

Shocks as a Source of Vulnerability: An Empirical Investigation from Pakistan

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The objective of this paper is to investigate the incidence of different types of shocks in rural Pakistan and identify the household characteristics that are associated with this phenomenon. It is observed that one-third of households experience an adverse shock, be it natural/agricultural, economic, social or relating to health. The natural/agricultural shocks have major share in the total burden of shocks while the households' coping mechanism is overwhelmingly informal and largely asset-based. The poorest of the households adopt behaviour-based strategies like reducing food consumption, employ child labour, work more hours etc. Overall, households of with less educated heads, high dependency ratio, large household size, low welfare ratio, farm household, ownership of land and residing in south Punjab or Sindh are more vulnerable to suffer shocks, particularly of income. Vulnerability in terms of a decline in consumption is observed for households who are hit by natural/agricultural or health shocks. For all these reasons, a gradual shift from traditional emergency relief measures towards ex-ante actions to reduce and mitigate hazard impacts should be encouraged along with non-exploitative credit and more effective safety nets.

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1. INTRODUCTION

Households in developing countries are frequently hit by severe idiosyncratic shocks and covariate shocks which result in welfare loss not only directly but also as a consequence of the costly measures used by households to protect consumption from such shocks including less risky but also less profitable agricultural investment [Fafchamps (2009)]. The emphasis on the impact of shocks to consumption leads to the concept of vulnerability analysis. The inability to avoid welfare declines when hit by exogenous shocks can be called vulnerability. The extent of vulnerability depends on the level of underlying shock, the ability to cope with shock management strategies, and long-term income generating capacity [Chaudhuri (2003)]. Some of these shocks can have long-lasting effects in terms of perpetuating and increasing poverty and in adverse human development outcomes [Foster (1995) and Jacoby and Skoufias (1997)]. In developing countries where financial and insurance markets are incomplete or even

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absent, poor households are exposed to a variety of risks resulting in high income volatility [Baulch and Hoddinott (2000); Dercon (2002); Paxson (1992)]. In this context, such households may attempt to smooth income *ex ante* in the expectation of natural disasters. For instance, farmers can choose crop portfolios to reduce exposure to risk [Kurosaki and Fafchamps (2002)] or allocate more of their labour to non-agricultural activities when weather risk in agricultural production is high [Ito and Takashii (2009)].

Shocks emanating from different sources may result in economic or non-economic loss spread across space and time, and may differ in frequency, duration, intensity and scope. The typology of shocks typically classified and based on scope are idiosyncratic and covariate. Households' idiosyncrasy shocks comprise household-specific shocks such as illness, injury, death, job loss, crop failure and loss of transfers which are compounded by lack of financial intermediation and formal insurance, credit market imperfections and weak infrastructure, while covariate shocks such as weather adversity and market fluctuation tend to have an impact on a larger group of population in the same area at the same time [Dercon (2006)]. All these shocks can potentially contribute to high income volatility of the households. Proper conceptualisation and characterisation of the underlying dynamic process is thus imperative from both theoretical and policy perspectives.

To generate well-being in response to negative affect of shocks, households have tangible (natural, human, physical and financial capital) and intangible social capital in the form of proximity to markets, health and education facilities and empowerment at their disposal. More specifically, human capital refers to the household members' education and their health status while physical capital is related to productive assets such as land, tools, equipment and work animal, and household assets like housing and household services, livestock, food and jewellery. Finally, financial capital refers to cash, savings, and access to credit. Intangible assets consist of social capital, the proximity to market, health and education facilities and empowerment. Both types of assets are important in the context of risk management [Siegel and Alwang (1999)].

Shocks can also be divided into following categories: natural/agriculture; economic; political/social/legal; crime; health; and life-cycle shocks. Natural/agriculture shocks include earthquake, flooding, erosion, pestilence affecting crops or livestock. Economic shocks include business closures, mass layoffs, job loss, wage cuts, loss of remittances. Political/social/legal shocks include court cases and bribery, long duration general strikes, violence, crime and political unrest while health shocks include death, injury and illness. The presence of these risk and shocks can distort household's inter-temporal resource allocation behaviour which can be economically costly and may propel households into chronic poverty.

Households can smooth consumption not only across space but also over time by saving and borrowing or by accumulating and selling non-financial assets. In developing countries poor households may have difficulties in adopting these strategies because they have limited or no access to formal credit markets and they may find it hard to save or be cautious in running down assets to smooth consumption. Moreover, households may choose inputs and production techniques that reduce variability or may diversify income sources. These strategies may have long term consequences when risk leads poor households to choose safe but less profitable choices or to reduce investment in human

capital, thereby increasing the gap between the rich and the poor and pushing poor households into the poverty trap [Alderman and Paxson (1994)].

The number of natural disasters reported appears to be increasing globally—it was less than 100 per year in the mid-1970s while it was approximately 400 per year during the 2000 (EM-DAT).² Pakistan is classified as being extremely vulnerable to natural disasters due to its geographical location, the frequency of their occurrence, and the number of affected people. The top 10 natural disasters occurred during the period 1900 to 2013 out of which, fifth, seventh, and eighth disasters in the top10 category occurred during the 1990s and 2010s, respectively, of which floods and earthquakes were major disasters.

Recently, in Pakistan earthquake, flood and drought have caused tremendous damage to livelihoods and infrastructure, with severe implications for food security; earthquake 2005, 2010 flood and 2014 drought/famine resulted in the great losses to human life, agriculture and livestock. In this background, the role of risks, shocks and vulnerability in perpetuating poverty is important because poor households are relatively more negatively affected by uninsured shocks, as they are likely to lack the necessary human and physical capital to recover from them. In Pakistan incidence of poverty in 2010 was 20.7 percent: 22.4 percent in rural areas and 16.6 percent in urban areas [Arif and Shujaat (2014)]. They are not only suffering from average low consumption but also are subject to high fluctuations in consumption due to income risk and the lack of safety net measures. In rural areas, permanent non-farm employment is associated with the exit from poverty while education is key to such employment. Livestock is more pro-poor than crop agriculture but its role in economic growth may be limited. Social safety nets are weak; especially those provided by formal institutions, while private networks based on personal relations are more important safety nets [Kurosaki and Khan (2001)]. Since the majority of households in Pakistan depend on agriculture for their livelihoods, frequent droughts, floods, and other unexpected adverse events such as illness, loss of job, and conflicts, can lead to loss of their income and assets. While doing nothing is an option in the wake of a shock, many also tend to use several coping strategies including informal insurance, savings, loans, receiving aid and remittances, reducing consumption, and liquidating assets to at least sustain their welfare levels maintained prior to the shocks.

Improving the understanding of shocks at household level is an issue of increasing importance for Pakistan. This is particularly true for natural disaster related covariate shocks. There is limited knowledge of their incidence and the coping mechanisms adopted by households to deal with them [Heltberg and Niels (2009); Alderman (1996)]. Given the significance of risk and uncertainty associated with, policy-makers are required to incorporate shocks into their economic development strategies for quick reduction of poverty in Pakistan. In this scenario this study attempts to fill these gaps in the literature by investigating the following questions: What types of shocks most frequently affect households? Which households are more vulnerable to natural disasters such as floods and droughts? Which region is more affected by these types of shocks? What are the socio economic characteristic of the households hit by (self-reported) shocks? Finally, what are risk management strategies adopted by these households?

²<http://www.emdat.be/natural-disasters-trends> (accessed on April 17, 2015).

In this scenario the study has four main objectives related to shocks, vulnerability and coping mechanism: (i) to highlight frequency and severity of different types of shocks that affected the households in 2006-2010; (ii) to examine the correlation structure of shocks at village level; (iii) to assess the probability of occurrence a shock by a multivariate analysis; and (iv) to analyse which type of households in rural Pakistan are more vulnerable to shocks in terms of a decline in their consumption during such disaster.

The rest of the paper is structured as follows: the next section will provide review of the literature on shocks in developing countries. Section 3 lays out details of the data and methodology used for the paper and Section 4 discusses results in detail. Section 5 concludes the study.

2. REVIEW OF LITERATURES

In developing countries increased focus on risk and vulnerability motivated a series of studies aimed at theoretically conceptualising and empirically measuring household vulnerability to shocks. This section begins with a brief review of available literature on risk, shocks and vulnerability in Pakistan.

As one of the dimensions of vulnerability, Kurosaki (2006) investigates the inability of rural dwellers to cope with negative income shocks in KP province of Pakistan. Estimated results show that the ability to cope with negative income shocks is lower for households that are aged, landless and do not receive remittances regularly. While illustrating various measures of vulnerability proposed in the literature Kurosaki (2009) applies it to a panel dataset collected in rural Pakistan. The empirical results show that different vulnerability rankings can be obtained depending on the choice of the measure. By utilising these measures, it can be identified who and which region is more vulnerable to a particular type of risk. This kind of information is useful in targeting poverty reduction policies. Kurosaki (2010) also investigates the measurement of transient poverty when each person's welfare level fluctuates due to exogenous risk. Theoretical results show that poverty measures associated with prudent risk preferences perform better than other measures in assuring that the value of transient poverty increases with the depth of chronic poverty.

Using a cross-section survey Heltberg and Niels (2009) mapped and quantified shocks from all sources, ex-post responses and outcomes for a sub sample of relatively poor Pakistani households. They found high incidence and the cost of shocks, with health-related shocks being the worst. Two-thirds of the sample experienced at least one major shock in the three years prior to the survey while more than half of the reported shocks were related to health and 75 percent of the most important shocks were idiosyncratic. These findings add to the evidence that health shocks often dominate and impose severe coping costs in terms of medical expenses while relying mostly on informal and ad hoc responses: informal borrowing, spending savings, and working more were the most frequently used responses.

The relationship between health and death risk and income decisions in rural Pakistan was explored by Jacobsen (2009). He showed how insurance against hospitalisation and accidental death influenced the purpose of micro credit loans. He found that individuals were more likely to maintain the same loan purpose as their previous loan if they were insured. Their results suggest that households that are insured

against hospitalisation and accidental death pursue less diversified income portfolios. Hidayat and Takashi (2007) attempted to quantify the ill-effects of covariate shocks such as natural disasters on the sustainability of microfinance in Pakistan. Based on the difference-in-difference approach, contrasting regions that were hit by the 2005 earthquake, and regions that were not, it was found that the delay in repayment in the affected areas was 52 percent higher than that in the unaffected areas. The observed difference in the repayment delay was decomposed into changes in borrowers' composition and borrowers' behaviour. The decomposition result showed that the changes in borrowers' behaviour accounted for a large portion of the difference, suggesting a serious difficulty faced by borrowers and microfinance institutions in the earthquake-hit regions.

The literature on natural hazards typically perceives disasters to be acts of God while restricting the examination of their causes to biophysical and geographical explanations. Yasir (2009) takes a different approach; first, he argues that disasters are socially constructed and, second, he situates the interactions of large-scale natural forces with local political-economic conditions within the context of vulnerability to contend that disasters are consequences of unresolved development challenges. Using the Pressure and Release (PAR) Model his paper suggests the usefulness of the concept of vulnerability that shapes local geographies of risk and weak institutions which transform and enhance the negative impact of 'natural' hazards into 'man-made' disasters.

An empirical model of profit variability at the individual farm level was proposed by Kurosaki (1995) and was applied to Pakistan's agriculture. Results show that adding idiosyncratic yield shocks and adjusting for input costs makes the variability of net profits much larger than implied by the variability of average gross revenues. It is also demonstrated that the correlation between green fodder profit and milk profit at the farm level is substantially negative. This negative correlation implies an advantage, in terms of risk diversification, of combining fodder and milk production in one enterprise, which is commonly observed in the mixed farming system in Punjab province.

Based on fieldwork, theoretical modeling and empirical testing of agricultural households in Punjab, Kurosaki (1997) found households' characteristics affecting their production choices and the relationship between the individual decisions and the incompleteness of the rural market structure. He also observed that with substantial income uncertainties, the sample farmers were unable to share the risk efficiently with the outside world and they therefore had to diversify the risk through individual means such as crop choice and livestock management. He also sheds new light on the positive role of livestock in enhancing the welfare of households, especially of small land holders.

Using three-year household data on production and consumption from the Punjab province, Kurosaki (1996), explored that the household's livestock holding contributed to a reduction in income variability through the negative correlation of livestock income with crop income and through ex-post decumulation of livestock assets contingent on realised income in the crop sector. His results suggested that the rises in the livestock share in agricultural value-added in Pakistan during the 1980s should have improved the welfare position of smaller farm households with substantial livestock holding through reduced income variability.

Substantial evidence of consumption smoothing as well as differences in savings propensities between the rich and poor households was explored by Alderman (1996), using a three year panel data from Pakistan indicating that even poor households, use credit markets to maintain consumption in the presence of negative income shocks.

Displacement gives rise to particular vulnerability for those affected by shocks, necessitating special measures for assistance and protection that correspond to those vulnerabilities. The factors that have caused internal displacement in Pakistan in the recent past are a complex bunch and cannot be addressed by a one-size-fits-all approach. However, the official response has been largely reactive and characterised by a failure to formulate a comprehensive approach that focuses on preventing internal displacement, by avoiding conditions that may lead to displacement [Din (2010)].

This review of literatures on risk, shocks and vulnerability relating to Pakistan indicates direct implications for welfare loss due to health shock, agricultural shock and natural disaster that ultimately, translate into income shock.

3. MATERIALS AND METHODS

3.1. Data

Households in developing countries are frequently hit by severe idiosyncratic and covariate shocks, resulting in high income volatility. Pakistan being a low human development country, is frequently hit by major natural disasters, including earthquake of 2005 and flood of 2010 which resulted in huge human and economic losses. To study this scenario, panel household's survey is an important source of information but it is rarely available in developing countries. In Pakistan a three waves panel data set named 'Pakistan Rural Household Survey' is available. The first round, of Pakistan Rural Household Survey was done in 2001. The second round done in 2004 was restricted to two provinces Punjab and Sindh and the third round, renamed as Pakistan Panel Household Survey (PPHS)-2010, marked the addition of urban sample of four provinces. These longitudinal surveys were conducted by the Pakistan Institute of Development Economics with the financial assistance of the World Bank. This study is based on 'PPHS-2010' which covers all four provinces (Punjab, Sindh, Khyber Pakhtoonkhawa (KP) and Balochistan) with their urban and rural counterparts. The survey covered 16 districts³ from all four provinces of Pakistan. The household survey questionnaire consists of two parts; a male questionnaire and a female questionnaire. The male questionnaire constitutes thirteen modules while female questionnaire has twelve modules. The total sample size of PPHS-2010 was 4142 households; 2800 in rural and 1342 in urban while Punjab 1878, Sindh 1211, KP 601 and Balochistan 452.

The data used in this paper are based on a household-level 'Risk response module' included in PPHS-2010 and similar to that developed in Hoddinott and Quisumbing (2003), but modified for the Pakistan context. The module administered only in PPHS-2010 round, asks households to report any unexpected events that were outside of their control and caused a drastic reduction in income during the last five years prior to the

³Punjab: Faisalabad, Attock, Hafizabad, Vahari, Mazaffargarh; Sindh: Badin, Nawab Shah, Mirpur Khas, Larkana, KP: Dir, Mardan, Lakki Marwat, Balochistan: Loralai, Khuzdar and Gwadar.

survey i.e. 2006-2010. The survey provides information on data by year and type of disaster to provide a check for the consistency between the self-reported shocks and on the actual occurrence of such shocks. These reported shocks are divided into a four broad categories: natural/agricultural; economic; social (political/social/legal); and health/life-cycle shocks that inflict welfare loss. Natural/agricultural shocks include flooding, drought, fire, earthquake and crop failure. Economic shocks include business closures, mass layoffs, job loss, wage cuts, loss of remittances and other reasons. Social shocks in Pakistan include court cases and bribery, long duration general strikes, violence, crime and political unrest. Health/life-cycle shocks include death, injury and illness. The survey distinguishes between death or illness of the primary income earner and other household members. The respondents were also asked whether the household was affected by idiosyncratic (household-specific) shocks or covariate shocks that affected larger group of population in the same area at the same time and to report the monetary value of the cost of shock. The frequency and intensity of major disasters is also of great relevance to the recovery of households. Finally, households were also asked about the four important coping strategies to manage the reduction in income such as sale of assets including land, livestock and stored crop, decrease food consumption, increase labour supply particularly of women and children, saving, borrowing and assistances from friends and relatives, etc. The present analysis has used this information on the shocks and coping strategies together with socio-economic characteristics (i.e., individual characteristics such as sex (if male=1), age in years and formal years of education) and household characteristics, like household size in numbers (taken as adult equivalent), dependency ratio,⁴ per capita consumption expenditure (to be precise, 'per capita' implies "per adult equivalence unit), poverty status,⁵ the ratio of female in the household size⁶ (working age 15-55 years), agricultural land ownership in acres, livestock ownership in numbers, access to formal credit (yes=1), household member abroad (yes=1), welfare ratio,⁷ sector of employment of household head (agriculture=1), changes in agriculture landownership in acres and livestock ownership used as proxy of assets and welfare ratio (between 2004 and 2010). In addition to individual and household level characteristics, place of residence like Punjab and Sindh (yes=1) provinces also included. Since there is a socioeconomic gap and a difference in historical legacies between the northern and southern parts of Punjab, the analysis divided Punjab into two portions, north and south (yes=1) regions.

As reported earlier the self-reported shocks occurred between 2006 and 2010. To assess the relationship between socio-economic characterise and exposure to specific type of shocks, the data on such characteristics is used from a prior wave of the panel survey, PRHS-2004. Since the PRHS-2004 was restricted to only rural areas of two provinces, Punjab (48 villages) and Sindh (46 villages), this paper has used a sub-sample of the PPHS-2010 consisting of two provinces, Punjab and Sindh. However, the frequency of

⁴The dependency ratio takes the sum of the population under the years of 15 and over 64 and divided by the population in the intermediate range of 15-64.

⁵The poor are defined as a household with per adult equivalent consumption expenditure below the poverty line Rs 878.64 and Rs 1671.89 per month for the year 2004 and 2010, respectively [Arif and Shaujaat (2014)].

⁶Women make essential contributions to the agricultural and rural economies in all developing world.

⁷Welfare ratio is defined as consumption expenditure per adult equivalent divided by poverty line in the respected year.

shocks and their spread are reported for the whole sample of PPHS-2010 as well as the sub-sample of rural Punjab and Sindh.

3.2. Method of Analysis

This section will discuss methodologies to analyse the occurrence of shocks that lead to loss of household income, reduction in consumption, loss of productive assets, and serious concern/anxiety about household welfare:

- (i) Bivariate analysis; (ii) Correlation structure of shocks; (iii) Multivariate analysis; and (iv) Fixed effect model.

In bivariate analysis simple cross tabulation with row or column percentage is presented to analyse the different types of shocks against socio-economic characteristics.

To understand the correlation structure of different shocks, factor analysis is applied which is a standard technique used to find the latent shocks that account for patterns of variation among observed shocks. Factor analysis is a method used to reduce the number of variables to a smaller number of underlying dimensions, with highly covariant variables loading on the same factor; a loading is the correlation between the variable and the component

In order to determine the characteristics of households which are likely to be affected by the occurrence of an adverse shock, a dichotomous dependent variable was constructed in this study which would be equal to one if occurring, five years preceding the survey would lead to loss of household welfare and would be equal to zero otherwise. Because the indicator is dichotomous, a logistic regression model was estimated. This model makes it possible to estimate the probability of a shock conditional on independent variables. In the same way a probability of natural/agricultural shock is also estimated.

To construct the broad group of shocks, households were classified into three groups- those that had not suffered any type of shock, those who face an income shock (natural/agriculture and economic shocks) and those who had an event of societal shock (health and social shocks). Because the variable is trichotomous, the multinomial logistic regression model is estimated. The independent variables are classified into three groups: individual, household and community-level factors for the estimation of this model.

Finally, for rural households, vulnerability in terms of a decline in their consumption is investigated when their village is hit by shocks such as floods and droughts, etc. Fixed effect (FE) model is used to explore the relationship between predictor and outcome variables within an entity (village). Each entity has its own individual characteristics that may or may not influence the predictor variables. When using FE it is assumed that something within the individual may impact or bias the predictor or outcome variables and which need to control for this. This is the rationale behind the assumption of the correlation between entity's error term and predictor variables. FE remove the effect of those time-invariant characteristics so we can assess the net effect of the predictors on the outcome variable. The standard Fixed Effect model is estimated as:

$$y_{it} = x'_{it}\beta + z'_i\alpha + \varepsilon_{it}$$

There are K regressors in x_{it} , not including constant term. The heterogeneity, or individual effect is $z_i'\alpha$ where z_i contains a constant term and a set of individual or group specific variables, which may or may not be observed. If z_i is observed for all individuals, then the entire model can be treated as an ordinary linear model and fit by least squares. If z_i is unobserved, but correlated with x_{it} , then the least squares estimators of β is biased and inconsistent as a consequences of omitted variables. However, in this instant, the model:

$$y_{it} = x_{it}'\beta + \alpha_i + \varepsilon_{it}$$

Where $\alpha_i = z_i'\alpha$, takes all the observable effects and specifies an estimable conditional mean. This fixed effects approach takes α_i to be group specific constant term in the regression model. The term ‘fixed’ effect as used here, indicates that the term does not vary over time [Greene (2003)].

The present analysis takes the specification of fixed effect model as:

$$dlnc_{2010-2004} = \alpha_i + \beta \cdot H_{iv,2004} + \gamma \cdot S_{iv,2010} + \varepsilon_{iv}$$

where

$dlnc$ is the outcome variable (namely, change in log real per capita consumption of household i in village v between 2004 and 2010), α_i the group specific constant term for each village, $\gamma \cdot H_{iv}$, is a vector of variables of household and socio-economic characteristics in 2004, $\beta \cdot S_{iv}$ shocks to households experienced between 2004 and 2010, and ε_{iv} is an error term.

4. EMPIRICAL RESULTS

4.1. Shocks and Coping Mechanisms: A Descriptive Analysis

In this section the data on the distribution of shocks in the sample are illustrated. The objective is to present a description of what kinds of shocks occurred, who was affected by them and what kind of coping mechanisms were adopted.

The section defines the frequency, category, costliness and impact of shocks as reported by the sample households occurred during five years (2006-2010) preceding the survey. The sample households also identified the main coping strategies and several other details of the shocks including whether the event affected only the individual household (idiosyncratic) or the entire community (covariate shocks).

As reported in Table 1, almost one-third (33.4 percent) of the sample households experienced one most severe shock over the five-year recall period. The most common types of shocks are natural/agriculture related (55.9 percent of total) and health shocks (33.7 percent) which have resulted in major fall in income. The natural/agriculture events include loss of personal and business assets due to natural disaster, crop failure, loss of livestock and drop in crop income while health shocks comprise illness or disability and death of an income earner or other family members. Far less frequent are economic (2.0 percent) and social shocks (8.4 percent). The economic shocks consist of loss of personal or business assets due to violence or conflicts, business failure due to low sale/demand, unsuccessful investment and job loss while social shocks comprise internally displaced person and other social shocks including land or family dispute, etc.

Table 1

Extent of Shocks by Selected Shocks in Rural Pakistan (%)

Type of Shock	Reported Shocks	How Widespread was this Shock?				All
		Only Affected this Household	Affected few Households	Affected many Households	Affected Almost every Households	
		Idiosyncratic	□	□	Covariate	
Natural/Agriculture	55.9 (18.8)	21.7	8.1	19.4	50.7	100
Economic	2.0 (0.8)	74.2	25.8	0	0	100
Social	8.4 (2.5)	79.3	16.2	4.4	0	100
Health	33.7 (11.3)	91.4	4.0	1.6	3.1	100
Overall	100 (33.4)	51.1	7.7	11.7	29.4	100

Source: Computations are based on the micro data of PPHS-2010.

While analysing the spread of shocks, it is observed that the risk of shock may emanate from two broad sources: idiosyncratic shocks; or covariate shocks. Covariate shocks i.e., community level shocks, are typically natural disasters like floods, draughts and pest attack which affect agriculture production severely and potentially contribute to high income volatility of households. It is indicated that natural and agriculture shocks contribute a major share in covariate shocks. Household's idiosyncratic shocks that are household specific are shocks such as death of principal income earner, chronic illness or unemployment/underemployment etc. Health shock added 91.4 percent share in this category. Health shocks may be having more importance because they affect the household's ability to produce and generate income. These types of shocks are fairly common in developing countries including Pakistan, mainly due to the absence of easy access to medical care, drinking water, unhygienic living conditions, and limited opportunities for diversifying income sources. These difficulties are compounded by lack of financial intermediation and formal insurance, credit market imperfections and weak physical infrastructure.

The effects of shocks are multi-dimensional and affect a variety of aspects of household welfare. Table 2 reports that all types of shocks invariably affect both poor and non-poor households while rural households are disproportionately exposed to natural and agricultural shocks and are less exposed to economic shocks, specific to a formal economy. As far as family headship is concerned, female headed households are more vulnerable to overall shocks and its impact varies from shock to shock indicating a high share of health shock that is 51.1 percent of total shock while male headed households get major welfare loss due to natural/agriculture shocks that is 51.6 percent of the overall impact of shock. The impact of different types of shocks classified by assets ownership shows that households which had ownership of land and livestock suffer a major welfare loss due to natural and agriculture shocks; 70.6 percent and 65.4 percent respectively.

Table 2

Incidence of Shocks by Household Characteristics: Rural Pakistan

Household Characteristics	Type of Shock (%)				Incidence of Shock (%)
	Natural/Agricultural	Economic	Social	Health	
Poor	47.4	3.9	10.9	38.1	31.7
Non Poor	58.2	1.6	7.7	32.6	35.6
Agri Household	65.5	15.9	53.9	45.9	55.8
Credit Access	56.2	2.0	7.7	34.2	42.0
Male Head HH	57.4	2.0	2.5	33.0	32.3
Female Head HH	32.8	0	8.0	59.1	47.9
Land Ownership	62.5	1.9	5.4	29.8	60.1
Livestock Ownership	84.2	34.8	73.8	74.6	79.1
Punjab	52.7	1.6	7.3	38.3	33.6
Sindh	61.8	2.4	8.0	27.9	41.3
Total	56.1	2.1	8.1	33.7	33.4

Source: Computations are based on the micro data of PPHS-2010.

The PPHS-2010 also provides information on data by year and type of disaster to make consistent with the self-reported shocks and with the information on the occurrence of such shocks as presented in Table 3. It is reported that 67.8 percent of all shocks are occurred in 2009-10 in which a major natural disaster in the form of flood was witnessed. It was the one of the largest floods in the history of Pakistan causing unprecedented damage and killing more than 1,700 people, affected over 20 million people; in undated almost one-fifth of the country's land. The estimated cost of the flood to the economy was \$9.7 billion in losses through damages to infrastructure, housing, agriculture and livestock, and other family assets.

Table 3

Major Shocks Occurred during the Last Five Years (%)

Year of Shock	Type of Shocks				Overall
	Nat/Agriculture	Economic	Social	Health	
2009-10	64.6	33.3	50.2	61.4	61.9
2008-09	22.3	46.4	21.8	19.3	21.9
2007-08	7.4	20.3	10.1	8.4	8.2
2006-07	2.5	0	12.8	11.0	5.9
2005-06	2.5	0	5.1	0.6	2.0

Source: Computations are based on the micro data of PPHS-2010.

The severity of shocks is elaborated in Table 4. The mean total cost of the most severe shock as reported by sample households, is Rs 10894.9 (or \$1230). This is equivalent to 40 percent of average per adult annual household expenditures in Pakistan. In respect of average cost of shock, social shocks (Rs 233456.9 per event) are the most expensive followed by natural/agricultural shocks (Rs 113093.9 per event), economic shocks (Rs 99217.4 per event) and health shocks (74900 per event). Because of their high frequency and high costs, natural/agricultural shocks caused by far the largest share in total cost of shocks comprising 58 percent of the total burden while health shocks took 23 percent of the total burden.

Table 4

Costs and Scope of Shock, by Type of Shocks

Type of Shocks	Cost of Shocks			Scope of Shocks	
	Mean Rupees per Shock	Standard Deviation	% of Total Burden *	Covariate % of Shocks in Category	Idiosyncratic % of Shocks in Category
Natural/Agri	113093.9	169925.6	58.6	78.3 (88.9)	21.7 (24.4)
Economic	99217.4	91088.9	1.8	20.3 (0.8)	79.7 (3.1)
Social	233456.9	380357.2	16.2	26.6 (4.1)	73.4 (11.1)
Health	74900.6	127709.1	23.4	9.1(6.2)	90.9 (61.4)
Overall	10894.9	185783.5	100	49.7	50.3

Source: Computations are based on the micro data of PPHS-2010.

*% burden of shock is computed by taking % share of reported shocks out of total cost.

In parenthesis percentage distribution of type of shocks are given.

Table 4 also highlights shocks according to scope indicating that the major share of idiosyncratic shocks originates from health shocks (90.9 percent) while a larger part of covariant shocks originates from natural/agricultural shocks (78.3 percent). Health insurance is also rare in Pakistan where out of pocket expenditures accounted for 71 percent of total medical expenses, compared to 13.2 percent in the United States. When a risk materialises and becomes a shock it causes a significant major income loss to these households. These shocks can be large and may trigger substantial consumption fluctuation which can have important consequences for household welfare in the short and long run.

The coping responses practised by households to deal with shocks are illustrated in Table 5. Survey respondents were asked how they managed the reduction in income caused by the most severe shock and about their use of saving, credit and assistance in general. It is observed that coping mechanisms are overwhelmingly informal and largely asset-based using savings, sale of livestock or borrowing. The ex-post coping strategies can be divided into four main categories: (i) asset-based strategies; (ii) assistance-based strategies; (iii) borrowing-based strategies; and (iv) behaviour-based strategies. These strategies can depend on formal or informal coping mechanisms.

Asset-based coping strategies are adopted by 54 percent households experiencing shocks. This coping mechanism includes use of saving and sale of assets such as agricultural land, livestock or stored crop. Saving is likely to be held in cash that constitutes 37 percent of assets-based strategy while sale of livestock and other assets (land or stored crop) contributes 52 percent and 11 percent respectively of all asset-based responses as reported in PPHS-2010. These assets are used primarily to cope with natural/agricultural and health shocks. Assistance-based strategies were reported to have been used for 10 percent of shocks; assistance is used largely to cope with health shocks (60.6 percent) and rarely to cope with economic shocks (2.1 percent). All types of assistance received by respondents come from relatives and friends while formal coping instruments (government/NGOs) are lacking. These findings are quite comparable with Heltberg and Niels (2009) who had reported the results of a novel survey of shocks, coping, and safety nets in Pakistan. They found high incidence and cost of shocks borne by these households and in the absence of formal and effective coping options they use mostly self-insurance and informal credit. Borrowing-based strategies are used by 18.7

Table 5

Ex-Post Coping Strategies by Type of Shocks: Rural Pakistan

Strategy	Type of Shocks				
	Natural / Agricultural	Economic	Social	Health	Total
Asset-based Strategies	58.9 (57.3)	1.5 (39.4)	7.3 (49.6)	32.3 (51.8)	100 (54.5)
Assistance-based Strategies	44.2 (7.9)	5.3 (25.8)	8.1 (10.1)	42.4 (12.5)	100 (10.0)
Borrowing-based Strategies	41.2 (13.8)	1.5 (13.6)	9.7 (22.5)	47.7 (26.3)	100 (18.7)
Behaviour-based Strategies	69.8 (20.9)	2.6 (21.2)	8.6 (17.8)	19.0 (9.4)	100 (16.8)
Total	56.1	2.1	8.1	33.7	100

Source: Computations are based on the micro data of PPHS-2010.

In parenthesis percentage distribution of types of strategies are given.

percent shock affected households. Credit is almost entirely informal, offered by friends (28 percent of all loans and credit), family (40 percent) and moneylenders (22 percent); formal credit sources such as banks or microfinance (10 percent) are of marginal importance for this analysis. Informal instruments of coping mechanism dominate across all strategies. Behaviour-based strategies such as consuming less, increasing labour supply or taking children out of school for work, were used as the primary coping response in 16.8 percent of the households when hit by the worst shocks. These type of coping strategies were practised more often for natural/agricultural shocks than for economic shocks. In addition, many households reduced food consumption, non-food consumption and increased labour supply of children or women in response to shocks as a secondary coping strategy.

Dynamics of poverty and type of shocks in rural Pakistan are presented in Table 6. It is observed that non-poor households are more affected by natural/agriculture shocks as they have productive assets like land and livestock which are at risk when any hazard occurred. Serious adverse natural/agricultural shocks affect households in a variety of ways, but typically the key consequences work through assets. Assets themselves may be

Table 6

Dynamics of Poverty and Type of Shocks: Rural Pakistan

Poverty Status	Type of Shocks				
	Natural/Agricultural	Economic	Social	Health	Total
Chronic Poor	51.1 (7.9)	6.8 (30.4)	9.7 (11.2)	32.4 (8.4)	8.8
Transient Poor	51.0 (16.3)	3.5 (31.9)	7.5 (18.0)	18.1 (18.1)	18.0
Transient Non-poor	46.6 (11.6)	1.6 (11.6)	8.9 (16.5)	42.9 (17.7)	13.1
Never Poor	61.3 (64.1)	0.9 (26.1)	7.0 (54.3)	30.9 (53.7)	60.1
Total	56.1	2.1	8.1	33.7	100

Source: Computations are based on the micro data of PPHS-2010. Figures in parenthesis are column percentages.

lost directly due to the adverse shocks—such as crop failure, loss of livestock, soil erosion, while assets also play a central role in attempts to buffer income fluctuations, and may therefore be used or sold, affecting the ability to generate income in the future. Likewise, chronic poor and transient non-poor households are relatively more suffered from health shocks which affect the possibility of income earning opportunities for households and a rise in health expenditure.

Shocks for the rich and poor against expenditure quintiles are presented in Table 7. Natural/agriculture shocks hit the upper two quintiles more than the bottom quintiles as the rich have land or livestock that are more vulnerable to natural disaster. Social shock makes the poor more vulnerable due to conflict/disputes, or funeral expenditure. Health shock affects the second quintile as compared to the richest households due to uninsured risk.

Table 7

Shocks for the Rich and Poor: Rural Pakistan

Type of Shock	Expenditure Quintiles 2004				
	Q 1 Poorest	Q 2	Q3	Q4	Q5 Richest
Natural and Agriculture	46.7	55.1	54.5	63.3	64.0
Economic	2.8	3.8	1.4	1.4	0.9
Social	10.0	8.5	6.8	9.3	3.3
Health	40.4	32.6	37.3	26.1	31.8
Main Coping Strategies					
Asset-based Strategies	50.2	43.8	54.1	63.5	61.1
Assistance-based Strategies	8.1	13.1	10.1	4.8	13.0
Borrowing- based Strategies	27.3	18.1	18.5	19.9	12.8
Behaviour-based Strategies	14.5	25.1	17.2	11.8	14.8

Source: Computations are based on the micro data of PPHS-2010.

Different types of coping mechanisms are also given against household's economic status indicating that the poorest bottom quintiles adopted behaviour-based strategies which include reducing food consumption, employing child labour, working more hours, etc. It is also observed that when a shock hits, the main strategy adopted by households is to use their assets in some way rather than to ask for help from friends and relatives, while private and public social safety nets exist but offer little effective protection. The poor are less resilient than the rich and the coping strategies used by the poor damage their prospects to escape poverty. Recent study shows that there are considerable poverty related movements depending on the type of shocks and degree of risk and uncertainty that households are faced with. Even if aggregate poverty levels remain constant over time, the share of the population which is vulnerable to poverty might be much higher [Azam and Katsushi (2012)].

4.2. Correlation Structure of Shocks

To measure the degree of covariance of the occurrence of a shock at a particular location all primary sampling units (PSUs) in which no one reported experiencing a shock in last five years were excluded from this exercise. First, the information on the incidence of the shocks at the level of the primary sampling unit was aggregated, and

then the proportion of households reporting the shock was estimated in each PSU. The present survey records information on 15 specific shocks, plus two catch-all categories; idiosyncratic or covariate.

The standard variance-covariance matrix can be used to find the pairs of shocks with the strongest association, i.e., ‘business failure—drop in income’ pair. The standard technique used to find the latent shocks that account for patterns of variation among observed shocks is factor analysis which is a method used to reduce the number of variables to a smaller number of underlying dimensions, with highly covariant variables loading on the same factor.

Table 8 presents the component loadings (i.e. a loading is the correlation between the variable and the factors) on the first five factors (whose eigenvalues are greater than one). The higher is the loading, the higher is the association between a variable and a factor. The present study employed factor analysis in which five components considered as ‘bunched-shocks’ are extracted. Factor one includes three health shocks illness/disability of household member, death of income earner and household member and loss of personal and business assets due to conflicts are positively correlated at village level. Factor two includes natural/agricultural shocks which contain, crop failure, loss of livestock due to disease or other causes and loss of personal assets due to natural disaster are moving in same direction while factor three consists of economic shocks including drop in crop income, unsuccessful investment and business failure due to low sale/demand. The three social shocks such as internally displaced persons, illness/disability of income earner and other social shocks are in fourth factor while in fifth factor two shocks related to loss of business assets due to natural disaster and job loss are correlated.

Table 8

<i>Bunched Shocks: Understanding the Correlation Structure using Factor Analysis</i>					
Shocks	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Illness/Disability of HH Member	.759	.006	-.080	.178	-.117
Death of other Household Member	.659	-.275	.336	.182	-.231
Death of an Income Earner	.600	.086	-.142	-.215	.319
Loss of Personal Assets _ Conflict	.548	.436	.012	-.215	.024
Loss of Business Assets _ Conflict	.494	.049	-.038	-.091	-.045
Crop Failure	.037	.766	-.034	-.091	-.043
Loss of Personal Assets _Natural Disaster	-.050	.701	.233	.037	-.134
Loss of Livestock _ Disease/ Causes	.251	.467	-.276	.168	.386
Drop in Crop Income	-.036	.030	.757	.128	-.048
Unsuccessful Investment	-.157	.055	.733	-.122	.215
Business Failure _ Low Sale/Demand	-.230	-.164	.340	.141	-.118
Illness/Disability of Income Earner	.066	.114	-.122	.643	-.107
Internally Displaced Persons	-.014	.557	.107	.562	.025
Other Social Shocks	.218	.478	.090	.553	-.056
Job Loss	.065	-.108	.061	.046	.833
Loss of Business Assets _ Natural Disaster	-.182	.014	.155	.034	.394

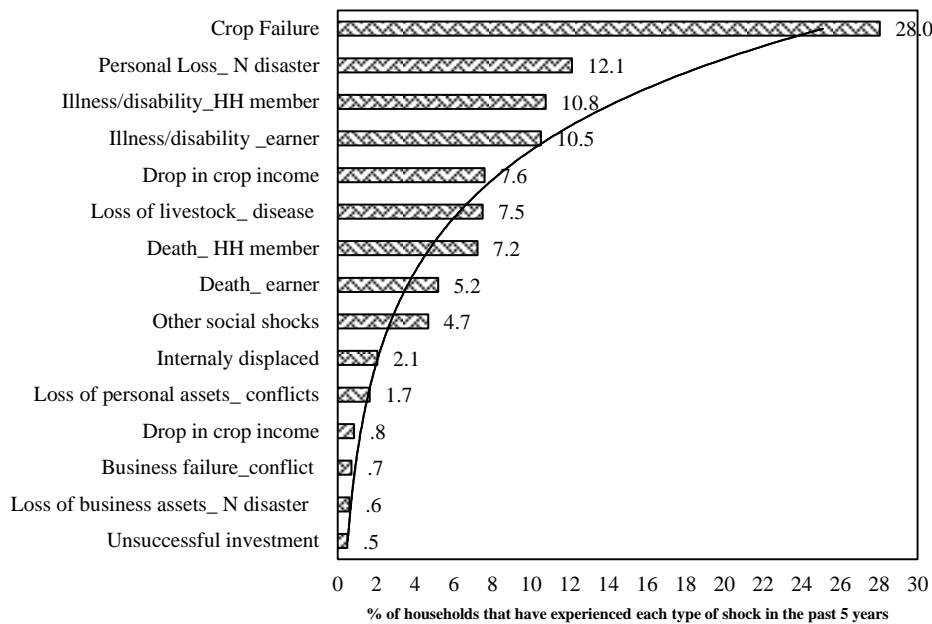
Source: Computations are based on the micro data of PPHS-2010.

Note: Only principal components with eigenvalues > 1 are shown.

Reported statistic: Factor loadings after oblique rotation.

The frequency distribution of these reported shocks are also given in Figure 1. It is observed that highest reported shocks are crop failure (28 percent) and personal loss due to natural disaster (12.1 percent) while third and fourth shocks are related to health shocks; disability/illness of household member (10.8 percent) and earner (10.5 percent). A significant number of households also reported death of earner (5.2 percent) and member (7.2 percent) of households. Economic shocks including job loss, low sale, loss in investment and loss in business have small share in total shocks.

Fig. 1. Sources of Shocks in Rural Pakistan (%)



4.3. Multivariate Analysis

The result of the shocks estimated through logistic regression models to determine factors influencing the incidence and occurrence of shocks are reported in Table 9. Models in this table represent an event of shock versus no shock which resulted in welfare loss due to decrease in income. The data on shocks have been taken from the risk response module of PPHS-2010. The shocks include natural/agricultural, social, economic and health which were faced by households during 2006 to 2010. It is important to highlight that most of the determinants of the occurrence of shock are however, themselves affected by shocks. For instance, while acquisitions of such assets as ownership of land and livestock have been taken as determinant of shock, they themselves could be influenced by shocks. Another vicious circle may exist between the poverty status of the household and different types of shocks. To overcome this issue a restricted sample of panel households of rural Punjab and Sindh provinces is used to observe the impact of 'pre-shock' socioeconomic characteristics in year 2004 on the probability of experiencing an adverse shock between years 2006 to 2010.

Three types of explanatory variables have been used: individual characteristics of the head of household i.e. sex, age and years of education; household characteristics including household size (as adult equivalents), female ratio in the household, dependency ratio, welfare ratio, productive assets such as agriculture land and livestock, poverty status (poor/non-poor), household member abroad, formal credit, sector of employment (agriculture/non-agriculture) and community level variable i.e., province (South Punjab/North Punjab and overall Sindh/North Punjab). In addition to these characteristics, the analysis also adds difference in assets (ownership of land and livestock) and welfare ratio between the 2004 and 2010 period.

Table 9

Effects of 2004 Socioeconomic Characteristics on the Probability of Experiencing a Shock between 2006 and 2010

Correlates (2004)	Model-1		Model-2	
	Shock/No Shock		Shock/No Shock	
	Coefficient	S.E	Coefficient	S.E
Male Headed Households	0.450**	0.190	0.430**	0.190
Age of HH Head	-0.002	0.002	-0.002	0.002
Head Education(Years)	-.015**	0.006	-0.013**	0.006
Household Size	0.048*	.006	0.043*	0.006
Dependency Ratio	0.007	0.030	0.007	0.030
Poverty Status	-0.032	0.059	0.032	0.059
Female Ratio	0.158	0.196	0.165	0.196
Welfare Ratio	-0.073*	0.024	-0.073*	0.024
Land Ownership (Acres)	0.012*	0.002	0.012*	0.002
Livestock Ownership (no)	0.014*	0.004	0.002	0.004
Credit Access	-0.253*	0.055	-0.251*	0.051
Member Abroad	-0.110	0.175	-0.110	0.248
Sector of Employment	0.317*	0.048	0.335*	0.066
South Punjab/North Punjab	0.718*	0.066	0.734*	0.066
Sindh/North Punjab	1.114*	.062	1.175*	0.062
Constant	-1.89	0.239	-1.746	0.241
Difference in Landholding	—	—	0.007*	0.003
Difference in Livestock	—	—	-0.025*	0.004
Difference in Welfare Ratio	—	—	-0.082*	0.022
LR Chi-square	511.77		662.29	
-2 Log likelihood	8946.7		7881.7	
Pseudo R ²	0.097		0.113	
Observations		1335		

Source: Computations are based on the micro data of PRHS-2004-05 and PPHS-2010.

*Significant at 1 percent, and ** Significant at 5 percent.

A glance at Model 1 reveals that a number of patterns emerge while using the panel households of rural Punjab and Sindh provinces. With respect to individual level characteristics, male headed households are more likely to experience a shock as compared to female headed households. The years of formal education achieved by household head is included in explanatory variables to capture the household ability to adopt risk management strategy. It is indicated that as the years of schooling increases,

the probability of occurrence of a shock decreases. This could be because the welfare level of educated households is higher than uneducated households in general, implying that educated households have larger room for consumption curtailment when hit by an adverse shock [Kurosaki (2009)]. Household size is positively correlated with shocks reporting rates across the board, as larger households are exposed to more shocks from multiple dimensions. With regards to the variables poverty status and female ratio in household became insignificant while welfare ratio had negative and significant relation indicating that as the welfare level of households increases, the probability of suffering a shock decreases. Access to credit plays an important role in smoothing consumption. In this analysis those household who had obtained formal credit have negative and significant relation in explaining the probability of shock because formal credit is usually taken for investment in agriculture purposes which generate stable consumption paths, even when shocks occur. Households with productive assets such as ownership of agricultural land and livestock have greater probability of reporting a shock than those which do not own these assets because assets themselves may be lost directly due to the adverse shocks—such as crop failure and loss of livestock. It is commonly believed that households whose heads are employed in agriculture sector report more shocks on average as agrarian households are often exposed to a larger sets of shocks than non-farm counterparts particularly, crop failure, loss of livestock, and natural hazards like, flood/drought. This analysis confirms this belief. Those households which are employed in agriculture sector (52 percent in Punjab and 60 percent in Sindh) are more likely to report different type of shocks. The analysis has also included those household who had member abroad and receive remittances showing less likely to hit by any type of shock but turns out to insignificant in explaining this phenomenon. Geographical location also plays an important role in determining risk and shocks. This analysis indicates that rural South Punjab and Sindh provinces are more vulnerable in term of experiencing shocks as compare to north Punjab because districts located in these regions like Muzafargarh, Bahawalpur, Nawabshah, Mirpurkhas and Badin were the worst hit in 2010 flood.

In model 2, differences in the values of three correlates (landholding, livestock and welfare ratio) between the 2004 and 2010 are added in the model. There is no major change in results when compared to model 1 except that the livestock which was significant in model 1 turned out to be insignificant in model 2. However, all the three variables—difference in two periods have significant relation with probability of occurrence a shock. The difference in livestock and welfare ratio has a negative and significant relationship with probability of a shock while landholding has positive relation to experience a shock. This analysis indicates that not only the initial socio-economic conditions of households but also a change in these conditions overtime has correlation with the probability of a shock. Thus, it can be concluded that households with positive changes in livestock and welfare ratio can lead to less likelihood of experiencing a shock as livestock can be used as buffer stock when households exposed to risk. However, difference in landholding which is included to proxy households' productive capacity and permanent income generating potential has positive and significant relation with an occurrence of shock.

Natural disasters such as floods, droughts, earthquakes, and other weather-related phenomena can affect household welfare through the destruction of physical and human

capital stock. These shocks are more frequent in developing countries, and the poor are more likely to suffer damages from natural hazards as usually they can only afford to live in marginal areas and have a limited ability to manage these risks [UNDP (2007-08)].

In Table 10, model 3 explores the factors that make households more likely to experience from natural/agriculture shock that had also resulted in loss of income and assets. It is worth mentioning that the findings of these models are not different from the outcome of model 1 and 2, with a few exceptions. *Ceteris paribus*, if the household head is older, the household faces a lower risk of shocks. Similarly; more educated household heads are less likely to experience a shock than those with less education level. Large households' size, high dependency ratio and sector of employment are more at risk to suffer a shock. The poverty status of the household head which was insignificant earlier came out to be significant indicating more likelihood to suffer from natural/agriculture shocks while female ratio and welfare ratio turned out to be insignificant. Household productive assets, like land and livestock have positive and significant relation with experiencing a shock. In terms of

Table 10

Effects of 2004 Socioeconomic Characteristics on the Probability of Experiencing an Agriculture Shock between 2006 and 2010

Correlates (2004)	Model-3		Model-4	
	Agri Shock/No Shock		Agri Shock/No Shock	
	Coefficient	S.E	Coefficient	S.E
Male Headed Households	0.563*	0.251	0.589**	0.252
Age of HH Head	-0.004**	0.002	-0.005**	0.002
Head Education(Years)	-0.036*	0.007	-0.036*	0.008
Household Size	0.038*	0.007	0.034*	0.007
Dependency Ratio	0.089**	0.035	0.093*	0.036
Poverty Status	0.319*	0.075	0.310*	0.075
Female Ratio	0.129	0.206	0.120	0.206
Welfare Ratio	-0.002	0.018	-0.021	0.027
Land Ownership (Acres)	0.017*	0.002	0.022*	0.002
Livestock Ownership (no)	0.004**	0.002	0.004	0.005
Credit Access	-0.291*	0.061	-0.297*	0.061
Member Abroad	0.083	0.219	0.034	0.218
Sector of Employment	0.693*	0.059	0.659*	0.060
South Punjab/North Punjab	1.034*	0.81	1.031*	0.082
Sindh/North Punjab	1.006*	0.070	1.031*	0.072
Constant	-2.927	0.299	-2.795	0.300
Difference in Landholding	—	—	0.012*	0.003
Difference in Livestock	—	—	-0.003	0.004
Difference in Welfare Ratio	—	—	-0.016	0.025
LR Chi-square	609.81		630.7	
-2 Log Likelihood	8560.97		8624.1	
Pseudo R ²	0.062		0.064	
Observations		1335		

Source: Computations are based on the micro data of PRHS-2004-05 and PPHS-2010.

*Significant at 1 percent, and ** Significant at 5 percent.

economic well-being Punjab province is better off as compare to Sindh province while within Punjab, Southern region is worse off in terms of human and social development as compare to Northern region [Haq and Azher (2013)]. Finally, as expected households residing in south Punjab and Sindh regions are more exposed to natural disaster as witnessed frequent floods and droughts in this regions.

In model 4, differences in the values of three predictors (landholding, livestock and welfare ratio) between the 2004 and 2010 are added in this analysis to explore the probability of occurrence an agriculture shocks. There is no major change in results as compared to model 3 except livestock ownership turn out to be insignificant while difference in landholding between these periods is significant and households turned out to be more vulnerable to ill effect of shocks.

The shocks are multi-dimensional and affect a variety of aspects of household welfare. For this multivariate analysis, all shocks are decomposed into income shock and societal shock. Income shock is computed by aggregating natural/agricultural shocks and economic shocks while societal shock includes health shocks and social shocks. The results of multinomial logistic regression model presented in Table 11 show the effects of the independent variables on the probability of an income shock vs. no shock and societal shock vs. no shock. Income shock constitute the highest burden of shock with 58.8 percent while societal shock takes 41.2 percent in total welfare loss as reported in descriptive analysis. With respect to the individual level characteristics, a male headed household is found to be more likely to suffer income shock while it is insignificant for societal shock. Age of household head is insignificant in both models while household size has positive and significant relation with the probability of occurrence of an income and societal shocks indicating that as household size increases households are more vulnerable to shocks. Education level of household head reduces probability of income shock but insignificant for probability of societal shocks. The dependency ratio which is used to measure the pressure on productive population is positive and significant showing that as this ratio increases, a household is more likely to suffer an income shock. Women make essential contributions to the agricultural and rural economies in all developing countries including Pakistan. They often manage complex households and pursue multiple livelihood strategies but many of these activities are not defined as “economically active employment” in national accounts but they are essential to the well-being of rural households. To analyse the impact of working age female population in household size, female ratio is included in the model, but this variable turn out to insignificant in explaining the probability of experiencing a shock in both models. Poverty status indicates deprivation of a household, had negative and significant relationship with reference to income shock while it increases the probability of societal shock. Welfare ratio which is a measure of overall well-being of household turns out to be significant indicating that as economic status of the household increases probability of suffering an income shock reduces. When the effect of ownership of productive assets is examined, it was found that a household with land and livestock ownership significantly increases the probability of income shock while it reduces the likelihood of occurrence of societal shocks.

Table 11

Multinomial Logistic Regression: The Probability of Experiencing a Shock

Correlates (2004)	Model 5			
	Income Shock /		Societal Shock/	
	No Shock		No Shock	
	Coefficient	S.E	Coefficient	S.E
Intercept	-2.245	0.336	-1.567	0.293
Male headed Households	0.719**	0.277	0.194	0.225
Age HH Head	-0.003	0.002	0.001	0.002
Head Education (Years)	-0.028*	0.008	0.002	0.008
Household Size	0.053*	0.007	0.043*	0.009
Dependency Ratio	0.0985**	0.037	-0.080**	0.040
Poverty Status	-0.197**	0.078	0.153**	0.074
Female Ratio	0.200	0.221	0.110	0.215
Welfare Ratio	-0.015**	0.020	-0.069	0.033
Land Ownership (Acres)	0.016*	0.002	-0.018*	0.003
Livestock Ownership (no)	0.007***	0.004	-0.022*	0.004
Credit Access	-0.447*	0.064	0.047	0.067
Member Abroad	-0.288	0.253	0.334***	0.203
Sector of Employment	0.631*	0.063	0.053	0.063
South Punjab/North Punjab	1.098*	0.086	-0.397*	0.080
Sindh/North Punjab	1.249*	0.076	-0.967*	0.078
Chi-square		853.977		
-2 Log Likelihood		15730.0		
Pseudo R ²		0.104		
Observations		1335		

Source: Author's computation is from the micro data of PRHS 2004-05 and PPHS-2010.

*Significant at 1 percent, and ** Significant at 5 percent. a. The reference category is: No shock.

Access to formal credit is used to capture the household's capacity to mitigate the effect of shock. It was observed that a household with access to credit is less likely to report an income shock while it is insignificant for probability of societal shocks. Sector of employment demonstrates positive and significant relation with probability of economic shock while it is insignificant for societal shock. Significant regional variations exist in determining the likelihood of shocks. In model 5, southern Punjab and Sindh provinces are more vulnerable to hit an income shock while it is negative for societal shock. When a shock hits a household, it affects household assets. To capture this effect, the study had taken change in landholding, livestock and welfare ratio between the two periods as reported in Table 12. There is no major change in correlates of this model except a couple of exceptions, i.e., ownership of livestock turn out to be insignificant in both type of shocks. The sensitivities of shock responses to differences in landownership and welfare ratio lower the probability of societal shock while it is positively related to income shock in case of land ownership. The changes in livestock ownerships is negatively associated with probability of income shocks indicating that positives changes in this productive assets is used as ex ante coping mechanism to avoid an income shock.

Table 12

Multinomial Logit Model: The Probability of Experiencing a Shock

Correlates (2004)	Model 6			
	Income Shock / No Shock		Societal Shock/ No Shock	
	Coefficient	S.E	Coefficient	S.E
Intercept	-2.114	0.341	-1.259	0.299
Male Headed Households	0.736**	0.277	0.167	0.226
Age HH Head	-0.004	0.002	0.001	0.002
Head Education (Years)	-0.028*	0.008	0.003	0.008
Household Size	0.049*	0.008	0.037*	0.009
Dependency Ratio	0.09**	0.038	-0.081**	0.040
Poverty Status	-0.185**	0.079	0.099	0.075
Female Ratio	0.195	0.221	0.115	0.216
Welfare Ratio	-0.053**	0.029	-0.069**	0.033
Land Ownership (Acres)	0.021*	0.002	-0.015*	0.004
Livestock Ownership (no)	0.005	0.005	-0.004	0.006
Credit Access	-0.451*	0.064	0.062	0.067
Member Abroad	-0.218	0.252	0.371***	0.205
Sector of Employment	0.602*	0.063	0.0129*	0.062
South Punjab/North Punjab	1.098*	0.088	-0.444*	0.082
Sindh/North Punjab	1.27*	0.078	-1.073	0.081
Difference in Landholding	0.012*	0.003	-0.013**	0.006
Difference in Livestock	-0.009*	0.004	0.048*	0.006
Difference in Welfare	-0.035	0.026	-0.107*	0.031
Chi-square		985.622		
-2 Log Likelihood		15587.0		
Pseudo R ²		0.119		
Observations		1335		

Source: Author's computation is from the micro data of PRHS 2004-05 and PPHS-2010.

*Significant at 1 percent, and ** Significant at 5 percent a. The reference category is: No shock.

These shocks can affect assets in many ways, first, through the impact on their amount, value and productivity. This could be the direct result from the shock or a ramification of its impact through the absence or inadequate application of coping mechanisms. Poor households tend to pay a higher cost for mitigating and coping with risk due to their reduced asset base. Next section discusses vulnerability measured in terms of sensitivity of consumption changes due to shocks.

4.4. Vulnerability: Sensitivity of Consumption Changes Due to Shocks

In developing economies poor households are likely to suffer not only from low level of welfare on average but also from fluctuations in their welfare to their limited coping abilities [Fafchamps (2009); Dercon, *et al.* (2005)]. The inability to avoid welfare declines when hit by exogenous shocks can also be called vulnerability [Ligon and

Schechter (2003); Kurosaki (2006)]. Idiosyncratic and village-level negative shocks may have been responsible for the consumption decline of certain households when the country experienced a consumption increase on average. Aggregate shocks such as droughts and floods cannot be perfectly insured by risk sharing.

Given this inability, Kurosaki (2013) explored households which are more vulnerable in terms of a decline in consumption when a village is hit by shocks like flood, drought and health and what kind of microeconomic mechanism underlies the household heterogeneity in vulnerability, using two-period panel data collected in rural Pakistan in 2001 and 2004. This study also investigates households in rural Pakistan who are vulnerable to shocks in terms of a decline in their consumption expenditure when their village is hit by covariate or idiosyncratic shocks which is based on risk response module of panel data of 2010 with base year 2004. To measure vulnerability change in real per capita log consumption expenditure (*dlnc*) for the years 2004 and 2010 is taken as welfare measure. The average real consumption expenditure increased between the two periods as presented in Table 13. The increase is larger in Punjab province than in Sindh province while within Punjab it is higher for northern Punjab as compare to southern Punjab, indicating spatial disparity across the two provinces which accounts for approximately 80 percent of Pakistan's total population. This increase in the average consumption is not shared equally among all households. Among the full sample of panel households, the average of *dlnc* was 0.21, indicating an increase of 11.5 percent in real consumption over the two survey periods. However, 35.4 percent of individuals suffered from a decline in their welfare levels (i.e., *dlnc* was negative). Thus, the aggregate figure hides the fact that certain households suffered from a severe decline in their welfare during the two survey period. The welfare changes can also be analysed by taking households with different groups of shocks which was reported in PPHS-2010 indicated that those households who are experienced by shocks had less positive changes in consumption as compared to no shocks. In addition, households who suffered health shocks due to injure/sickness/death had the least positive growth in consumption per capita as compared to other groups.

Table 13

Household level Welfare Changes in Rural Pakistan from 2004 to 2010

	Distribution of <i>dlnc_i</i> (changes in log consumption per capita)		
	Mean	Standard Deviation	% <i>dlnc</i> >0
Shock	0.18	0.71	62.5
No Shock	0.22	0.69	65.7
Agricultural Shock	0.18	0.67	62.9
Economic Shock	0.17	0.41	68.3
Social	0.27	0.62	73.0
Health	0.17	0.78	59.1
Overall	0.21	0.70	64.6
Punjab	0.23	0.65	67.2
North Punjab	0.30	0.60	70.0
South Punjab	0.16	0.70	64.5
Sindh	0.18	0.74	62.0

Source: Author's computation is from the micro data of PRHS 2004-05 and PPHS-2010.

As controls for household characteristics that determine consumption growth, the paper follow the standard literature on the determinants of welfare in developing countries [Glewwe (1991)] and include variables such as agricultural production assets owned by the household, farmland and household assets like milk animals, bullock, sheep and goats, etc., with other households characteristics in 2004. The household level covariate/idiosyncratic shocks that occurred after the first round of survey may have affected the consumption level due to income loss. For this reason, four groups of shocks reported in the last five years in PPHS-2010 that are exogenous to initial consumption are included in the model.

The estimated results of village level fixed effect model⁸ is presented in Table 14. Among household characteristics, seven variables have statistically significant coefficients: household head's age (positive), household head's years of schooling (positive), household size (negative), sector of employment (positive), welfare ratio (positive), the size of owned land (positive) and number of livestock (positive). The analysis shows that aged household heads with more year of schooling and high welfare ratio had experienced higher growth in consumption between the two periods. The coefficient of household size is negative and statistically significant indicating that as household size increases, require larger amount of consumption thus growth in consumption decreases between the two periods. The finding that households with land and livestock ownership are ahead forward in consumption growth suggests that growth from 2004 to 2010 was based on agricultural sectors in rural Pakistan.

Table 14

Vulnerability: Sensitivity of Consumption Changes and Household Characteristics

Explanatory Variables	Dependent Variable: $d\ln c$ (Change in log Consumption)	
	Coefficients	Standard Errors
Intercept	0.27	0.04
Male Headed Households	-0.15	0.144
Age HH Head (Years)	0.0035***	0.0014
Head Education (Years)	0.011*	0.005
Household Size	-0.08*	0.019
Dependency Ratio	0.003	0.24
Female Ratio	0.26	0.13
Welfare Ratio	0.16*	0.01
Land Ownership (Acres)	0.003***	0.001
Livestock Ownership (No)	0.035*	0.014
Credit Access	0.010	0.006
Sector of Employment	0.024*	0.009
Natural and Agriculture Shocks	-0.17**	0.023
Economic Shocks	-0.035	0.05
Social Shocks	-0.0047	0.01
Health Shocks	-0.036**	0.121
R-sq: Within Village = 0.27		
Between = 0.16		
Overall = 0.24		
F(15,852) = 13.15		
Prob > F = 0.0000		

⁸With village fixed effects, a Hausman test comparing the fixed effects (within) regression and the random effects regression gives a p-value of .0005. The result of the test provides evidence in favour of the village fixed effect being uncorrelated with the other regressors and helps confirm this specification.

With regard to coefficients on shocks, all are negative but only natural/agriculture shocks and health shocks are significantly related to welfare. The absolute value of the coefficient on natural/agricultural shock is especially large, indicating that households had to reduce consumption by 15 percent⁹ when their households located in particular village is hit by floods/drought/ earthquake. This implies a substantial decline in welfare capturing a major disaster of 2010 flood especially in Punjab and Sindh province. Analysis from Arif and Shujaat (2014) using the same panel data suggest that those household who are suffered from agriculture shocks are more likely to fall into poverty. On the other hand, the coefficient on economic shocks and social shocks are statistically insignificant. In addition to these shocks, health shock is significantly negative specifying a decline of 8 percent in consumption when a household member or earner get sick/injured indicting income loss due work days lost. The decline in consumption can also captured due to death of earner which suspended income flow in the family.

5. CONCLUSIONS

In developing countries, shocks from many sources strike frequently and hit hard, causing loss of life, assets, and livelihoods which has also established the fact that the cost of risk exceeds the impact of shocks. The objective of this study is to investigate sources of vulnerability defined as households' exposure to shocks and their limited ability to mitigate the impact of shocks. It has used household survey data from PRHS-2004 and PPHS-2010 focusing on the risk response module to explore the probability of shocks and sensitivity of consumption changes due to shocks.

The findings of this study elaborate that approximately one third of the rural households experience an adverse shock during the last five years 2006-2010, including natural/agricultural shocks 55.9 percent, economic shocks 2.0 percent, social shocks 8.4 percent and health shocks 33.7 percent. The incidence of shock is greater from natural/agricultural events and health related shock. Households with agriculture land and livestock ownership are more vulnerable to face shocks. As far as the scope of shock is concerned, 53.7 percent households suffer from idiosyncratic shocks, particularly health related while 46.3 percent had covariate shocks focusing on natural disasters. The natural/agricultural shocks contribute the major share of loss due to shocks. It is observed that coping mechanisms are overwhelmingly informal and largely asset-based using savings or sale of livestock whereas the poorest bottom quintiles adopted behaviour-based strategies which include reducing food and non-food consumption, employment of child labour and increased working hours, etc. The analysis also sheds new light on the positive role of livestock in mitigating adverse impact of shocks as 29 percent households' sale livestock as coping measures.

To determine factors influencing the incidence of shock, the available panel households from rural Punjab and Sindh are taken to determine the pre shock characteristic of households. A number of patterns emerge while using all type of shocks and natural/agricultural shock: male headed households, large household size, land and livestock ownership, employment in agriculture sector and resident of south Punjab and Sindh are more vulnerable to suffer from shocks whereas educated household head, high

⁹ $(1 - \exp(-0.1708)) = (1 - 0.84366) = 0.157$.

welfare ratio and access to formal credit reduces probability of a shock. In addition to it, high dependency ratio and poverty status of the households are more likely to increase the probability of natural/agricultural shocks. However, positive changes in ownership of livestock and welfare ratio between two time period, lower the probability for occurrence of shocks. .

When the sample is categorised into income and societal shocks, it is observed that male headed households, large household size, dependency ratio, land ownership, livestock ownership, sector of employment, south Punjab and Sindh increase the probability of income shock while welfare ratio and access to formal credit lower it. However, land and livestock ownership, member abroad, south Punjab and Sindh lower the probability of societal shocks.

This paper also elucidated which households in rural Pakistan are vulnerable in terms of a decline in their consumption when their village was hit by a shock. It is found that those households who experienced a shock had less positive change in their consumption levels as compared to those households who have experienced no shocks. The empirical analysis of consumption vulnerability also found that households with agricultural and health shocks are more vulnerable as compare to other households.

Shocks will continue to occur, however to mitigate their impact in the future requires a reduction in the socio-economic vulnerability and increased resilience that can be achieved through policies geared towards improving social conditions and living standards. In this regard, access to micro credit to build up productive assets such as livestock, as it smooth consumption, enables to do saving and productive assets. Lastly, health insurance is imperative especially for the poor segment of the society because in case of health shock they had not only to bear health expenditure but also loss market hours of work.

Finally, to strength the ‘National Disaster Management Authority’ which will be the focal point for coordinating and facilitating the implementation of strategies and programmes on disaster risk reduction, response and recovery, particularly in case of flood which is a common phenomenon in case of Pakistan.

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