9	-26.1
"Always non-poor"	-7.8	-240.6	-53.1	-2.7

Notes: (Monetary assets) = (Formal credit to financial institutions, outstanding) + (Informal credit to others, outstanding) – (Formal debt to financial institutions, outstanding) – (Informal debt to others, outstanding).

In 1996, on average, monetary assets were negative (net debtor) for "All the sample households," "Always poor households," and "Impoverished households" but positive (net creditor) for "Always non-poor households." In 1999, on average, "All the sample households" and "Always poor households," remained net debtor whereas "Impoverished households" turned into net creditor and "Always non-poor" households turned into net debtor. Very negative numbers for these two classes in % change indicate the change of this status.

Table 6. Changes in Primary School Enrollment

	Enrollment rate of the cohort with age 6 & 7 in 1996		
	Age 6 & 7 in 1996	Age 9 & 10 in 1999	Change
Total children (%)			
All the sample	44.1	38.2	-5.9
"Always poor"	30.0	32.9	2.9
"Impoverished"	44.4	32.3	-12.2
"Always non-poor"	78.6	76.9	-1.6
Males (%)			
All the sample	57.1	62.2	5.0
"Always poor"	38.3	48.5	10.2
"Impoverished"	66.7	66.7	0.0
"Always non-poor"	66.7	100.0	33.3
Females (%)			
All the sample	29.3	18.7	-10.6
"Always poor"	20.9	18.9	-2.0
"Impoverished"	22.2	0.0	-22.2
"Always non-poor"	87.5	62.5	-25.0

Notes: The size of cohort "Age 6 & 7 in 1996" is 211 for the total panel households. Enrollment in this table is defined as the number of school-going children divided by the total number of children belonging to the same cohort in two surveys.

Table 7. Probit Estimation Results for Vulnerability and Income Shocks

	Parameter estimate	Standard error		$\partial\pi/\partial Z$
Intercept	-1.559	(0.158)	***	
Reasons/factors for negative shock (Z)				
Bad crop harvest	1.082	(0.200)	***	0.257
Bad prices for farm product	0.832	(0.242)	***	0.197
Low wages from outside employment	1.378	(0.277)	***	0.327
Lost jobs in outside employment	1.114	(0.286)	***	0.265
Remittances declined	1.482	(0.509)	***	0.352
Bad business in non-farm self-employment	0.141	(0.499)		0.033
Others	0.804	(0.213)	***	0.191
Log-likelihood	-126.648			
LR statistics for zero slope	118.995	***		
Fraction of correct prediction	0.819			

Notes: The dependent variable (π) is the probability of a household replying that they had to reduce food consumption or to reduce children's enrollment due to negative shocks (see Appendix 1). The number of observations is 299, among which 94 replied yes. Standard errors were computed from analytical second derivatives (*** significant at 1%).

Table 8. Consumption Changes and Households' Initial Attributes

	Total consumption			Food consumption		
α_v: Village dummies						
Village A	169.9	(185.4)		545.7	(128.6)	***
Village B	311.0	(99.8)	***	478.5	(73.6)	***
Village C	919.5	(145.2)	***	847.3	(132.7)	***
b_1: Coefficients on Δx_i when $\Delta x_i > 0$						
Intercept	0.508	(0.251)	**	0.453	(0.233)	*
Household size	-0.007	(0.014)		-0.002	(0.009)	
Dependency ratio	-0.464	(0.233)	**	-0.358	(0.173)	**
Age of household head	-0.001	(0.005)		-0.002	(0.004)	
Dummy for non-farm full-time employees	-0.102	(0.109)		-0.096	(0.091)	
Dummy for regular remittance receipt	-0.147	(0.091)		-0.055	(0.080)	
Land ownership dummy	0.063	(0.121)		0.032	(0.094)	
Land asset value	0.080	(0.095)		0.059	(0.080)	
Education of household head	-0.014	(0.017)		-0.008	(0.013)	
b_2: Coefficients on Δx_i when $\Delta x_i < 0$						
Intercept	0.149	(0.087)	*	0.156	(0.067)	**
Household size	-0.008	(0.003)	***	-0.002	(0.002)	
Dependency ratio	-0.261	(0.097)	***	-0.237	(0.085)	***
Age of household head	0.005	(0.002)	***	0.003	(0.001)	***
Dummy for non-farm full-time employees	-0.028	(0.049)		-0.059	(0.042)	
Dummy for regular remittance receipt	-0.117	(0.066)	*	-0.064	(0.044)	
Land ownership dummy	-0.193	(0.046)	***	-0.174	(0.036)	***
Land asset value	-0.002	(0.002)		-0.003	(0.002)	**
Education of household head	0.018	(0.006)	***	0.014	(0.004)	***
R^2 based on transformed data	0.443			0.349		
F statistics for zero slope	11.040	***		7.456	***	

Notes: Estimated by a two-stage weighted least squares method with household size as a weight. Dependent variables are instrumentalized by household attributes in 1996 and dummy variables for "Adjustment to positive shock if any" and "Adjustment to negative shock if any." Δx_i is instrumentalized by household attributes in 1996 and dummy variables for "Reasons/factors for positive shock" and "Reasons/factors for negative shock." The number of observations is 299. Huber-White heteroscedasticity consistent standard errors are reported in the parenthesis, with *** significant at 1%, ** at 5%, and * at 1%.

Appendix 1. Definition and Statistics of Variables Used in Regression

Name, definition, and unit	Mean	Std.Dev.
Income and consumption changes from 1996 to 1999		
Change in total consumption per capita (in 1996 Rs.)	40.2	3268.8
Change in food consumption per capita (in 1996 Rs.)	287.4	2591.7
Δx = Change in household income per capita (in 1996 Rs.)	-1919.8	7578.4
Households' initial attributesin (those in 1996)		
Household size (in numbers)	9.247	5.273
Dependency ratio (number of dependents divided by the household size)	0.453	0.205
Age of household head (years)	49.7	16.6
Dummy for non-farm full-time employees	0.482	
Dummy for regular remittance receipt	0.054	
Land ownership dummy	0.515	
Land asset value (1,000,000 Rs.)	0.511	2.305
Livestock value (1,000,000 Rs.)	0.014	0.031
Net monetary asset (1,000,000 Rs.)	-0.009	0.062
Other asset value (1,000,000 Rs.)	0.019	0.077
Education of household head (years)	2.211	3.844
Reasons/factors for unanticipated positive shock		
Good crop harvest	0.278	
Good prices for farm product	0.174	
High wages from outside employment	0.070	
Gain jobs in outside employment	0.070	
Remittances increased	0.050	
Good business in non-farm self-employment	0.067	
Others	0.050	
Reasons/factors for unanticipated negative shock		
Bad crop harvest	0.284	
Bad prices for farm product	0.137	
Low wages from outside employment	0.107	
Lost jobs in outside employment	0.107	
Remittances declined	0.023	
Bad business in non-farm self-employment	0.030	
Others	0.217	
Adjustment to the positive shock if any		
More food consumption	0.268	
More durable goods consumption	0.140	
Worked less hours	0.013	
Save in banks, pay back loans to banks	0.003	
Gold & jewelry purchase	0.003	
Livestock purchase	0.017	
Land purchase	0.013	
More grain storage	0.134	
Helped others through loans, including debt repayment	0.050	
More education to children	0.033	

(continued)

Appendix 1. Definition and Statistics of Variables Used in Regression (continued)

Name, definition, and unit	Mean	Std.Dev.
Adjustment to the negative shock if any		
Less food consumption	0.311	
Less durable goods consumption	0.140	
Worked more hours	0.017	
Dis-save in banks, obtained loan from banks	0.017	
Gold & jewelry sale	0.007	
Livestock sale	0.027	
Land sale, including mortgage	0.010	
Less grain storage	0.130	
Helped by others through informal loans, etc.	0.311	
Less education to children	0.013	

Note: The statistics are for the complete panel households. Therefore, the number of observations is 299. For dummy variables, the table reports the ratio of households whose dummy variable is one.

Appendix 2. On Attrition Bias

Let the indicator variable $d_i = 1$ if y_{i2} is observed in period 2 and $d_i = 0$ otherwise. Suppose that y_{i2} is observed if the latent variable

$$d_i^* = \gamma R_i + \epsilon_i \geq 0, \tag{2}$$

where R_i is a vector of variables including Z_i and other identifying variables W_i and ϵ_i is a standard normal error. Then the probability of non-attrition is a probit function given by

$$Prob(d_i = 1) = \phi(\gamma R_i), \tag{3}$$

where $\phi(.)$ is the standard normal distribution function. The probit model was estimated by maximum likelihood, yielding the following table. Results show that attrition occurred more for households living in Village A and whose heads were more educated. Other household attributes are not statistically significant.

	Coef.	S.E.	dP/dX
Intercept	1.307	0.409 ***	0.272
Village A dummy	-0.655	0.210 ***	-0.136
Village B dummy	0.541	0.266 **	0.113
Household attributes in 1996			
Household size	-0.011	0.020	-0.002
Dependency ratio	0.262	0.473	0.055
Age of household head	-0.001	0.006	-0.000
Dummy for non-farm full-time employees	-0.045	0.189	-0.009
Dummy for regular remittance receipt	-0.387	0.337	-0.081
Land ownership dummy	-0.114	0.205	-0.024
Land asset value	0.095	0.152	0.020
Net monetary asset	-0.290	1.668	-0.060
Other asset value	3.362	3.376	0.701
Livestock value	4.593	4.843	0.958
Education of household head	-0.052	0.024 **	-0.011
Number of observations	355		
Log likelihood	-133.4		
LR test for zero slopes	42.70	***	
Fraction of correct prediction	0.848		

Note: Standard errors were computed from analytical second derivatives.