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Abstract

In this study, we focus on impact of exposure to natural disaster on migration. Here, we focus on a very specific type of migration where the households send household member(s) outside the community for earning purposes. We study this in the context of a tropical cyclone called Aila in the southern coastal region of Bangladesh. We find the household's decision to migrate is systematically associated with exposure to natural disaster. We find this association for both self reported exposure to the natural disaster and also with the intensity of the exposure measured by total loss normalized by total asset of the household. We further find that households induced by the disaster to have a migrant member has less to gain from the migration compared to households who would otherwise migrate in absence of the disaster, suggesting evidence of sorting in migration decision. Public policy should recognize the importance of migration as a possible crisis coping instrument and also take into consideration the possible selection when designing policy to help people vulnerable to extreme weather and climate change.

Key Words:

Natural Disaster, Internal Migration, Crisis Coping

JEL Classifications: J61,Q54

1. Introduction

Bangladesh is among the countries that are the most vulnerable to climate change and global warming. It is a densely populated country with a very long coastline and intensive river systems. Tropical cyclones and seasonal floods have always been part of the country's history. However, with global climate change there is an added uncertainty that may contribute towards poverty and destitute especially to the households that are poor and may have limited capacity to cope up with such disasters. It is important to understand the different ways households can aim to smooth consumption when they face natural disasters. In this paper, we aim to understand the role of internal migration within the country as a risk coping strategy for households living in the southern parts of the country who were faced with a major tropical cyclone in recent history.

Households need to take an important decision regarding consumption smoothing. High variability in consumption can put a household in a precarious situation and can seriously harm its economic and mental welfare (Townsend 1994, Mani, et al. 2013). Under the reasonable assumption of households being risk averse, one can make a simple case that the overall utility of the households will diminish because of high consumption variance. This will be especially detrimental for the households that are already at a low level of consumption and any negative shock to income in absence of insurance can push the households below poverty and even a famine-like situation, negatively affecting capability of the households and perpetuating the poverty status (Chetty and Looney 2006).

Hence, households engage in different strategies to smooth their consumption over time and also over possible outcomes of different shocks. In absence of uncertainty, savings, credit and storage can allow a household to smooth consumption over time with varied level of efficiency resulting in second-best outcomes (compared to an ideal complete market situation a-la Arrow-Debreau). When households face uncertainty, they will require access to some types of risk sharing mechanism or insurance. The developing countries are typically typified by absence of a well-functioning insurance market and households usually depend on different types of informal and incomplete risk coping mechanisms such as informal or semiformal credit, seeking help through social or kinship network or external support such as government relief (Fafchamps 1999, Fafchamps and Lund 2003). Literature also recognizes labor market as a source of buffering against unexpected negative income shock and migration has been recognized as one of the most effective means to cope up with unexpected negative shock resulting from natural disasters (De Weerdt and Hirvonen 2016).

In this paper, we aim to understand the households' decisions to use temporary migration of a household member to help the household to cope with a specific natural disaster that took place in May of 2009 affecting about 14 southern districts in Bangladesh. The natural disaster comprised of a tropical storm called "Aila". Such storms are common in Bangladesh and occur several times during the relevant seasons because of the unique geography of the country. While the fatality for this particular case was moderate compared to previous incidents, there was widespread water surge because of coincidence of high tide and torrential rain which negatively affected about four million people and had long-term effects because of breach in embankments.

Given the nature of the negative shock resulting from Aila, we have a unique situation to study the impact of the disaster on an affected household's decision to use migration as a coping

strategy and smooth consumption. We study a very specific type of migration of the household, which, as we will show is not very uncommon for our sampled households. We study households who have at least one household member living either temporarily or for a significant amount of time outside of home to earn and support the households. As such we do not have households that may have left the Aila affected areas permanently with all household members. So, we study labor market participation outside the community where the migrant's household was currently living. We further restrict ourselves to migration inside the country only.

We use two self-reported measures to understand the effects of Aila on the households. We explicitly ask whether Aila affected the households or not. Moreover, we ask the households about the various losses experienced by the households (details of which will follow later). We normalized the losses by household's current asset level to understand the intensity of the shock. We use these two measures to understand the household's decision to send one or more household members outside home for earning and possibly helping the households to smooth consumption and provide a buffer against loss from natural disasters such Aila.

The paper is structured as follows. In Section 2, we describe the background and context of the study. In Section 3, we describe the data we use for the study. In Section 4, we briefly describe the identification strategy and some additional empirical implications that we test in the data. In Section 5, we present the results followed by a concluding section.

2. Background and Context

Bangladesh has long been known as a country prone to natural disasters and calamities. It is primarily a plain land country with two of the major rivers in Asia flowing through it. The river system is further unique as the rivers flow into the Bay of Bengal and the coastal river system presents itself with geographical peculiarity and also adds to the country's vulnerability to natural disasters such as flood, tidal surge and tropical cyclones.

While various parts of the country are prone to different types of disasters, the southern coastal region is particularly vulnerable to intense tropical cyclones of advanced categories. For example, since 1990, Bangladesh has experienced 17 different incidences of tropical cyclones categorized by the relevant authorities (see Figure 1). Two particular cases are worth mentioning here, which are Sidr (a category 4 storm that made landfall in November, 2007) and Aila (a category 1 storm that made landfall in May 2009, see Figure 2). Aila remains the less severe of the two and fatality from the storm and during its aftermath was also low compared to Sidr (see Paul 2010). This was partly because of Aila being less severe in nature and also because of post-Sidr resilience building in the community living in the cyclone-prone regions of southern Bangladesh.

However, for a number of reasons we concentrate on understanding Aila and its effect on household migration decision and remittance. We collected the data in June-July, 2011 and Aila was the most recent cyclone of its kind then. Since we relied on self-reported information based on recall, we believe the self-reported effects of Sidr will have higher measurement errors compared to Aila. The nature of havoc caused by Aila also has some peculiarities. The fatality was much lower and there were less displacement from Aila (especially compared to Sidr, see Paul 2010). Hence, it provides a better set up to study the type of migration we are interested in. Moreover, because of breach of embankment, there were widespread losses of crop and livestock. Income generating activities were seriously compromised locally, motivating households to take advantage of migration to smooth consumption.

So, both the timings of the cyclone and the survey give us ample opportunity to understand how exposure to natural disaster allows household to cope up using migration. We will use an exogenous variation in the loss from Aila to identify the possible impact of natural disaster on migration decision and possibly its role in risk mitigation (as suggested by Bryan, Chowdhury and Mobarak 2014). We will also provide findings suggestive of the hypotheses that households who are getting involved in migration have a negative return at the margin. Hence, while migration can potentially have a high average return, it is possibly rational for the marginal households not to be engaged in leaving the community and moving to other places to look for work.

3. Methodology

3.1 Data

We use data from a baseline household survey conducted by Institute of Microfinance (InM) in June-July, 2011. 1 The survey covered 3,977 households in the districts of Khulna, Patuakhali and Shatkhira. These areas are generally remote and lack many facilities that are generally conducive for economic development. Moreover, these areas have distinct ecological problems such as salinity intrusions. The then, two recent major cyclones had immense negative impacts on the lives of the people living in these regions. The survey collected the information on household characteristics, migration status, income, assets, expenditure, types of disaster and the loss they have faced during those disasters from June 2010 to July 2011, i.e. over the past one year from the time of the survey.

3.2 Measuring Loss from Aila

In our households survey we explicitly ask the respondents to recall the losses caused by Aila. Natural disasters like cyclone and associated tidal surge can lead to a number of different types of shocks affecting households in a number of different ways. Firstly, the households can lose valuable assets such as land and livestock from the natural disaster. Secondly, because of a shock to the local economy households can lose earning opportunities and incur income loss. Thirdly, the households may face unexpected expenses resulting from exposure to the natural disasters such as higher health spending or for recuperating capital losses because of natural disaster. We collect information for all these cases through a structured questionnaire.

We have further gathered information on all these outcomes that are losses in assets and income as well as increased expenditure. We sum over all these outcomes to measure total loss for a household resulting from Aila. We further normalize the total loss by total value of assets of the households. It is possible that rather than the absolute size of the loss from the shock, the size of the shock in relative to the “steady state” level of capital stock is a more important estimate of the extent of shock that is relevant to the household. We use both the dichotomous report of exposure to shock (= 1 if reported being affected by Aila, = 0 otherwise) and the loss ratio to understand the impact of the natural shock on internal migration at both extensive and intensive margins.

[1] The institute has since changed its name to Institute for Inclusive Finance and Development. The survey was carried out to be used for a baseline for an evaluation of a program intervention.

3.3 Measuring Migration

We use a separate migration sub-module from the questionnaire used in the baseline survey to understand the extent of migration. The module asks whether any household member(s) lived outside the household for a significant period over the past one year for earning purpose. Thus we are only focusing on economic migration of a household member or more where the household remains in the local community. We ask which district within Bangladesh the household member went and the country, if the migration happens to be overseas. We further ask the amount of remittances the households had received over the same period, if any. We use both of these information that is whether the household migrated within Bangladesh and, in the second sets of analyses, how much remittance the household has received from the migrant household member(s). That is we again try to understand the migration outcome at both extensive and intensive margins.

3.4 Conceptual Framework and Econometric Model

While we do not have an explicit model for the migration decision, we can consider that migrating to work outside of the local economy is an occupational choice from the household point of view with positive returns and cost that can vary across households. This latent distribution is not observable to us. The cost includes opportunity cost of migrant worker who can either choose to stay home and work locally or travel to some other place to earn. This opportunity cost is not observable to us, however, we can assume that natural disaster will lower the opportunity cost by squeezing the local economy by restricting the income earning opportunities. 2 Hence, at the margin natural disaster will push more households to have migrant member, which we aim to test in this paper. However, there is an obvious corollary that the households who are induced to have a migrant worker may also have lower return from migration and in expectation the coefficient on natural disaster in a remittance model should be negative.

Again, we test these hypotheses under the assumption that exposure to Aila is exogenous to the household and specially the intensity of shock once we have control for relevant factors and asset levels through the normalization. However, households with certain characteristics can get exposed to natural disasters and we cannot reject this hypothesis completely. We control for the relevant set of variables in our model. For the remittance, we understand the model is left truncated and depend on the household's migration decision. Hence, we use a Tobit model to measure the possible impact of disaster on remittance. We further use an instrumental variable framework to check the robustness of this test. 3

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[2] Thus, we are basically invoking the classic Roy model of self-selection with some weak restrictions. Roy model was primarily developed to understand the migration decision as well and quite appropriate for this context as well. See Heckman and Honore (1990) for a discussion of Roy model.

[3] A similar framework has been used by Alem, Maurel and Millock (2016).

4. Findings

4.1 Household Characteristics

We present the basic household characteristics in Table 1. The results show that within our sample about 86 percent of the households are headed by a male member. This is quite typical in a patriarchal society like Bangladesh where men are usually decision makers of the households and hence considered as the head. The average age of the household member is 43 years and about 85 percent of them are married. Agriculture constitutes the most common occupation, which can include both daily labor work in agriculture sector or self-employment. We have a large uncategorized group that comprise of various service sector jobs and also some categories where the household heads are not participating in the labor market either formally or informally. We further look at some additional household characteristics. We find on average the households have about 1.3 members in the working age of 16 to 55. The average number of children per household is about 1.4 with an average household size being about 4. One should note that the average household size is somewhat lower than the national average of about 4.7 according to HIES (see BBS 2011). This is not very uncommon as households with high resource constraints often maintain a small household size to manage better the limited resources that they may have.

We further look at the remoteness of the households in the study area, which is a concern and can potentially add to the state of deprivation of the household. We find that the households have an average distance of eight km to the nearest "pacca" or paved road. The marketplaces are also about two and four km for small and large ones respectively. Even for drinking water, an average household needs to travel about six hundred meter with a large variation. The households also possibly face barrier to microcredit, which can provide much needed cash when they are faced with disaster (Udry 1994). Hence, the households in this area may have added benefit of migrating compared to other areas in Bangladesh.

4.2 Summary of Reported Disasters

Table 2 presents information on the effects of Aila. The majority of the households or about 52 percent reported to be affected by Aila. This suggests that households in this area are especially vulnerable to natural disasters such as tropical cyclones. As mentioned before, we measured the losses associated with Aila in three categories: loss in income, loss of asset and the cost or expenditure increased because of Aila. The households reported an average loss of 9.3 thousand taka, which is the largest in terms of size compared to other two types of losses. Households further reported to have a higher spending of about three thousand taka after Aila The income loss was about three thousand taka on average which is comparatively lower than other types of losses. On the other hand, the households also reported receiving support from the government and other agencies and the average value of this support amount to about four thousand taka.

We further normalize the losses with the current level of assets of the households. To estimate the total value of assets, we use multiple modules that collect households' asset information of various types (e.g. land, livestock, household non-durables). We add the reported current values of all the assets and use the total sum as the denominator. The average value of total loss as fraction of total asset is 0.27 with a standard deviation of about 0.88. We further show the distribution of the ratio for the households who reported being affected by Aila in Figure 3. The distribution further suggests that we have reasonable variation in the loss ratio outcomes among different households.

4.3 Migration Outcomes

We present the migration outcomes in Table 3. We find that about 703 households (or about 18 percent) reported at least one household member living outside home for the purpose of work during the past one year. Average number of household member migrating is 1.18 conditional on being a migrant family (i.e. among 703 households mentioned before). About 98 percent of the migration took place within Bangladesh with only 1.28 percent of the households reported a foreign migration.

Households received an average remittance of 8,324.84 taka. The households with migrant family member(s) received on average inward remittance of about 8,060.03 taka. There are also households in our sample who received remittances from somebody who they did not consider a household member. The average remittance received for this group was about 11,327.42 taka, which is interestingly higher than the previous group.

4.4 Impact of Disaster on Migration

Next, in Table 4, we present the impact of Aila on migration decision of the households. We use two different indices of natural disaster. For the first case, we use a dummy variable for self-reported exposure to Aila. We find that without the covariates we have an odds ratio of 1.37 with a p-value < 0.01). Hence, we find that the migration is associated with the households being exposed to tropical cyclone. When we further control for other covariates the odds ratio declines to 1.13 with a p-value of 0.16. So, while weaker, we still find a positive association between migration and experience with disaster about two years before the survey.

We further use a second measure of households' exposure to disaster, which is the total loss as a ratio of total household asset. The results are presented in Table 4, columns (3) and (4). We find that a loss ratio is associated with an odds ratio of 1.11 with a p-value of 0.03. With covariates, the odds ratio is 1.05 with a p-value of 0.03. This suggests that a loss ratio from 0 to 1 or a 100 percent increase in losses from Aila as a ratio to total asset is associated with a higher odds ratio of 1.05 of having at least one migrant household member.

These results suggest that there is an association between a household's exposure to natural disaster and that household's decision to have a migrant member. With a limited opportunity for the households to share risk within or outside the community and in absence of any insurance market, households engage in different strategies to ensure consumption smoothing, not fall back to poverty, to recover the lost assets and meet the excess expenditure that may be caused by common natural disasters such as Aila. While we are associating the migration to a specific type of disaster, which is tropical storms, it may also be linked with potential climate changes. As weather variability is expected to increase because of global warming, households may increasingly rely on short-term migration to cope up with such disasters and this may have further implication for the country's labor market that public policies may need to address.

4.5 Earnings from Migration Induced by Disaster

Next we look at remittance received by the households with migrant family members who were induced by migration. We will use a simple OLS model comparing remittance received between households exposed to Aila and not. We will also use the loss ratios as before to understand the relationship between intensity of disaster and remittances.

We show the results in Table 5. We find that the households exposed to Aila received 906 taka less than the households that reported no exposure to Aila (column (1)). We further find, taking log of the outcome variable to find that this amounted to about 27 percent lower remittance. However, we should keep in mind that remittance is a left censored variable with only positive values. So we use a Tobit model to correct for the possible bias because of this in the OLS models (columns (1) and (2)). The results show that exposure to Aila is associated with receiving about eight thousand take less or about one-fourth of what a household would receive if it were not exposed to Aila. The point estimates are robust if we use loss ratio instead of the dummy variable for exposure to Aila (see columns (5) and (6)).

We further use IV model to understand the impact on remittance for the households who are possibly in the margin. We use the interpretation that argues that IV estimates are basically local average treatment effects for the people who changed their decision because of the instrument (see Imbens and Angrist 1994, Heckman, Urzua and Vytlacil 2006). We show the results in Table 6. The results conform to hypothesis that households may be selecting to send household members outside the community and this is a negative selection in the sense that the households in the margin are even less likely to benefit from the migration and the remittance that they received are actually less than the households who received remittance but were not constrained in absence of the disaster.

5. Concluding Remarks

Migration, either temporary or permanent, has commonly been considered as the survival strategy to cope up with the natural disaster (De Weerdt and Hirvonen 2016). Weather variability and associated loss in agricultural productivity induces rural population to migrate to urban and other areas where local economy can provide better income opportunities enhancing migrant and household welfare (Iqbal and Roy 2015). However, the households' capacity to take advantage of such migration will depend largely on net benefit it can accrue from the migration choice and we can assume, in absence of an exogenous shock, household members perhaps already made the optimal migration decision based on unobserved comparative advantage. A direct corollary is marginal households induced by exposure to disaster can benefit less than an average household, thus the benefit from migration can be overstated.

This has important implication for public policy. For example, economic development has traditionally been accompanied by structural transformation where surplus labor from the rural sector has been absorbed into more advanced sector of the economy (for a classic explanation of this process, see (Lewis 1954, Harris and Todaro 1970). One can also advocate policies conducive to this transition, which can exhibit high rates of return and net benefit in terms of higher income for the migrant and higher consumption and nutritional intake for the sourcing household (Bryan, Chowdhury and Mobarak 2014). However, there are two potential caveats. Firstly, the migration is risky and average improvement may mask the cases of failure and even small risk can inhibit otherwise beneficial migration. Secondly, the households at the margin may already have sorted into not migrating based on their possibly hidden ability, suggesting the estimated benefit cost ratio may be an upper bound.

However, it is possible that the whole climate change issue makes the whole argument moot in the sense that increased weather severity from global climate change will push households or household members to seek work opportunities outside their homes. Bangladesh is one of the most

vulnerable countries to global warming and the households studied here live in areas that pose additional uncertainty to the households. There are previous works that have used more aggregate level data to understand the role of weather variability and migration, mediated possibly through fall in agricultural productivity (see Iqbal and Roy 2015). A major contribution of the present study is to relate the findings of these existing studies using micro household data from the southern coastal areas of Bangladesh.

We can draw some policy implications from the analyses. Firstly, we find that disaster is systematically associated with households sending members outside the community to earn. Hence, migration is indeed a mechanism by which households tend to cope up with disasters (Alem, Maurel and Millock 2016, De Weerdt and Hirvonen 2016). Such migration can certainly allow households with a significant return on migration investment (as evident from work of Bryan, Chowdhury and Mobarak 2014). However, these households are already resource constrained and any misadventure in costly migration can cause household significant loss in welfare (because of high concavity in utility function in the lower levels of capital, see Chetty and Looney 2006). So disaster insurance supporting such migration can further help the households to cope up better against natural disaster. Secondly, while evaluating such program, we should also keep in mind that a marginal migrant may have much less to benefit from such endeavor. So reducing the cost of migration and finding suitable jobs outside the community can further improve the welfare of the migrants and their households. Policy recommendations need to pay attention to these nuances to adapt better to an inevitable and very likely global climate change scenario.

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Table 1: Household Characteristics

	Mean	SD
Characteristics of Household Head		
= 1 if Male	85.8%	34.9%
Age in years	42.6	13.8
= 1 if Married	84.6%	36.1%
Primary Occupation		
Agriculture	48.7%	50.0%
Non-agriculture day job	3.8%	19.1%
Other Services	3.3%	17.8%
Earth Digging	9.1%	28.8%
Transport Sector	9.5%	29.4%
Uncategorized	25.6%	43.6%
Household Characteristics		
Working Age Member (N)	1.28	0.65
Children (N)	1.43	1.08
Household Size	4.01	1.46
Dependency Ratio	0.39	0.22
Distance in km to the nearest		
pacca road	7.95	14.27
small market place	1.91	1.63
big market place	3.91	2.45
source of drinking water	0.56	1.19
branch of MFI	3.08	1.97

Source: Household Survey. Total number of households is 3,977.

Table 2: Information on Households' Exposures to Aila

	N	Mean	SD
= 1 if affected by Aila	3977	51.9%	50.0%
Total Loss from Aila (BDT)	3977	13.83	70.26
Remedial Help Received (BDT)	3977	4.33	12.25
Total Asset Loss from Aila (BDT)	3977	9.31	24.74
Total Income Loss from Aila (BDT)	3977	1.51	63.48
Total Extra Expenditure from Aila (BDT)	3977	3.01	10.49
Loss net of Remedial Help (BDT)	3977	9.50	68.05
Total Loss as fraction of Total Asset	3966	0.27	0.88

Source: Household Survey. Total loss is measured by adding household reports of value of total asset losses, income losses and higher expenditure because of exposure to Aila in May 2009. Total asset values is measured at the time of the survey by adding values of land, livestock, households durables and others.

Table 3: Summary Information of Migration Outcomes

	Value	N
Number of households with at least one member migrating in the past year	703	3977
% of total households reported at least one migrant member	17.68	3977
Average number of household member(s) migrating	0.21	3977
Conditional on households reported at least one migrant member	1.18	3977
… of which		
Internal	98.43%	702
External	1.28%	702
Both	0.28%	702
Average amount of remittance (BDT)		
Overall	8,324.84	765
Migrant HH	8,060.03	703
Non-migrant HH	11,327.42	62

Source: Household Survey. Migration outcome is defined as household having one or more members staying outside for income purpose over the past one year.

Table 4: Effect of Aila on Migration of the Household

	(1)	(2)	(3)	(4)
Aila	1.37***	1.13		
	(0.00)	(0.16)		
Loss Ratio			1.11**	1.05**
			(0.03)	(0.03)
Observations	3,977	3,977	3,966	3,966

Note: ***, **, * represent level of significance of the coefficients at 1%, 5% and 10% level respectively. P-values are reported in parentheses. The outcome variation is defined as household reporting a member staying outside home over the past one year. Odds ratios are reported in here. We have controlled for household head and household characteristics as included in Table 1.

Table 5: Impact of Natural Disaster on Remittances Received by the Households

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS Results		Tobit Results			
VARIABLES	Remittance (BDT)	Ln (Remittance)	Remittance (BDT)	Ln (Remittance)	Remittance (BDT)	Ln (Remittance)
Aila	-906.03***	-0.27***	-7,993.80***	-3.04***		
	(218.93)	(0.08)	(2,388.79)	(1.08)		
Loss Ratio					-7,286.51**	-3.12**
					(2,980.71)	(1.33)
Observations	3,977	3,977	3,977	3,977	3,966	3,966

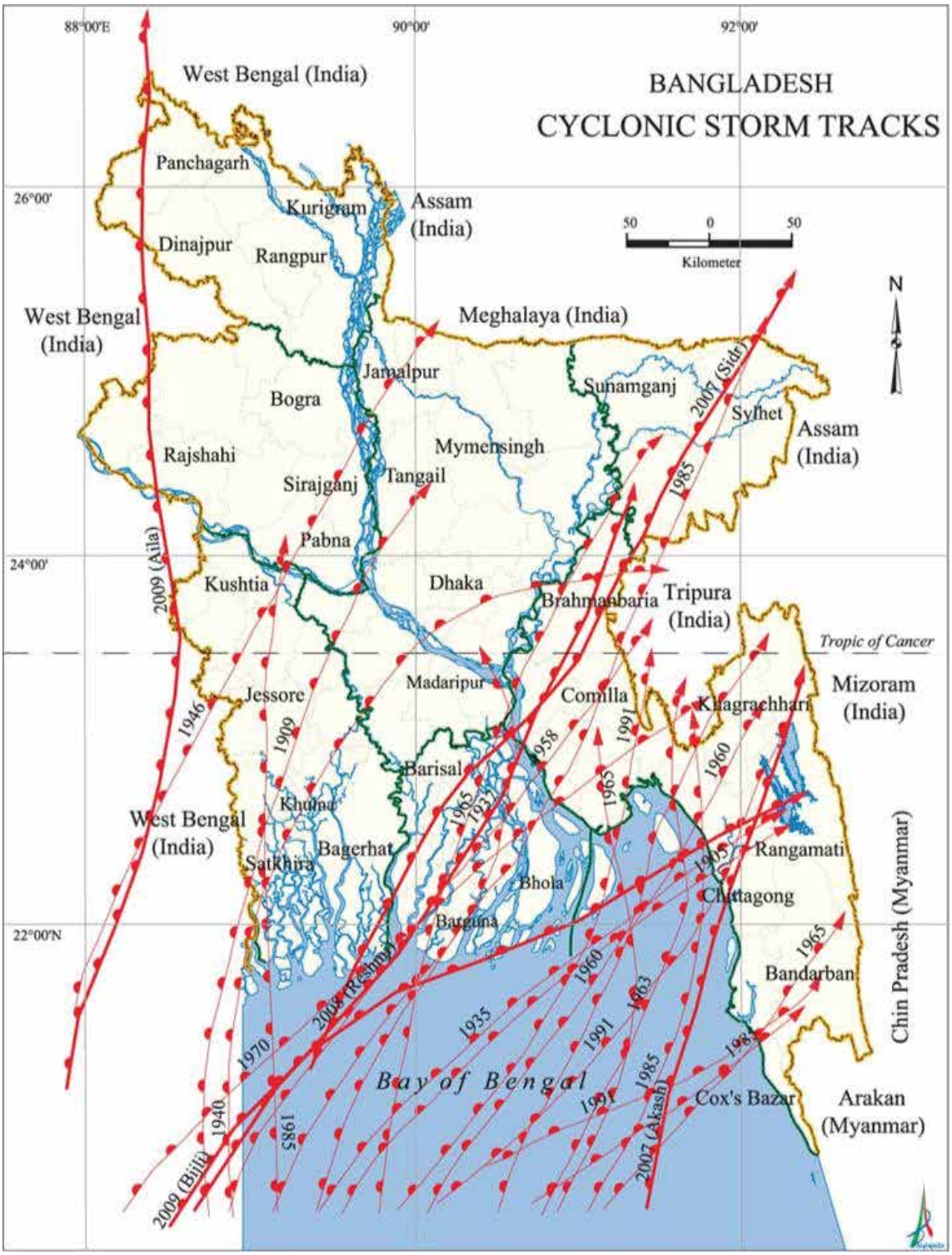
Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. We have controlled for household head and household characteristics as included in Table 1.

Table 6: Instrumental Variable Model for Remittance Outcomes

	(1)	(2)	(3)	(4)	(5)	(6)
		Remittance	Ln		Remittance	Ln
	Migration	(BDT)	(Remittance)	Migration	(BDT)	(Remittance)
First Stage						
Loss Ratio	0.329***			0.197***		
	(0.058)			(0.061)		
IV Estimates						
Migration		-14,557.05***	-5.33***		-26,006.98**	-9.39**
		(4,735.10)	(1.87)		(11,257.61)	(4.37)
Observations	3,977	3,977	3,977	3,977	3,966	3,966

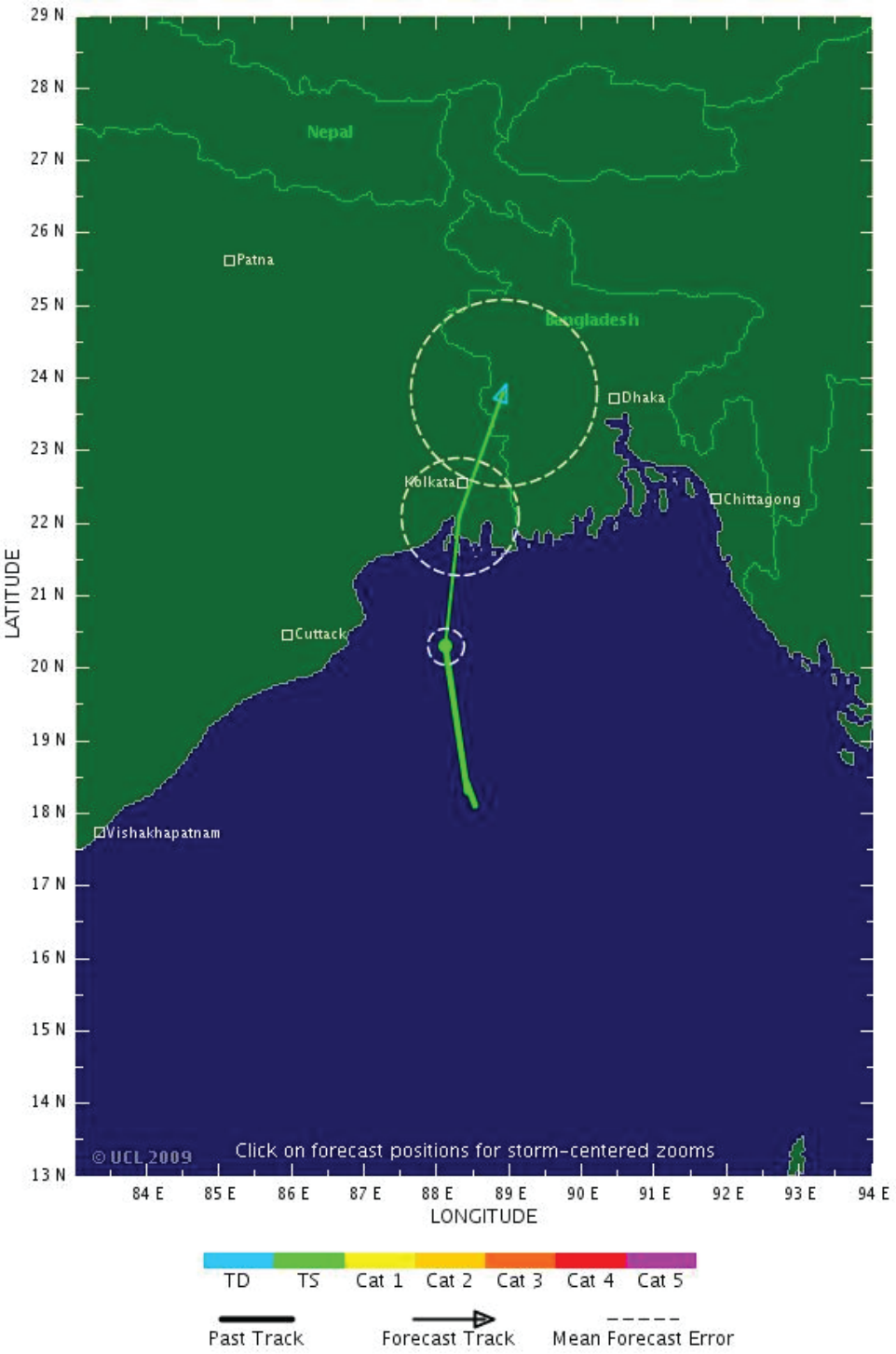
Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. We have controlled for the household head and household characteristics as included in Table 1.

Figure 1: Cyclonic Storm Tracks of Bangladesh



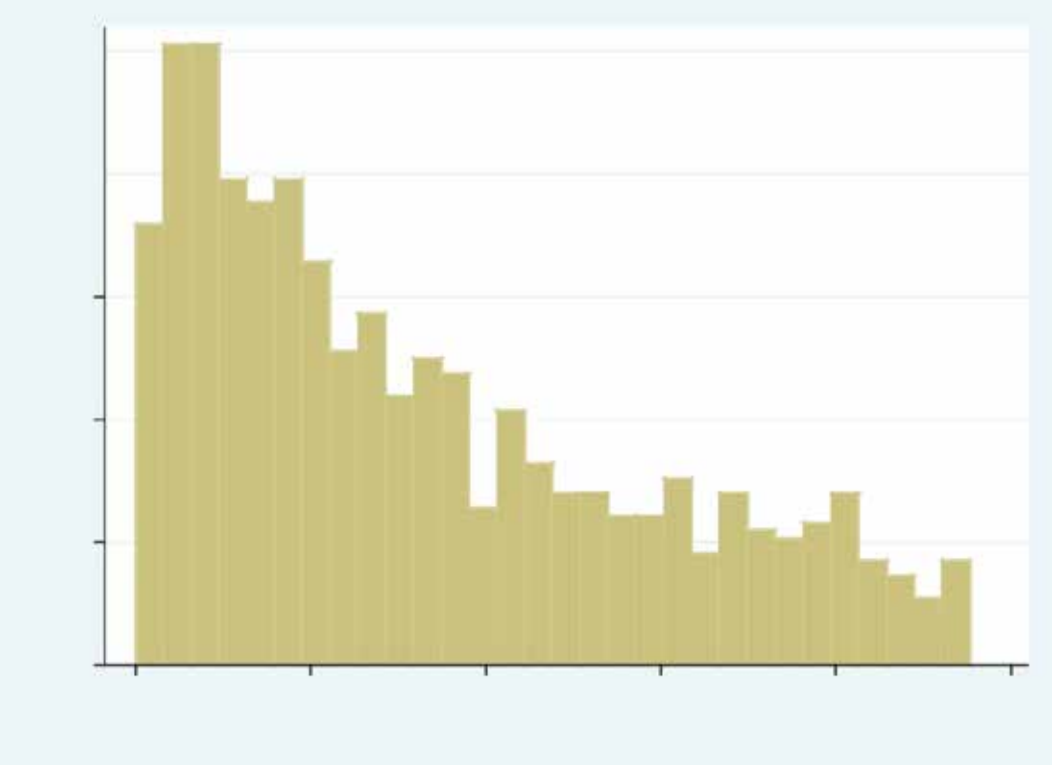
Source: Banglapedia. Link: https://goo.gl/ah0ppZ. Accessed on May 2, 2017

Figure 2: The Path of Aila



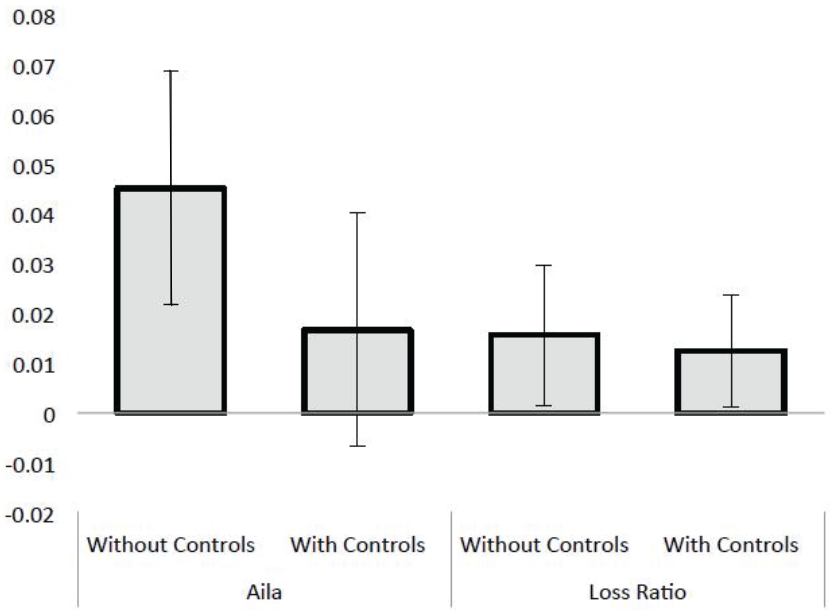
Source: http://www.lcgbangladesh.org/derweb/cyclone2009/predistion.html. Accessed on May 4, 2017

Figure 3: Distribution of Loss Ratios



Source: Authors' calculations from the household survey. The extreme values have been winsorized.

Figure 4: Excess Probability associated with Exposure to Aila



Source: Authors' calculations using household survey data.

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