SURVEY ASSESSMENT OF FLOODS

REPORT ON CDKN/START PROJECT WITH WWF-PAKISTAN AND LSE

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INTRODUCTION

The objective of this research is to establish the immediate and long-term impact of natural disasters on the well-being of affected households in Pakistan, and to document and evaluate their coping strategies and the role of disaster aid. In general micro-economic studies such as this are few and far between, although their number is increasing as vulnerability and adaptation to climate change becomes an important policy issue.

Previous studies of the immediate and longer-term impacts of natural disasters, such as hurricanes, floods and earthquakes, tend to find that some households are able to recover to their pre-disaster levels of well –being, using a variety of coping strategies. On the other hand, some households do not recover very quickly, while others are pushed into a so-called 'poverty trap' from which they do not recover at all (Carter et al 2006a, 2006b).

In recent years, as throughout its history, there have been a number of large scale flooding events on the Indus River in Pakistan. These have been disastrous for those located in the vicinity: Farming livelihoods were affected via loss of land and/or livestock, fisheries activities were hindered, particularly in the Indus delta area, and household capital such as housing and machinery were often destroyed. The questions concerning loss of well-being, coping strategies and recovery are therefore highly pertinent in the context of Pakistan. Microeconomic studies of this issue in Pakistan are scant and so the nuances of the particular arrangement of institutions, markets and social networks, and their role in determining the immediate outcomes and recovery have not been researched in any kind of detail. The one exception to this is a recent study of the role of risk sharing at the household level using data from 2001 and 2004 (Takashi 2014), which found a) that different shocks (health, flood, drought) affect households in different ways, while social networks and other risk sharing mechanisms tend to reduce the impact of natural disasters and health shocks to the point of being negligible. Most importantly, impacts are heterogeneous. Relatedly, Zimmerman and Carter (2003) provide theoretical predictions for rich and poor households. Their prediction suggest that poor households will tend to smooth assets over time since they are highly dependent on them for sustaining future well-being, while rich household will consumption smooth by running down their assets to maintain their well-being.

With these ideas in mind, in this study we are particularly interested in establishing the impact of the flood and investigate the strategies households undertake to maintain their well-being and to cushion the blow of flooding: do household sell assets to ensure that consumption is maintained? Do households reduce consumption in order to maintain their asset base to maintain future well-being? Furthermore, are different occupations affected in different ways? In particular is agriculture affected more than fisheries? Finally, what are the adaptations that households make in response, to disasters?

In order to answer these questions we undertook a household survey of around 300 households in two distinct areas both of which were affected by the flooding in 2009-2010. The approach we take to do this is to use the survey data to evaluate the nature and value of the immediate loss of some of the chief determinants of household well-being: assets, income and consumption, as a result of being effected by a natural disaster. We first undertake a graphical analysis which reveals how the distribution of these outcomes has changed over time for the various income groups and for those hit by the flood as well as a control group who quite by chance were not. We then evaluate the immediate and medium-term effect of the natural disaster on these determinants of well-being by looking at the impact immediately post-flood and later on in what we call the 'recovery period'.

THE IMPACT OF FLOODING ON THE MANCHAR AND CHOTIARI COMMUNITIES?

DATA AND METHODS

In order to evaluate the impact of the flood on household in the two regions of interest we look at simple measures of current and future well-being: consumption, income and assets. The household survey obtained detailed data on these aspects of households, along with other more general socio-economic data. The outcome variables are consumption, income and assets each measured in PKR (2012). Each of these is self-reported and constructed from an itinerary of assets, income sources and expenditure items. Details of these items can be found in Appendix 2 which contains the questionnaire. Section C shows that typical asset items include land, capital and housing, while income items include agricultural and off-farm incomes, while consumption items include food and other products.

The periods for which we have data are the year before the flood (2009), the year immediately after the flood (2010) and 2012. Respectively we call these periods the pre-flood, post-flood and recovery period and index them as $t = 0, 1, 2$ respectively. Data was collected for households that were hit by the flood (the treated group) and those that were not hit by the flood (the control). Table X provides summary of the some of the more important household level data for the treatment and control groups, respectively those hit by the floods and those not hit by the floods, for each area.

We first present the results of graphical and statistical analysis for each of the regions. The graphical analysis reveals the changing distribution of consumption, income and assets over the duration of the flood and the initial part of the recovery period until 2012. We use non-parametric kernel density estimates which reveal the entire distribution of the data in each period for the treated and control groups over this time horizon. While this is an extremely accessible way to look at the data, it does not lend itself well to general quantitative interpretation.

DIFFERENCE IN DIFFERENCES METHOD

In order to provide a more quantitative interpretation of the impact embedded in the diagrammatic analysis we undertake a Difference in Difference (DID) analysis. This allows us to say something about the average impact of the flood on the three outcome variables: consumption, income and assets, while controlling for any initial differences in these variables between the treatment and control group, general secular trends in these variables. Furthermore, since we essentially have panel data based on recall data of previous periods, the DID analysis also allows us to control for unobservable factors that are fixed over time that may have determined whether a household was in the treatment or control group. I.e. whether they were affected by flooding. Examples of such factors may include geographical features, unobservable household behavioural characteristics such as how prudent the household is, and so on.[1] The idea behind the method is to isolate the pure impact of flooding on the outcome variables, free of selection bias from observables and unobservable characteristics.

Formally speaking, the DID method works as follows. The simplest model takes the following form:

$$(1) \qquad Y_{it} = \alpha + \beta D_{it} + a_i + u_{it}$$

Where Y_{it} is the outcome variable, D_{it} is a dummy variable which is equal to one if a household i is subject to the flood at time t, and zero otherwise. The terms a_i is an unobservable 'fixed effect' which reflects all the unobservable characteristics of the household that are fixed over time, such as individual motivation or ability. The parameter β represents the impact of the flood on the outcome variable and can be identified and estimated under certain assumptions. The basic idea behind this model is that we estimate the change in the outcome variable for the treated group over time, and remove from this the change over time for the untreated group. The basic assumption here is that the treated group would have evolved like the untreated group had they not been treated. That is, the untreated group are assumed to be a valid counterfactual control group for the treatment group.

In order to deal with the potential for selection bias (the idea that those that were hit by the flood differed systematically in unobservable ways from those who were not hit by the flood) we undertake the DID analysis using the 'fixed effects' estimator of β. This removes the influence of unobserved heterogeneity among households, reflected by ai, on the estimate of β. Given that we have 3 years of data there is a number of ways in which the model in (1) can be specified.

PRE-FLOOD – POST-FLOOD ANALYSIS: TWO PERIODS

The simplest approach we use in the analysis is to estimate equation (1) estimator over two periods: the pre-flood and the post-flood periods. Here D_{2it} is equal to zero in the pre-flood period (t = 0) and equal to 1 afterwards (t = 1) for the treated group. D_{it} is everywhere zero for the untreated group. Here, β reflects the immediate impact of the flood on those affected by the flood compared to the untreated group.

[1] For a detailed explanation of this approach see Angrist and Pischke (2009, Ch.5) or Wooldridge (2006, Ch.21).

(2) $$Y_{it} = \alpha + \beta_1 D_{1it} + a + u_t \qquad (t = 0,1)$$

PRE-FLOOD TO RECOVERY ANALYSIS: TWO PERIODS

Here we compare the outcome variables pre-flood to its level in the recovery period. Here the 'treatment' dummy is defined as D_{2it} is equal to zero in the pre-flood period (t = 0) and equal to 1 in the recovery period (t = 2) for the treated group. D_{it} is everywhere zero for the untreated group. The analysis is undertaken using data from period t = 0 and t = 2 respectively and the interpretation of β is that it reflects the longer term impact of the flood on those affected by the flood compared to the untreated group.

(3) $$Y_{it} = \alpha + \beta_2 D_{2it} + a_i + u_{it} \qquad (t = 0,2)$$

PRE-FLOOD TO RECOVERY ANALYSIS: THREE PERIODS

Here we compare the outcome variables pre-flood to its level in the recovery period. Here D_it is equal to zero in the pre-flood period (t = 0) and equal to 1 in the post-flood (t = 1) and recovery period (t = 2) for the treated group. D_it is everywhere zero for the untreated group. The analysis is undertaken using data from all three time periods and the interpretation of β is that it reflects the average impact of the flood on the outcome variable over the two periods after the flood, compared to before the flood. The model is:

(4) $$Y_{it} = \alpha + \beta_3 D_{3it} + a_i + u_{it} \qquad (t = 0,1,2)$$

THREE PERIOD ANALYSIS

Using three periods of data allows us to estimate the impact immediately and in the long-term within the same model. This requires the definition of two treatment variables, D_{1it} and D_{3it}. D_{1it} is the dummy variable from the Pre-Post analysis in equation (2), while D_{3it} is the dummy variable in the 3 period analysis. The model estimated is as follows:

(5) $$Y_{it} = \alpha + \beta_1 D_{1it} + \beta_3 D_{3it} + a_i + u_{it} \qquad (t = 0,1,2)$$

For each region analysed we undertake each of these analyses.

HETEROGENEOUS IMPACT: IMPACT BY INCOME QUARTILE

We also control for 'income quartile' to see whether the impact of the flood is stronger for a particular income or wealth group and hence has distributional consequences. The theoretical work of Zimmerman and Carter (2003), as well as previous empirical work by Fafchamp et al. (1998), provides a theoretical and empirical rationale for thinking that the impact of natural disasters is likely to be heterogeneous, and certainly will differ by income levels. In order to evaluate this we derive indicator variables for the quartile of the distribution a household

is located in the 2009 pre-flood period. We then interact these indicator variables with the treatment variables in each case. Say we are interested solely in which half of the distribution a household lies, then the empirical model in the pre-post-flood analysis of equation (2) would be as follows:

$$(6) \qquad Y_{it} = \alpha + \beta_1 D_{1it} + \beta_4 D_{Ui} * D_{1it} + a_i + u_{it} \qquad (t = 0,1)$$

where D_{Ui} is equal to 1 if the household is in the upper half the income or wealth distribution, and zero otherwise. The sign of β_4 would tell is whether the richer group had a low or a higher impact of the flood.

We now turn to the analysis proper, starting with a graphical analysis.

RESULTS FOR CHOTIARI: GRAPHICAL ANALYSIS

THE IMPACT ON AGRICULTURAL HOUSEHOLDS IN CHOTIARI: CONSUMPTION

Appendix 1 presents some descriptive statistics for the Chotiari dataset. In this section we look at the impact of flooding on the agricultural households of the Chotiari region. We first present a graphical analysis which looks at the changing distributions of income consumption and assets for the pre-flood, post-flood and recovery periods. These periods are defined as the year before the flood (2009), the year immediately after the flood (2010) and 2012. Figures 1a and 1c refer to consumption for the treatment group (those hit by the flood) and illustrate respectively the changing distribution of income from the pre-flood period to the post- flood period, the pre-flood to recovery period and the post-flood to recovery. Figure 1d shows the pre-flood to post-flood consumption distribution for the control group, which was unaffected by the flood.

The diagrams can be understood as follows. The x-axis measures the consumption level, while the y-axis measures the likelihood of, or the proportion of the sample, consuming at each level of consumption. The higher the line, the higher the proportion of people at that level of consumption. As we can see, the highest proportion of households can be found at around 20000 PKR per annum, while a much smaller proportion of the households have consumption levels at 60000 PKR.

The overall message of the diagrams is that consumption has not really changed markedly between the pre- and post-flood period. In fact the distribution has moved to the right indicating a general increase in consumption levels, particularly at higher levels of consumption. In terms of consumption, the distributions are very similar throughout. There is certainly no general decline in consumption levels. Figure 1d shows that the consumption of the control group is unaffected in the post-flood period, as we would expect.

THE IMPACT ON AGRICULTURAL HOUSEHOLDS IN CHOTIARI: INCOME

Figures 2a – d provide the same information with regard to income. The general interpretation here is as follows. The comparison of the pre-flood and the post-flood income levels in Figure 2a shows that there is a higher likelihood of being at a low level of income after the post-flood. We do now know who these people are particularly, but they appear to be coming from the lower end of the income distribution. The fact that the pre and post-flood lines are more or less touching is an indication that the likelihood of being at the higher income level is unchanged after experiencing the flood. In sum, the flood has had a negative impact on incomes.

Figure 2b compares pre-flood and recovery levels of income. The lines are almost identical indicating that whatever changes took place in the aftermath of the flood disappear in the recovery period. Figure 1c illustrates the moderate growth in incomes as the curve shifts to the right making more or less all higher consumption levels more likely. Lastly Figure 2d shows that the income of the control group is unaffected by the flood, which is to be expected.

Figures 1a-1d. The impact on consumption (PKRs 2012, per annum) in Chotiari

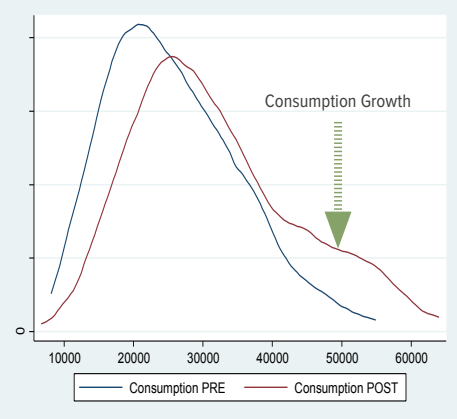

Figure 1a. post flood to pre-flood

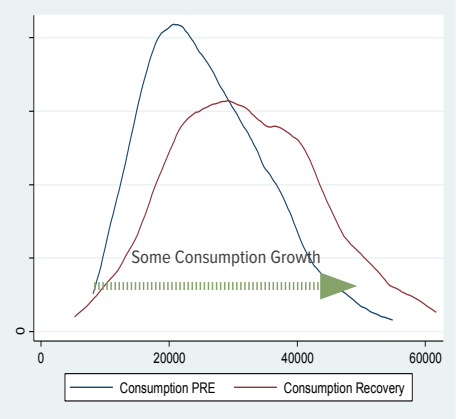

Figure 1b. Pre flood to recovery period

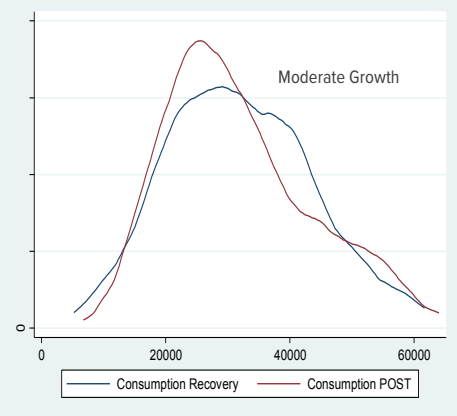

Figure 1c. Post flood to recovery period

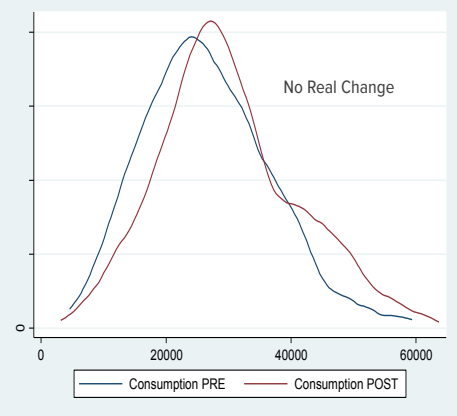

Figure 1a. post flood to pre-flood

Figures 2a-d. The impact on income (PKRs 2012, per annum) in Chotiari

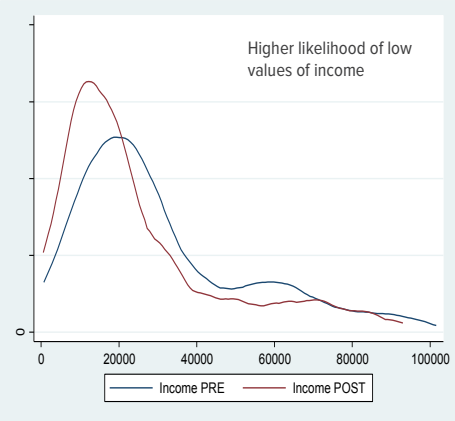

Figure 2a. post flood to pre-flood

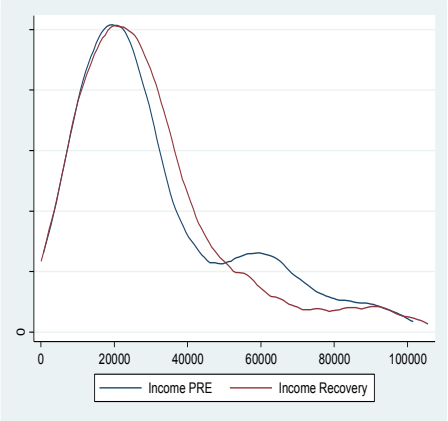

Figure 2b. Pre flood to recovery period

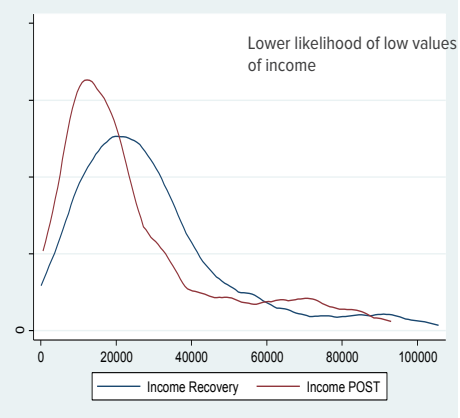

Figure 2c. Post flood to recovery period

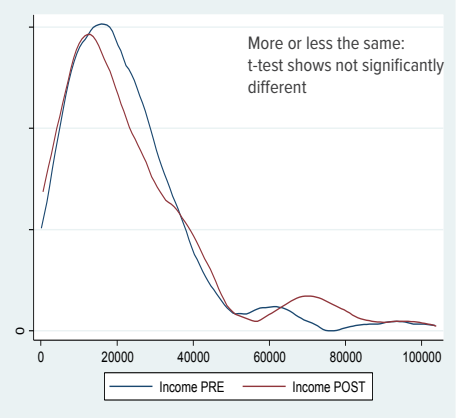

Figure 2d. Pre flood to post flood (Control group)

Figures 3a-d. The impact on assets (PKRs 2012, per annum) in Chotiari

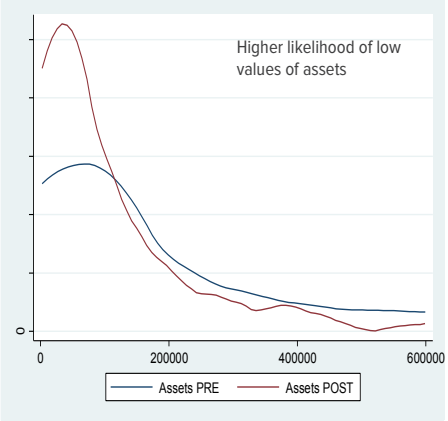

Figure 3a. post flood to pre-flood

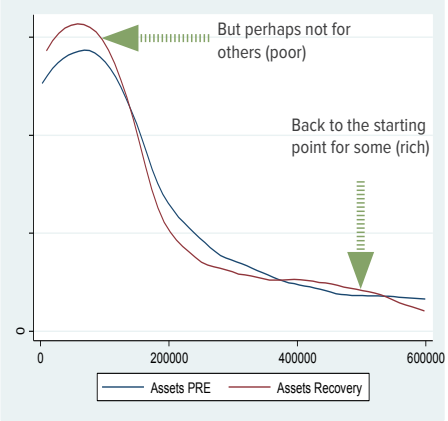

Figure 3b. Pre flood to recovery period

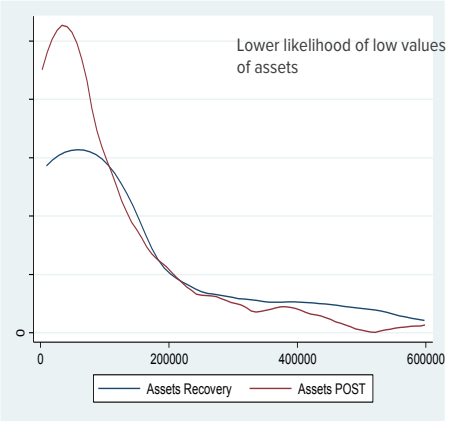

Figure 3c. Post flood to recovery period

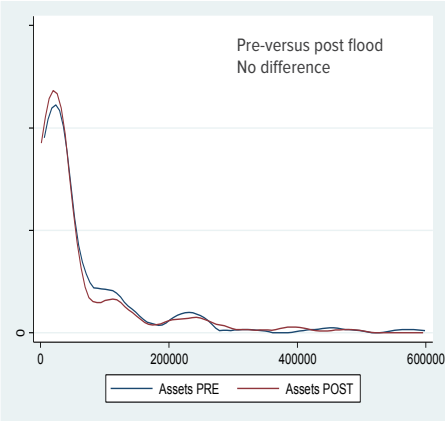

Figure 3d. Pre flood to post flood (Control group)

THE IMPACT ON AGRICULTURAL HOUSEHOLDS IN CHOTIARI: ASSETS

The previous results beg the question: How can it be that consumption has been largely unaffected by the flood, while incomes have been negatively affected. The answer to this question can be found in the analysis of the impact on assets found in Figures 3a-d.

Figure 3a compares the distributions of assets pre- and post-flood. The diagram shows a clear spike in the post-flood asset holdings at the low levels of assets. Elsewhere the distribution is lower than the pre-flood assets across the board. This indicates general and heterogeneous reductions in assets from all levels of asset holdings. Figure 3c shows that the value of assets is more or less restored recovers by the recovery period since the distance between the two distributions narrows. Figure 3b shows this recovery between the post-flood and recovery period as the peak at low asset values falls. There are indications that the recovery is not complete though in Figure 3b since the diagram suggests a higher proportion of people with low levels of assets in the recovery period than in the pre-flood period.

In summary these figures provide a detailed picture of the changing nature of the distribution of consumption, income and assets in the pre- and post-flood and recovery periods. They pro-

vide a qualitative story of consumption smoothing in the face of lower incomes which is potentially financed by consuming and/or selling assets. This accords with the theoretical picture painted by Zimmerman and Carter (2003) for richer households who consumption-smooth, rather than poorer households who prefer asset-smooth: limit the negative effects on their productive assets.

However, while the diagrams provide a detailed picture of what is happening at each level of asset, income and consumption, they do not provide any particular evidence of the causal nature of the impact nor of the statistical and economic significance of the impacts on households. We now turn to this.

RESULTS FOR CHOTIARI: DIFFERENCE IN DIFFERENCES ANALYSIS

As discussed the survey elicited recall data for a variety of pre- and immediately post-flood characteristics. In particular data on consumption, income and assets were collected motivated by the standard theoretical and empirical predictions found in Carter et al (2006a; 2006b), Zimmerman and Carter (2003) and Takayoshi (2014) inter alia. The graphical analysis shows the distribution of these data. The following tables show the economic and statistical significance of the results.

Table 1 shows the results of the fixed effects estimation of the models shown in equations (2) and (3), that is, the two-period analysis. Also estimated is a model that allows for heterogeneity of the impact by income quartile, with the lowest quartile acting as the reference category.

Variable	ASSETS (1)	ASSETS (2)	INCOME (1)	INCOME (2)	CONSUMPTION (1)	CONSUMPTION (2)
FLOOD1	-70119.6***	-103659.2***	-3242.9	15128.1***	296.7	1841.5
FLOOD1*inc2		57311.1		-18577.5***		-1895.8
FLOOD1*inc3		80100.1*		-17774.1***		-2345.3
FLOOD1*inc4		-9650.0		-31696.7***		-1568.0
year1	-6440.8	-6440.8	411.5	411.5	2376.5***	2376.5***
_cons	134606.1***	126612.3***	15644.2***	14629.7***	17404.5***	17228.2***
N	376	350	376	350	376	350
r2	0.1	0.2	0.0	0.2	0.3	0.3

legend: * p<.1; ** p<.05; *** p<.01

Table 1. Impact in Chotiari on Assets, Income and Consumption (PKRs, 2012): Pre-flood, post-flood analysis

Variable	ASSETS (3)	ASSETS (4)	INCOME (3)	INCOME (4)	CONSUMPTION (3)	CONSUMPTION (4)
FLOOD3	12176.2	99550.3**	33.6	5733.2**	-905.6	1590.1
FLOOD3*inc2		-107481.3**		-5063.3		-3172.7*
FLOOD3*inc3		-42258.1		-4638.1		-2704.2
FLOOD3*inc4		-160808.5***		-11263.3***		-3208.2
year2	37026.6**	37026.6**	1094.3	1094.3	5439.1***	5439.1***
_cons	129351.4***	124645.7***	15353.5***	14825.5***	16818.4***	16964.6***
N	375	359	375	359	375	359
r2	0.1	0.1	0.0	0.1	0.5	0.5

legend: * p<.1; ** p<.05; *** p<.01

Table 2. Impact in Chotiari on Assets, Income and Consumption (PKRs, 2012): Pre-flood to recovery period

SUMMARY OF DID RESULTS FOR CHOTIARI

In Table 1 the parameter on the variable FLOOD1 is an estimate of the impact on the outcome variable. Consider the impact on assets first. The model ASSETS (1) shows the estimates of equation (2) in the previous section for assets and shows a loss between the pre-flood and immediate post-flood periods or around PKR 70000 on average for the sample. The model ASSETS (2) shows how this loss is distributed between income quartiles. The interaction terms with income quartiles all have a positive sign, indicating that the losses for the poorest quartile were larger on average in absolute terms than for other income groups. Yet, none of the interaction terms are statistically significant at the 5% level, and only the third quartile of income could be argued to have experienced a lower level of impact since the coefficient on FLOOD*inc3 is positive and significant at the 10% level. So, in short, there is some heterogeneity of impact by income groups, but this is a weak result statistically. The loss in assets is valued at around 70000PKR, on average a 50% loss.

Model INCOME (1) shows that on average the loss of income was insignificant compared to the control group. However, this hides heterogeneity among income groups. Model INCOME (2) shows that in fact the poorest quartile benefitted from an income gain post-flood compared to the control group, while the second and third quantiles were not affected at all.[2] The richest quartile, on the other hand, sustained income losses of around 16000 PKR (15128.1 – 31696.7), compared to the control group, which is highly statistically significant.[3] This is approximately a 50% loss of income for this group.

As for consumption, Models (1) and (2) in Table 1 indicate that there has been no impact of the flood on consumption. Taken together the results paint a picture of consumption smoothing in response to the flood. This is facilitated by sale of consumption of their asset-base.

Table 2 shows the results of a similar DID analysis comparing the pre-flood (2009) with the recovery period (2012). This provides an indication of the medium-term impact of the flood after between 2 and 3 years of recovery. The overwhelming conclusion arising from Table 2 is that the negative impacts illustrated in Table 1 are not permanent, although there is heterogeneity among households.

With regard to assets, the first and third income quartiles have a higher value of assets in the recovery period than in pre-flood compared to the control group: they more than recover from the losses recorded in the post-flood period. For the second and fourth income quantiles, asset values are not significantly different in each of these periods. Simply put, whatever the immediate impact of the flood, these groups are indistinguishable, in terms of assets, from those that were not hit by the flood by 2012. So, for all income groups, asset values are at least restored to what they would have been in the absence of the flood by 2012.

The complete picture of impact that we can see from Table 1 and 2 is that those hit by the flood smooth consumption by selling assets. The poorest quantile more than recovers their asset values compared to those not hit by the flood.

[2] Note that an F-test of the null hypothesis that the coefficients of FLOOD1+FLOOD1*inc2 = 0 and FLOOD1+FLOOD1*inc3 = 0 fail to reject the null hypothesis for the ASSETS (2) model.

[3] We reject the null that the sum of these coefficients is equal to zero.

RESULTS FOR MANCHAR: GRAPHICAL ANALYSIS

Figures 4 (a – d) to Figures 6 (a – d) show the equivalent graphical analysis for the predominantly fishing orientated communities of Manchar. The analysis of these distributions of consumption, income and assets tell a different story of the impact of the flood on these determinants of well-being which speak to the source of livelihoods in this region. The descriptive statistics show that Manchar is a much poorer area than Chotiari, with lower levels of assets, consumption and income. According to theory, this may change the nature of responses to disasters. The occupational differences will also be important here.

THE IMPACT ON HOUSEHOLDS IN MANCHAR: CONSUMPTION

Figures 4a shows that the distribution of consumption shifts more or less uniformely to the right as we move from the pre-flood period to the post-flood period. In short, consumption levels are increasing over this period. Figure 4b and 4c show that this trend seems to continue between in the post-flood period particularly for higher consumption levels (one can see that the distribution has greater mass at higher levels of consumption in the recovery period). Looking at Figure 4d we see that a similar trend happens for the control group, with consumption levels increasing between the pre-flood and post-flood periods.

Given the consonance between the trends of the treated and control groups, this suggests that there will be very little impact of the flood recorded on consumption. While this appears similar to the Chotiari case, it is not yet clear whether the pattern of impacts on income and assets will be similar.

THE IMPACT ON HOUSEHOLDS IN MANCHAR: INCOME

Figure 5a shows a similar pattern for incomes as for consumption. For those hit by the flood, Figures 5a-c shows that incomes increase in the pre- to post-flood period, and somewhat between the post-flood and recovery period. Figure 5d shows a similar pattern (albeit a slightly different distribution) for the control group. In short, there is a lower proportion of households at low levels of income with each successive period for both treatment and control groups. Again, this is suggestive of minimal impacts of the flood on incomes in this region.

THE IMPACT ON HOUSEHOLDS IN MACNHAR: ASSETS

The distribution of assets in Manchar is far more skewed than in Chotiari. This can be seen in the long right hand tail of the distribution. This is an indication that inequality is higher in Manchar, with most people having very few assets, and very few people having large amounts of assets. The analysis shows that assets are much lower in the post-flood period, with the distribution having shifted to the left and the mode now being at a lower level of asset holdings.

The main losses appear to be coming from the 15000PKR to 30000PKR range, where the likelihood of holding this level of assets has diminished post-flood. Figure 6c shows that that the level of assets is more or less restored by the recovery period, since the distributions coincide and are largely indistinguishable.

Figure 6d shows that the control group, those unaffected by the flood, also suffers a minor reduction in asset values in the pre- to post-flood period, presumably for different reasons.

Figures 4a-d. The impact on consumption (PKRs 2012, per annum) in Manchar

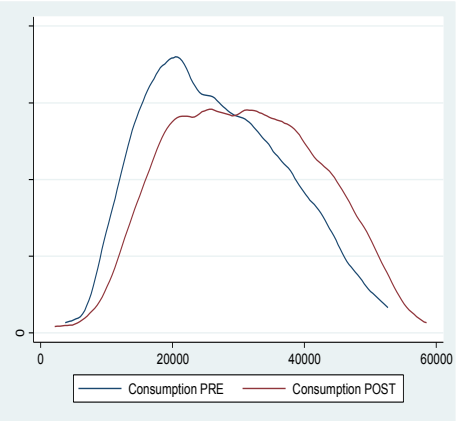

Figure 4a. Pre-flood to post-flood

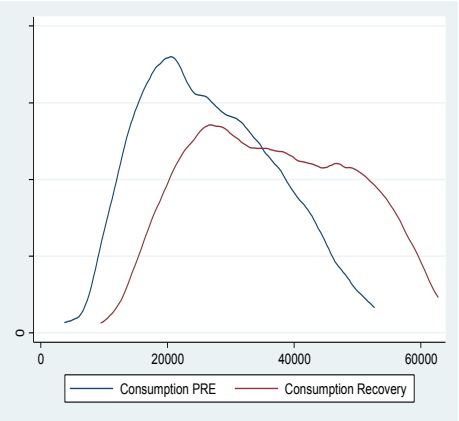

Figure 4b. Pre-flood to recovery period

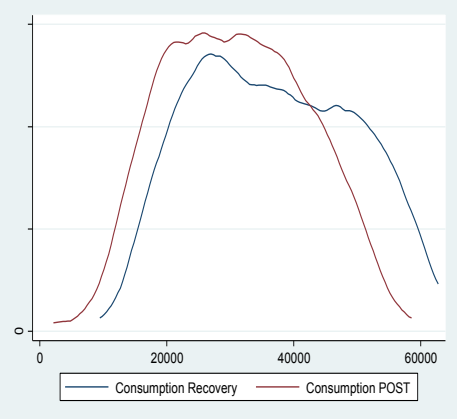

Figure 4c. Post- flood to recovery period

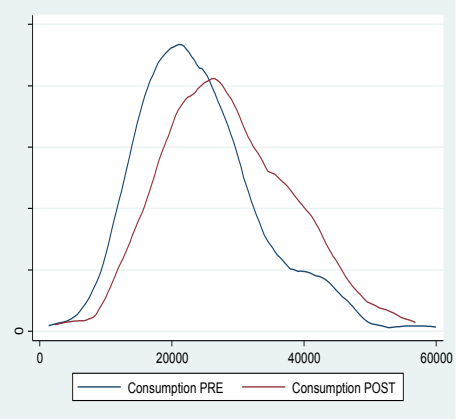

Figure 4b. Pre-flood to post-flood (Control Group)

Figures 5a-d. The impact on income (PKRs 2012, per annum) in Manchar

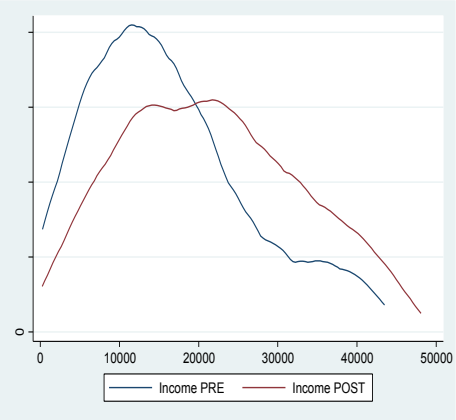

Figure 5a. Pre-flood to post-flood

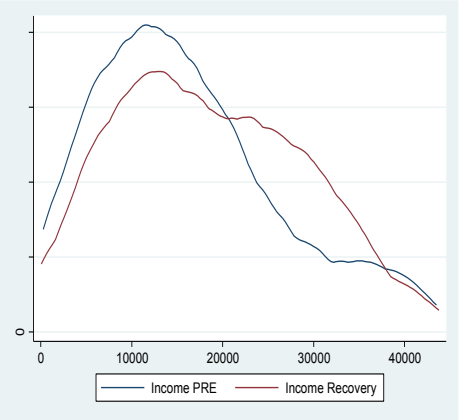

Figure 5b. Pre-flood to recovery period

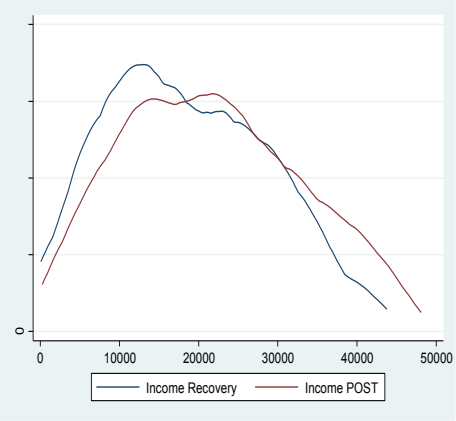

Figure 5c. Post- flood to recovery period

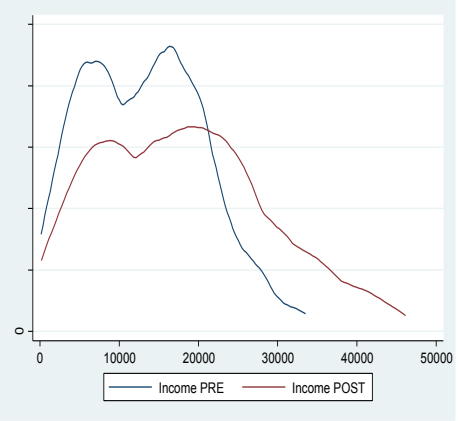

Figure 5d. Pre-flood to post-flood (Control Group)

Figures 6a-d. The impact on Assets (PKRs 2012) in Manchar

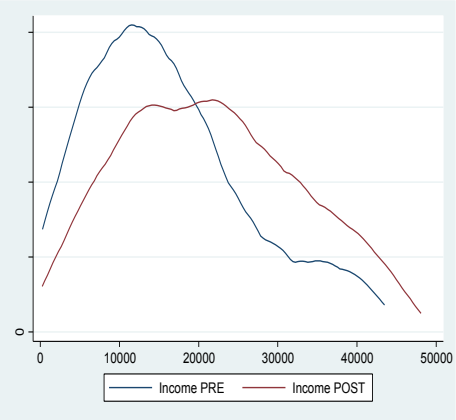

Figure 6a. post-flood to pre-flood

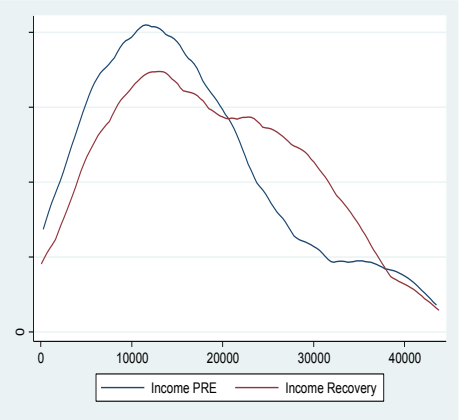

Figure 6b. Pre flood to recovery period

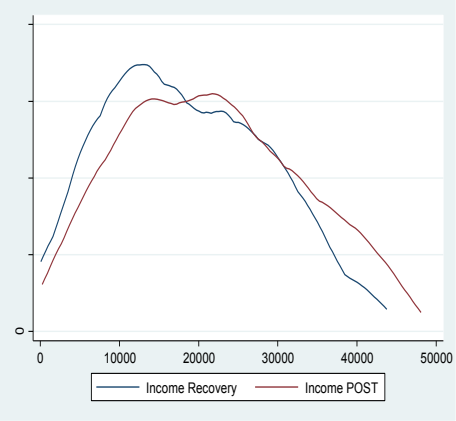

Figure 6c. Post flood to recovery period

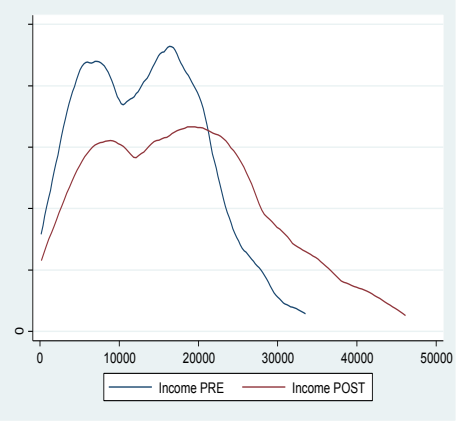

Figure 6d. Pre-flood to post-flood (Control Group)

RESULTS FOR MANCHAR: DIFFERENCE IN DIFFERENCES ANALYSIS

The qualitative analysis is suggestive of the impact of the floods being heterogeneous at different parts of the income, consumption or asset distribution. The following tables show the economic and statistical significance of these differences using DID analysis, that is, by comparing the outcomes of those hit by the flood to the counterfactual of those not hit by the flood.

Table 1 shows the results of the fixed effects estimation of the models shown in equations (2) and (3), that is, the two-period analysis. Also estimated are models that allow for heterogeneity of the impact by quartile of the income distribution, with the lowest quartile acting as the reference category.

SUMMARY OF DID RESULTS FOR MANCHAR

Table 3 shows the results for two models for each of assets, income and consumption. The analysis compares the pre-flood and post-flood outcomes for the treated and control group. The ASSETS (1) model suggests that on average those hit by the flood ended up with lower

assets than the control group by around 23000PKR. ASSETS (2) disentangles this average and shows that the source of this reduction in asset values liesin the upper quartiles of the income distribution, with the only statistically significant effect coming from the 3rd quartile of income whose assets are reduced in value by approximately 40000PKR. Apart from a decline in income for the highest income quartile, this is the only significant impact on these hit by the flood compared to the control group.

Table 4 confirms what was predicted from the graphical analysis: compared to the control group there the flood has no impact on consumption, income or assets in the medium to long-term according to this DID analysis. In fact the first 3 income quartiles are slightly better off in terms of income and consumption in the recovery period.

One interpretation of these results is that the rich have reduced their assets in order to smooth consumption in response to the flood. The poor have either not lost assets or have not used them to smooth consumption. This is only partially in line with the theoretical predictions of Zimmerman and Carter (2003) for instance. Neither does this accord with the idea that the flood has pushed household into a poverty trap.

Variable	ASSETS (1)	ASSETS (2)	INCOME (1)	INCOME (2)	CONSUMPTION (1)	CONSUMPTION (2)
TREAT	-23168.7***	-10186.0	-667.7	226.9	1399.0**	1008.0
TREATinc2		-21714.3		-351.7		205.2
TREATinc3		-41150.0**		-91.1		-606.7
TREATinc4		1401.7		-2751.8**		1536.7
y1	-22830.6***	-22830.6***	3163.2***	3163.2***	2715.4***	2715.4***
_cons	97377.2***	96626.2***	7850.4***	7800.7***	16426.9***	16344.4***
N	411	394	411	394	411	394
r2	0.3	0.3	0.3	0.4	0.4	0.4

legend: * p<.1; ** p<.05; *** p<.01

Table 3. Impact in Manchar on Assets, Income and Consumption (PKRs, 2012): Pre-flood, post-flood analysis

Variable	ASSETS (1)	ASSETS (2)	INCOME (1)	INCOME (2)	CONSUMPTION (1)	CONSUMPTION (2)
TREAT3	-6146.3	-15721.4	-40.0	1619.5*	1643.0**	3296.9***
TREAT3inc2		15579.6		-1215.7		-1731.6
TREAT3inc3		-8699.4		-451.5		-1943.8
TREAT3inc4		19866.4		-4042.7***		-2677.1*
y2	-11097.4*	-11097.4*	1017.7***	1017.7***	5446.9***	5446.9***
_cons	97367.0***	97236.5***	8008.3***	7890.4***	16638.4***	16379.5***
N	414	397	414	397	414	397
r2	0.0	0.1	0.1	0.1	0.6	0.6

legend: * p<.1; ** p<.05; *** p<.01

Table 4. Impact in Manchar on Assets, Income and Consumption (PKRs, 2012): Pre-flood to recovery period

CAVEATS

There are numerous caveats that need to be mentioned in evaluating this preliminary excursion into the data. Aside from the fact that more investigation of the underlying heterogeneity of the impact needs to be undertaken, there are some serious issues concerning the econometric identification of the impact measure. The DID method relies on assumptions which in this dataset are untestable. For instance, the following assumptions must hold:

1. The trend in the transitory unobservable determinants of the outcome must be the same for the treatment and control groups

2. There can be no spillover between the treatment and control groups: e.g. via induced price changes (e.g. due to increased demands for commodities in the control group area), migration away from the flooded area, and so on.

3. Conditional on the unobservable fixed effects, the incidence of flooding must be random and not correlated with the unobservable determinants of household outcomes. If it were the case that those who were hit by the flood we those of a particular type, then the analysis is invalidated.

In addition to this there may be data problems that remain despite extensive and prolonged cleaning. One major worry is the use of recall data. It could be that serious measurement errors are arising in the outcome and explanatory variables. For instance, the descriptive statistics show that income levels are consistently underestimated since they are often lower than the reported consumption levels. It could be that poor or even strategic memories of the pre and post-flood periods are introducing variation that drives the results shown here.

Nevertheless, the results appear to tell an intuitive story about the impact of flooding, and this may be a measure of the quality of the data.

DISCUSSION OF RESULTS

Taken as read, the results indicate that on average the impact of the flood has had no long-lasting effect on consumption, income or assets in either Chotiari or Manchar. Even when one disaggregates the analysis by income groups, there is no indication that being hit by the flood has caused any permanent effects or pushed household into a poverty trap.

The level and pattern of impact differs across districts though. In Chotiari, all income groups appear to smooth their consumption levels, since these do not differ across the pre-, post-flood and recovery period, compared to the control group. All income groups that are hit by the flood have diminished assets in the post-flood period. Assets are reduced by 50% on average, and incomes for the richest quartile are reduced by a similar margin among the richest quartiles. This is commensurate with the behaviour of richer households: consumption smoothing by partially running down assets, that is predicted by economic models of behaviour under

risk, as well as evidenced in empirical work around the world (e.g. Carter et al., 2006a; Zimmerman and Carter, 2003).

In Manchar the story is different. The first thing to notice is that Manchar is much poorer in terms of assets, and hence consumption and income. The impact of the flood on assets is only negative among the richer quartiles. Here, the evidence suggests either that consumption is smoothed by running down assets, or, given that the impact on the poorer quartiles of income is also negligible, it could be that the flood had negligible impact per se. One possible reason for this is that the predominantly fisheries oriented livelihoods were augmented by the flooding, whereas the agricultural livelihoods were affected negatively, albeit temporarily.

However, a great deal more work is required in order to investigate the complete and nuanced story of the way in which the flood has been dealt with, the features that have attenuated or exacerbated the shock and the way in which people have been able to return to, and in some cases exceed the levels of assets, consumption and income of the control group.

Further research should focus on the role of credit institutions, local risk sharing, financial and other disaster aid, all of which, with more time, can be analysed using the dataset here.

REFERENCES

Carter M.R, Little, P.D., Mogues, T. and Negatu, W. (2006a). Poverty Traps and Natural Disasters in Ethiopia and Honduras World Development Vol. 35, No. 5, pp. 835–856.

Carter M.R, Little, P.D., Mogues, T. and Negatu, W. (2006b). Shocks, Sensitivity and Resilience: Tracking the Economic Impact of Natural Disasters on Assets in in Ethiopia and Honduras. IFPRI Development Strategy and Governance Development Working Paper No. 32.

Fafchamps, M., C. Udry, and K. Czukas. (1998) Drought and Saving in West Africa: Are Livestock a Buffer Stock?, Journal of Development Economics 55(2) 1998 pp.273-305.

Kurosaki T (2014). Vulnerability of household consumption to floods and droughts in developing countries: evidence from Pakistan Environment and Development Economics, page 1 of 27.

Zimmerman, F. and M. R. Carter. (2003) Asset Smoothing, Consumption Smoothing and the Reproduction of Inequality under Risk and Subsistence Constraints. *Journal of Development Economics* Vol.71 2003 pp.233-260.

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