Natural Disasters and their Labor Market Consequences: Evidence from the 1998 Flood in Bangladesh

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Abstract: Natural disasters have particularly devastating impacts on economic growth in developing countries since they impede the accumulation of capital. The resilience of labor markets is crucial especially for the poor who rely only on labor to diversify their income portfolio and buffer against risk. Such a risk management strategy may become more challenging as global climate change increases the frequency of natural disasters. We use the Bangladesh Flood Impact panel household survey to evaluate how the 1998 "flood of the century" affected labor markets in Bangladesh. We find long-term declines in wages where non-agricultural labor markets are more severely affected. We also evaluate how the availability of irrigation, drainage, credit access, and proximity to auxiliary labor markets cushions labor markets against the disaster. The most compelling evidence shows that workers in areas further from centers of economic activity are more vulnerable to flood-induced wage losses. Our findings suggest that future emergency relief and climate change programs should consider the protection of labor markets by improving infrastructure to facilitate job searches in alternative locations or reduce migration costs.

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Natural disasters can have devastating long-term impacts because they can impede the accumulation of physical and human capital stock (Skoufias, 2003; Yamauchi, Yohannes, and Quisumbing, 2008a, 2008b). It is now widely accepted that climate change will not only increase the frequency of two types of natural disasters that affect agriculture and rural households, droughts and floods, but will also alter rainfall patterns, thereby changing farming practices, household behavior, and welfare. According to the IPCC Fourth Assessment Report, anthropogenic emissions may be responsible for at least a 40-cm sea-level rise by the 21st century (IPCC, 2007). Such increases in sea-levels cause the salinization of ground and surface water sources, jeopardizing the supply of drinking water, capacity to produce crops, and displacing populations.

Numerous studies have accounted the adaptation strategies adopted by households to reduce the income loss incurred by short-term shocks (e.g., Kazianga and Udry, 2006). In the absence of credit markets, households can underinvest, exchanging lower risk portfolios for lower average returns, (Zimmerman and Carter, 2003; Rosenzweig and Binswanger, 1993; Eswaran and Kotwal, 1990) or sell their productive assets without replenishing them after the shock (Fafchamps, Udry, and Czukas, 1998; Rosenzweig and Wolpin, 1993). These short-term coping strategies affect the growth of current markets and the development of future markets. Economic stagnation particularly with respect to agricultural growth is more prominent in areas that experience frequent shocks (Sachs, 2001; Gallup and Sachs, 2000).

Examining the relationship between climate shocks and labor markets is particularly relevant for the design of future development and climate change strategies. Households migrate or seek labor in rural agricultural and non-agricultural markets to diversify their portfolio and buffer against risk (Takasaki, Barham and Coomes, 2007; Cameron and Worswick, 2003; Rose, 2001; and Kochar, 1999). It then becomes crucial to understand how resilient these markets are to climate shocks and the extent to which these markets can absorb the excess labor induced by shocks. Policies aimed at improving the reallocation of labor after the shocks, e.g., by protecting or facilitating migrant labor markets, may be a lower cost alternative to other investment-heavy candidates.

Bangladesh is a country where annual flooding is considered a normal part of the agricultural cycle. However, severe floods, such as those occurring in 1998, can have devastating short- and long-term impacts. Unlike the “normal” floods that occur annually, the 1998 floods lasted until mid-September in many areas, covering more than two-thirds of the country, causing over 2 million metric tons of rice crop losses (equal to 10.45 percent of target production in 1998/99) (del Ninno et al., 2001). Using district-level data, a recent study evaluates the impact of riverine floods on agricultural wages in Bangladesh (Banerjee, 2007). Banerjee (2007) finds agricultural wages decline by 5 percent in areas that are more flood-prone and by 14 percent in severely exposed areas during “extreme” floods in the short term. We build upon this work by evaluating both the short-term and long-term effects of the most severe flood experienced by households in Bangladesh, using a household panel survey that was specifically collected for this purpose immediately after and five years after the 1998 flood. In addition to using a household panel, our data extends beyond the time period used in Banerjee (2007) to account for the long-term impacts of this particular flood. Our paper also makes an additional contribution by measuring the flood effect on non-agricultural labor markets and identifying specific mechanisms that mitigate labor market damages in the short and long term.

We estimate reduced-form wage regressions using four rounds of the Bangladesh Flood Impact household panel survey collected by the International Food Policy Research Institute.

The panel has four rounds spanning immediately after the September flood, November-December 1998, to five years after the flood, April-May 2004. The survey was administered to 757 randomly-selected households in 126 villages which were chosen on the basis of flood severity and representation of low income households (del Ninno et al., 2001). The survey has been used to account for immediate (del Ninno, Dorosh, and Smith, 2003; del Ninno et al., 2001) and long-term 1998 flood damages (Quisumbing, 2005a, 2005b) with a specific focus on asset losses, consumption declines, and reductions in nutritional status. Yamauchi, Yohannes, and Quisumbing (2008a, 2008b) have more recently looked at the impact of flood exposure on human capital accumulation. We broaden the evaluation of the 1998 flood to include its impact on labor market shifts, specifically measuring how the magnitude of this flood affected the wages of daily and casual laborers in the long term. Our identification strategy depends on the inclusion of district and time fixed effects to control for unobserved spatial and time heterogeneity, as well as reported pre-flood wage information to control for the initial labor market conditions of each village.

Our empirical results show that for every one-foot deviation from the usual flood depth, daily wages on average declined approximately 2 percent. Upon distinguishing between short- and long-term effects on wages, we find that the long-term impacts dominate. In particular, variation in wages a year after the event could not be attributable to the deviations in the flood depth that occurred in 1998. However, we did find a statistically significant impact of the magnitude of the flood on the variation of wages after five and a half years. The persistence of damages five years past the natural disaster is consistent with findings related to drought effects on labor markets in Brazil (Mueller and Osgood, forthcoming) and on growth patterns in Ethiopia (Dercon, 2004). Wages declined between 4 and 5 percent for every one-foot (increase) from the usual flood depth over five years after the major flood. Further distinguishing between agricultural and non-agricultural labor markets, we find agricultural markets experience a wage loss of 4 percent, which remains constant over time. In contrast, non-agricultural labor markets experience a greater decline in wages of around 7 percent, with greater losses over time. The persistent negative impact of the flood on credit dependence in Bangladesh may be partially responsible for the negative long-term impact on investment in labor and other related markets (del Ninno, Dorosh, and Smith, 2003). Our findings also corroborate the limitations of the food assistance programs in Bangladesh, which enhanced food availability in the short term but had no bearing on long-term household purchasing power (Quisumbing, 2005a).

We also evaluate the roles of mitigating factors on cushioning labor markets from severe flood damages. In particular, we measured how factors related to labor demand and/or supply dampened the impact of floods on wages. The factors under investigation were i) irrigation, which can reduce vulnerability by shifting cultivation to the dry season; ii) drainage capacity, which can reduce the scope of crop loss; iii) the presence and scale of an informal credit system, which can reduce distress sale of assets; and iv) proximity to markets and bazaars, which provide workers access to additional outlets for surplus labor. Our results indicate that labor markets in predominantly clay-soiled areas were more severely affected than other areas in the short term. While we observe the potential for irrigation and credit access to mitigate the flood impact on labor markets, the labor market effects were not statistically significant or robust (in the case of credit access). Finally, we find that labor markets that were closer to the weekly market or bazaar were less affected than those further away. This suggests that the lack of auxiliary labor markets for workers exacerbated the impact of floods on wages. While the analysis is representative of a modest number of villages in Bangladesh, our work suggests that future development and disaster relief policies might consider increasing workers' access to additional labor markets through investments in infrastructure and transportation.

In what follows, we provide a theoretical framework and a review of the literature describing why labor markets may be affected by natural disasters in the long term (Section I). We then account the chronology of the 1998 flood in Bangladesh and summarize the findings from previous studies (Section II). In Section III, we describe the household panel survey. We present our empirical model, identification strategy, and empirical results in Section IV. Our concluding remarks are discussed in Section V.

1 Theoretical Insight on Natural Disasters and Labor Markets

Applications of the permanent income hypothesis (PIH) model (Modigliani and Brumberg, 1954; Friedman, 1957) have been used to demonstrate household vulnerability to adverse shocks. In the model, each risk-averse household chooses a consumption pattern over time to maximize its expected utility over a finite period. The model predicts that changes in household consumption depend only on unanticipated changes in permanent income (expected lifetime earnings). The PIH model essentially assumes that households have unlimited access to credit. Households smooth fluctuations in income by saving during periods of high income and borrowing during periods of low income. Paxson (1992) popularized the use of this framework evaluating saving responses to income shock proxies, deviations in rainfall. She finds a high propensity of savings comes from transitory shocks to income, indicating the use of savings to smooth consumption. However, smoothing may be incomplete since there is also a positive propensity of savings with respect to permanent income. Several studies have expanded upon her work by observing consumption responses to permanent income over time. Other work also considers the relevance of asset-smoothing in the absence of credit markets (Kazianga and Udry, 2006; Zimmerman and

Carter, 2003; Udry, and Czukas, 1998; Morduch, 1995; Rosenzweig and Binswanger, 1993; Rosenzweig and Wolpin, 1993). Most of these studies find that consumption-smoothing is incomplete even in the presence of informal insurance arrangements.

A related literature has emerged to understand the role of labor supply adjustments to facilitate household coping among low-income households (Takasaki, Barham and Coomes, 2007; Cameron and Worswick, 2003; Rose, 2001; and Kochar, 1999). Adjustments in labor supply depend on the relative importance of the income and substitution effects. If a damaging shock is realized (e.g., severe flooding), then the income effect is such that the household will increase their labor supply to maintain a minimum level of income (Rose, 2001). The substitution effect is indeterminate, and will depend on the relationship between the shock and productivity in the own-farm production and labor market. With the exception of Cameron (2003), the empirical evidence in this literature generally indicates that the income effect dominates or the conditions are such that the substitution effect reinforces the income effect. Kochar (1999) finds household males increase their market hours. Rose (2001) observes increases in labor participation rates in response to risk, however, households facing riskier distributions ex ante adjust less ex post than other households. Cameron (2003) finds workers allocate their labor to more productive forms of employment rather than adjust their total hours worked. Takasaki, Barham, and Coomes (2007) find that households intensify fishing effort in response to flood-induced crop loss. While households can mitigate damages from adverse shocks through labor supply adjustments, these studies find that such coping strategies offer only partial insurance; income generated from such strategies does not compensate for losses in consumption or profit. Moreover, climate shocks can have severe and persistent impacts on labor demand because of the destruction of productive assets and failure to replenish them.

The aforementioned studies provide insight on the vulnerability of households to climate shocks in the short-term. However, very few studies demonstrate the long-term impacts of incomplete smoothing or the ramifications of widespread severe covariate shocks on markets as a whole, possibly because of data limitations. This is an important gap in the literature, because there may be several reasons why we may expect a short-term climate shock to affect factor markets in the long-term. Community risk-sharing prevalent in other settings (e.g., Townsend, 1994) may be limited in these contexts and informal credit systems overburdened. A lack of credit institutions could lead low-income households to invest in less-risky portfolios with lower average returns (Zimmerman and Carter, 2003; Rosenzweig and Binswanger, 1993; Eswaran and Kotwal, 1990). Some households cope with climate shocks in the short-term by selling their productive assets to obtain a minimum level of consumption (Kazianga and Udry, 2006; Fafchamps, Udry, and Czukas, 1998; Rosenzweig and Binswanger, 1993; Rosenzweig and Wolpin, 1993). Since the occurrence of climate shocks can trigger an underinvestment in capital, labor markets may also be affected in the long-term. As long as farmers are unable to replenish their productive assets, agricultural labor demand will decline. The scope of this problem will depend on farmers' credit access and the complementarity of labor and capital. Moreover, the surplus of agricultural labor may seek employment in the non-farm rural sector. Depressed wages in the local non-farm labor market may ensue if migration is costly or the demand from the rural non-farm sector is insufficient to accommodate the surplus labor induced by the shock. In a recent study, Jayachandran (2006) finds shock-induced wage losses are reduced in areas with greater access to credit and lower migration costs.

2 Contextualizing the Bangladesh "Flood of the Century"

Bangladesh experiences an annual flood, ranging days or weeks in July or August, that covers thirty percent of the country (del Ninno et al., 2001). Because farmers are accustomed to these floods, production losses attributable to these events are uncommon. Severe floods are also part of Bangladesh's history, with specific cases occurring in 1954, 1974, 1987, and 1988. The 1998 flood achieved similar dangerous depths in comparison to the 1988 flood; however, households sustained these levels for 25 more days (del Ninno et al., 2001). The floods began in early July and did not end until mid September, affecting sixty-eight percent of the country at various times (del Ninno et al., 2001).

The government of Bangladesh responded to the flood by providing food assistance through two programs. The Gratuitous Relief (GR) program, initiated in August 1998, was designed to provide food aid to households living in flood-affected areas. The Vulnerable Group Feeding (VGF) program was a larger scale program targeting flood affected areas as well as relatively poor segments of the population. Once the targeted communities were selected, the communities themselves selected recipient households based on their earnings, asset holdings, and employment status. In her evaluation of the programs, Quisumbing (2005b) determined the VGF was more successful at targeting the poor than flood-exposed households. The participation of the program has dwindled over time. For example, among the households sampled by the Bangladesh Flood Impact survey, the percentage of villages receiving GR dropped from 66 percent at the time of the flood in 1998 to 8 percent in January-April of 2004 compared to the 69 percent of villages receiving VGF dropping to 18 percent over the same period (Quisumbing, 2005b).

Del Ninno et al. (2001) and del Ninno, Dorosh, and Smith (2003) examine the immediate impacts of the flood. Del Ninno, Dorosh, and Smith (2003) observe changes in the consumption, nutritional, and borrowing behavior of households over a 13-month period after the drought (using the first three rounds of the IFPRI Bangladesh survey used in this paper). They find calorie consumption of poor households fell to 1638 calories per person by November 1998 but rose to 2208 calories per person in April 1999 and 2200 calories per person in November 1999, which they attribute to decreases in rice prices (del Ninno, Dorosh, Smith, 2003). Twenty-two percent of children in flood-exposed households were wasted immediately following the flood (del Ninno, Dorosh, Smith, 2003). By 1999, fifty-four percent of households were still in debt, with debt comprising a large share of total expenditure (del Ninno, Dorosh, Smith, 2003). The channels of borrowing were largely formed by neighbor and friend networks perhaps due to the high institutional loan interest rates ranging from 21% to 67 % (del Ninno, Dorosh, Smith, 2003).

The 1998 flood also had short-term ramifications on asset ownership and employment in the first three months after the flood. Fifty-five percent of households lost assets comparable to 16 percent of their pre-flood asset values (del Ninno et al., 2001). The destruction of assets was more severe for households with greater levels of flood exposure. Poor households' losses largely were in the form of housing and their productive assets (e.g., cattle and poultry) (del Ninno et al., 2001). The wage labor market also was greatly affected by the flood in the short term. Day laborers suffered underemployment, working 3 days less in October-November of 1998 than in 1997 (del Ninno et al., 2001). Wages also declined 18 percent below the pre-flood wage levels (del Ninno et al., 2001).

Quisumbing (2005a, 2005b) and Yamauchi, Yohannes, and Quisumbing (2008a, 2008b) recently evaluate the long-term impact of flood exposure on consumption, physical capital and human capital accumulation. These studies are based on the Bangladesh Flood Impact survey used by (del Ninno et al., 2003) plus an additional round collected in 2004 to capture the longer-term impact. Quisumbing (2005a, 2005b) focuses on the role of food assistance programs in protecting household consumption and asset holdings. Quisumbing (2005a) finds poor GR participants have significantly greater levels of assets 15 months after the flood. She determines that the GR program was more successful than the VGF program due to its immediate allocation of food and targeting effectiveness, owing to the participation of severely flood-exposed households in the former in contrast to impoverished households in the latter (Quisumbing, 2005a). Yamauchi, Yohannes, and Quisumbing (2008a, 2008b) estimate the long-term impact of flood exposure on human capital accumulation. They find that, while the flood slowed schooling progression for children, those children who were taller prior to the flood were less adversely affected. This suggests that prior investment in child biological human capital—such as investment in child nutrition—protects against more severe impacts on investments in schooling. These studies provide evidence of the long-term adverse impacts of the 1998 floods in addition to the sensitivity of these impacts to *ex ante* and *ex post* coping strategies and interventions. This paper builds on this work to examine how the 1998 flood affected labor markets and what factors helped mitigate these adverse effects.

3 Data

The Bangladesh Flood Impact panel household survey collected by the International Food Policy Research Institute comprises 757 households in 126 villages spanning November 1998 to May 2004. Seven thanas were selected based on the severity of flooding (according to the Bangladesh

Water Development Board), the district level of poverty, representation in previous studies, and geographical variation (del Ninno et al., 2001).[2] Households were randomly selected based on a probability sampling technique involving several stages (see del Ninno et al. (2001) for more details). The panel consists of four rounds: i) November-December 1998 (two months after the peak of the flood), ii) April-May 1999, iii) November-December 1999, and iv) April-May 2004. The survey collects an array of household (and community) information including demographics, consumption, assets, employment, agricultural production practices, and borrowing.

The labor modules of the survey provides information on three types of employment: salaried workers, business and cottage activities (which primarily includes self-employed workers), and the casual labor market (day laborers). The casual labor market had the greatest percentage of workers (33.5 percent) in 1998 and suffered the greatest losses immediately following the flood (del Ninno et al., 2001). Because we expect the casual labor market to be particularly vulnerable to flood shock since households use the labor market to diversify risk and as an additional source of income, and because the market lacks contractual arrangements committing employers to hiring workers for a fixed period of time, we concentrate on this market to analyze the labor market impacts of the 1998 flood.

Two forms of daily wages (which includes the value of food) are documented in the survey: wages in the last month prior to the survey, and wages in the three months before the last month prior to the survey. For instance, in the first round, wage data are collected for October 15-November 14, 1998 and July 15-October 14, 1998. The first round also asks workers to report their pre-flood wages for the same three-month period in 1997, specifically July 15-October 14, 1997. In our regression, the dependent variable consists of the previous month wage data to reduce measurement error. We also construct a variable which takes the averages of the

[2] A thana is an administrative unit that is smaller than a subdistrict and larger than a village.

individual pre-flood wages in each village to control for the initial labor market conditions in the regression.

Our 1998 flood variable is created from data collected in the first round of the household survey. Data on the usual flood depth and depth of the flood in 1998 (in feet) were collected for all household plots that were owned and used. We first subtract the value of the normal flood depth for each plot from the realized depth value in 1998. We then construct a 1998 flood shock variable which consists of the village means of the all of the individual plot shock values. The construction of the shock variable captures the covariate nature of the shock and allows for variation in the damages caused by the flood. It must be noted that since the 1998 flood shock was a one-time event, the flood shock variable does not vary over time, which affects our empirical identification strategy.

Table 1 presents the means, standard deviations, and number of observations for each variable included in our wage regressions. We convert the wages from all rounds into 2004 terms using the Consumer Price Indices provided by the Bangladesh Bureau of Statistics. We evaluate four types of village level characteristics that can alter vulnerability to flood exposure: the percent of irrigation, whether the land consists of over 50 percent clay soil, whether there is a village moneylender (*mahajan*) providing credit, the value of *mahajan* loans per capita, and the distances from the weekly market and bazaar. The percent of irrigated area, the *mahajan* dummy, and distance variables were taken from round 4 of the community questionnaire. The clay and *mahajan* loans per capita variables are constructed from the household surveys and vary by village and over time.

[INSERT TABLE 1]

4 Empirical Strategy and Results

4.1 Regression Specification

The first specification of our model is a pooled ordinary least squares regression to measure the impact of the deviation in the flood depth in 1998 from normal conditions on daily wages:

$$w_{ijmt} = \beta_0 + \beta_1 X_{it} + \beta_2 F_i + \beta_3 F_i \times \delta_m + \beta_4 A_{it} + \beta_5 F_i \times A_{it} + \beta_6 w_i^{1997} + \alpha_j + \delta_m + \lambda_t + \varepsilon_{ijmt}. \qquad (1)$$

The dependent variable w_{ijmt} is the natural logarithm of the wage for individual i in thana j in month m of year t, X_{it} are variables that control for individual labor supply characteristics, F_i is the 1998 deviation in depth from normal flood conditions, A_{it} are various labor supply or demand characteristics that mitigate the losses incurred during the 1998 flood, w_i^{1997} is the natural logarithm of the pre-flood village wages, α_j, δ_m, and λ_t are thana, month, and year fixed effects, and ε_{ijmt} is the error term. For robustness, we also estimate a variant of (1) which includes a household random effect to account for unobserved heterogeneity, replacing $\varepsilon_{ijmt}=\mu_i+u_{ijmt}$.[3] Though the random effects model can be more efficient, it also strongly assumes that unobservable household characteristics are independent of the covariates. In both pooled and random effects versions of (1), we allow for clustering at the thana level, allowing for arbitrary spatial correlation of the flood impacts (Wooldridge, 2003). Of particular importance in this study is the parameter on the flood variable β_2. The flood variable is a proxy for the loss of productive outputs and/or assets in the agricultural and non-agricultural sectors. Though farmers account for normal flooding conditions prior to the agricultural production season, the 1998

[3] Inclusion of the time invariant flood variable precludes the estimation of a household fixed effect version of (1).

flood was unique in its scope, scale, and duration. Therefore, we expect the severity of the flood to at least have ramifications on labor demand, $\beta_2 \leq 0$.[4]

The market's dependence on environmental conditions and the availability of mechanisms to mitigate losses determine the extent of the impact of the disaster on labor demand. We allow the effect of the 1998 flood to differ by labor market (agricultural/non-agricultural) and land quality (whether the soil was predominantly clay). We expect agricultural labor markets and labor markets in areas with high clay content to experience greater losses in the form of wages, $\beta_5 < 0$. With respect to the latter, while clay soil normally provides favorable conditions for agricultural production, it lacks drainage capacity. Thus, the flood can have particularly severe consequences on agricultural labor markets if the farmers most affected are also the ones that have the greatest influence on labor demand since they may be responsible for hiring the workers. Moreover, non-agricultural markets may be affected, in addition to the possibility of floods depleting the markets' productive assets, by the surplus labor made available by the decline in agricultural labor markets. We additionally check for the potential for entrepreneurial adaptation to mitigate the flood-induced losses in labor markets by allowing the flood impacts to vary by availability of credit or irrigation (which allows a shift in production to the dry season). In areas with greater access to credit or irrigation, we would expect the flood impact on wages to be less severe, $\beta_5 > 0$.

We also evaluate the extent to which proximity to weekly markets or bazaars affects wages. These venues can provide additional labor market opportunities or outlets for generating income through trade. Where roads and public transportation are lacking, we might expect distant villages to realize greater losses as auxiliary labor markets or outlets for revenue to

[4] We note the possibility of no effect since it is possible that the out-migration of labor in response to the flood causes the opposite effect. For example, if workers can freely migrate and in-migration is non-existent, labor supply may decrease yielding a positive effect on wages.

absorb or occupy unemployed or underemployed workers are absent. Note that it is also possible that we observe the opposite effect if migration is costless. If workers migrate to other labor markets and in-migration is limited, then the ensuing shortage of labor could increase wages.

Our final model allows for distinctions in the severity of the flood over time. In order to test the impact of floods over time, we modify (1) to include variables that interact the severity of the flood variable with the time dummy variables:

$$w_{ijmt} = \beta_0 + \beta_1 X_{it} + \beta_2 F_i + \beta_3 F_i \times \lambda_t + \beta_4 F_i \times \delta_m + \beta_5 A_{it} + \beta_6 F_i \times A_{it} + \beta_7 F_i \times A_{it} \times \lambda_t + \beta_6 w_i^{1997} + \alpha_j + \delta_m + \lambda_t + \varepsilon_{ijmt}. \quad (2)$$

The flood may have differential effects on wages in the short and long term for two reasons. First, some of the emergency relief programs, particularly those that involved cash transfers, were short-lived. It is interesting to observe how wages evolved particularly in relation to the termination of emergency relief programs. Second, if the flood has long-term impacts on asset accumulation (which the overarching credit debt of households implies) then it is likely that investment declines, further exacerbating labor market prospects.

4.2 Regression Results

We first estimate models (1) and (2) excluding any variables that account for flood mitigation mechanisms *A*. Table 2 reports the results from our baseline regressions. The estimated parameters and standard errors from the pooled OLS regression in panel (1) of Table 2 indicate that for each additional foot of water attributable to the 1998 flood (relative to normal flood conditions), wages decline 1.9 percent. The random effects model reported in panel (2) produced a smaller decline in wages of 1.7 percent. When distinguishing the effect of the 1998 flood over time, the pooled OLS regression indicates that the negative impact on wages gradually worsened over time. Although the parameters on the short-term flood shock effects are not significant, the parameter on the long-term effect on wages is significant and the magnitude is larger than the previous specification of the model. The pooled OLS regression in panel (3) indicates that over five years after the major flood, wages decreased by 4.7 percent for every additional foot in flood depth. The alternative random effects model specification in panel (4) provided a slightly smaller estimate, indicating a 4.4 percent decline in daily wages.

Our results are consistent with the five percent decline in district wages following extreme floods among more flood prone districts noted in Banerjee (2007). There are a few noteworthy differences in our study that has implications on the interpretation of our results. First, we include agricultural and non-agricultural wages in our regression. Second, our baseline wages (i.e., wages collected in the first round of the household survey) may already reflect a flood-induced decline since the data reflect earnings one month after the flood. Although we do account for pre-flood wages at the village level, this could possibly explain why we do not observe a similar short-term effect on wages. Additionally, this also suggests that our findings may underestimate the true impact since we are not comparing long-term wages to pre-flood wages. Third, we distinguish between short-term and long-term effects on wages. Our five percent decline in wages reflects a long-term effect rather than an immediate effect. The long-term effect may exceed that of the short-term if there is a history of emergency relief programs which dampen immediate effects but fail to protect assets and related markets.

[INSERT TABLE 2]

Our results in Table 2 suggest that the consequences of the 1998 flood on the daily and casual labor market were more severe in the long term than the short term. As mentioned previously, this could be an artifact of the design of our regression specification where comparisons are being made to wages one month after the flood rather than pre-flood wages.

Another possible explanation for the differential impacts on wages over time may result from the influence of emergency relief programs on labor market dynamics. First, emergency relief programs might have protected asset depletion in the short term. In her analysis of the impact of the food assistance programs on assets, Quisumbing (2005a) finds the GR (rather than the VGF which predominantly distributed transfers in kind) was more successful at protecting the assets of the poor. These programs were short-lived and, being targeted to the poor, did not enable most wealthy households to protect their investments. Second, emergency relief programs might have shifted labor supply upward, offsetting the impact the decline in labor demand would have had on short-term wages. Households might substitute leisure for consumption in response to the income gain in the short term. Skoufias, Unar, and Gonzalez-Cossio (2008) do not find an effect of cash or in-kind transfers on labor market participation in Mexico. Instead, transfers affected the allocation of time spent between agricultural and non-agricultural activities. Their findings suggest it may be important to distinguish flood impacts by the type of labor market (e.g., agricultural vs. non-agricultural). A third possible explanation for the differences in wage impacts over time may be the dwindling of informal credit sources. Following the flood, the majority of the loans were financed by relatives (23 percent) and neighbors (31 percent) (del Ninno et al., 2001). These sources might have reached their capacity in the years following the flood. In spite of the number of formal financial options provided by NGOs, banks, or cooperatives, the limited availability of low-interest loans might have affected households' ability to borrow. We explore the relevance of access to credit later in this section.

Our next regression specification allows for the distinction of the 1998 flood impacts by labor market. Estimates from the pooled OLS and random effect versions of model (1), where we include variables that interact the flood shock variable with a dummy indicating whether the worker participated in an agricultural task, are reported in the first two panels of Table 3. The results indicate that agricultural wages were more negatively affected by the 1998 flood, but the parameter estimates are not statistically significant at the 10 percent critical level.

[INSERT TABLE 3]

We further distinguish the flood impacts by labor market and time following the specification in (2). The third and fourth panels of Table 3 report the pooled OLS and random effect estimates. The pooled OLS and random effect model estimates suggest that agricultural wages experienced a decline immediately following the shock of 2.4 and 2.2 percent ($\beta_2+\beta_6$ in model (2)), respectively, for every foot increase in flood depth attributable to the 1998 flood.. For the same increase in flood depth in 1998, a statistically significant decline in non-agricultural wages was only observed five years after the event. Additionally, the magnitude of the decline was more severe than in the agricultural market (6.9 and 6.5 percent in the pooled OLS and random effect regressions). The loss in agricultural wages only increased slightly five years later from 2.4 to 3.5 percent (in the pooled regression) and 2.2 to 3.3 (in the random effects regression). The results suggest the decline in agricultural wages remained relatively stable, in contrast to the non-agricultural labor market which was more deeply affected in the long term. Several factors may contribute to the greater decline in agricultural markets. A greater level of asset depletion may have influenced the labor demand of this market. The non-agricultural labor market may be more vulnerable to the flood consequences of related markets. For example, Quisumbing (2005a) found declines in non-food per capita expenditures particularly among the wealthier household participants of food assistance programs. Thus, the decline in the demand in non-food markets for example may have severe repercussions on the non-agricultural labor market. Finally, it is also possible that the surplus of workers from the agricultural labor market switched their employment to the non-agricultural labor market, further exacerbating wage declines.

4.3 Factors Affecting Flood Vulnerability

The next regression specifications allow for distinctions in flood impacts by labor demand and supply characteristics that may mitigate flood impacts on wages. Table 4 provides the estimates from the pooled OLS and random effect versions of models (1) and (2), allowing flood impacts to vary by percent of irrigated land. The first two panels in Table 4 present the estimates of the flood impact on wages from the pooled OLS and random effect versions of model (1). One of the limitations of using the irrigation variable is that it was only collected in community questionnaires during the fourth round of the survey and therefore the variable varies over villages, not by time. The time invariant nature of the variable makes identifying its effect on the vulnerability of wages to the flood shock difficult. The parameter on the percent of irrigated land variable is positive, suggesting that the marginal productivity of labor increases with irrigation. However, the parameter is not statistically significant (at the 10 percent critical level). The flood shock parameter is less negative than in previous specifications but not significant. What is interesting is that the areas with greater percentages of irrigated land are more vulnerable to the flood. Although the parameter describing this interaction is not statistically significant, one possible explanation for the sign is that the timing of the demand for labor on irrigated land differs from the timing of the demand for labor on rainfed land. Labor demand may be limited during the monsoon season for markets that depend on irrigated land since more of their production may shift to the dry season. Thus, the limited labor demand during the monsoon season may decline even further after facing a severe flood. We also provide estimates from the pooled OLS and random effect versions of model (2) allowing the flood effects to vary by irrigation status and survey year in the third and fourth panels of Table 4. In the pooled OLS model, we observe a statistically significant negative long-term effect on wages of 5.3 percent, where the magnitude of the decline remains robust to previous specifications of the model. The random effects version of the model yields a negative effect of 5 percent (though the parameter is statistically insignificant). In contrast to the estimates from versions of model (1), we now observe that irrigation may dampen the long-term decline in wages but the parameters that reflect these effects also are not statistically significant.

[INSERT TABLE 4]

Table 5 includes the estimates from the pooled OLS and random effect models that allow for the flood impacts to vary by soil quality. To understand the relevance of drainage on the flood impact, we focus on distinguishing flood effects across areas with and without greater than 50 percent of their land consisting of clay soil. The estimates from model (1) are reported in panels 1 and 2 of Table 5. They indicate that clay soil increases the marginal productivity of labor, yet these same areas are more vulnerable to the flood impacts perhaps due to the lack of drainage. We also provide estimates of model (2), which further differentiates the flood effects by type of soil and elapsed time in panels 3 and 4 of Table 5. The long-term impact of the flood on wages remains consistent with previous estimates reflecting a long-term decline of around 5 percent. Accounting for time differentiation of the effects, we now observe that areas with clay soil are severely affected immediately following the shock, however, they recover a year after the flood. Note this effect is only statistically significant in the random effects model. We are unable to identify an effect that is significantly different from zero on the parameter measuring the effect of the flood on land that predominantly consists of clay soil five years after the flood.

[INSERT TABLE 5]

We provide estimates from wage regressions that distinguish flood impacts by access to informal credit in Table 6. We evaluate the impacts of credit using two different variables: whether the village has access to loans through a *mahajan* (or local moneylender), and the total amount of loans per capita received by households in the village from a *mahajan* over time. The first variable was taken from the community questionnaire collected in round 4 of the survey and therefore does not vary over time. The second variable was taken from the household responses over the four rounds and therefore varies over time. Panels 1, 2, 5, and 6 of Table 6 present the results from versions of model (1) with the two measures of credit access. Access to credit through the local moneylender potentially dampens or offsets the flood impact on wages. However, the parameters that capture this effect are not statistically significant. Panels 3, 4, 7, and 8 in Table 6 present the estimates from model (2). Focusing on panels 3 and 4, that use the *mahajan* dummy to measure local access to credit, we observe a statistically significant negative effect on wages one year (unlike previous model specifications) and over five years after the event (consistent with previous model specifications). Villages with access to loans from their own *mahajan* may have a less severe effect. The magnitude of the parameters on the variables interacting the flood shock, the own *mahajan* dummy, and the time dummy variables suggest that the ability for credit to dampen the negative effect of wages dwindles over time. However, we are limited in our interpretation of these parameters due to their lack of statistical significance. Panels 7 and 8 present the results from model (2) using the amount of loans per capita received from *mahajans* within a village over time. We no longer observe a significant negative effect on the flood shock parameters. Instead, access to credit interacted with the flood shock seems to have a statistically significant positive effect on wages immediately following the flood and a statistically significant negative effect on wages over five years after the flood. The results from versions of model (2) provide evidence that the availability of local, informal credit protected households in the short term but not in the long term, though the results are not particularly robust across specifications of informal credit.

[INSERT TABLE 6]

Our final model allows the flood impact to vary by distance to auxiliary labor markets. We use two measures of distance from labor markets: the distance from the weekly market and the distance from the bazaar. The results from the pooled OLS and random effects versions of models (1) and (2) using both measures of distance to auxiliary labor markets are reported in Table 7. The estimates of model (1) are presented in panels 1, 2, 5, and 6. The results indicate that the wages in villages that are more distant from these areas of economic activity are severely impacted. These findings are robust and significant (at the 10 percent critical level) in all model specifications and to measurement of distance to auxiliary labor markets. The estimates of model (2) are presented in panels 3, 4, 7, and 8 in Table 7. We observe that the flood shock has significant and increasing consequences on wages over time. Moreover, villages that are further away from weekly markets or bazaars suffer more immediately after the shock but are in a better position one year and five years after the flood. One possible explanation for the change in the impact of distance over time is that the migration response of workers is not immediate. This is plausible especially in distant areas where workers need to mobilize a sufficient amount of financial resources prior to migrating. The shortage of labor that ensues following the out-migration of workers may benefit those that remain behind.

[INSERT TABLE 7]

5 Conclusion

We find that real wages of workers in the casual labor market declined between 4 and 5 percent over five years after the 1998 "flood of the century" in Bangladesh. Wages in the short-term were not affected perhaps due to the assistance provided by emergency relief programs. These programs provided mostly food assistance, with a small distribution of cash transfers in the initial months following the flood. Mechanisms for the protection of assets were quite limited in the long term and outstanding debts prevailed. It is possible that the programs also provided incentives for workers to reduce their labor effort, which also prevented wages from declining in the short term.

Previous studies that evaluate the impacts of disasters on labor markets focus on the agricultural sector (Banerjee, 2007; Jayachandran, 2006). Our findings suggest that agricultural labor markets experience declines in the short term, which stabilize over time. In contrast, non-agricultural markets are more severely affected in the long term. Non-agricultural markets may be more vulnerable to natural disasters due to their dependence on the recovery of other markets. For example, non-food expenditures declined after the flood as a greater share of household income was spent on food since purchasing power was low and food prices were high (del Ninno, Dorosh, and Smith, 2003). The vulnerability of the non-agricultural labor market to severe floods has implications on role of the rural non-farm employment to help households diversify and cope with risk. Workers that switched sectors and remained employed in the non-agricultural sector in response to the flood were worse off in the long term.

We explore how the vulnerability of labor markets was affected by soil type and access to credit. We distinguish the flood impacts by whether the land predominantly consisted of clay soil, which is suitable for agricultural production but lacks drainage potential. Our estimates suggest that the benefits of clay soil in terms of enhancing the marginal productivity of labor likely outweigh the losses from poor drainage in the short term. There is evidence (though not robust) that credit access mitigated the losses in the short term but not the long term. The availability of low-interest loans might have dwindled as households remained in debt years following the flood and fewer sources of such funding were available. Lack of credit access may have repercussions on the ability of households to accumulate assets and investments in markets related to labor.

Lastly, migration to other labor markets can mitigate the effects of a severe flood on local labor markets. Migration calls for the mobilization of financial resources to transport migrants elsewhere, which may be difficult for the poor. In spite of this limitation, access to alternative labor markets after the flood can diversify future income risk and reduce the supply of labor, preserving wages in local labor markets. Helping workers find employment elsewhere after a severe flood or providing household incentives to migrate by reducing their transaction costs may be a temporary solution to help labor markets recover years after a major flood.

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APPENDIX

Table 1: Summary Statistics

Variable	Mean	Standard Deviation	Observations
Wages (2004 Taka)	72.94	26.55	1470
1998 Flood shock (feet)	3.48	1.39	1470
Female dummy	0.08	0.27	1470
Age	36.3	12.89	1470
Agricultural labor dummy	0.60	0.49	1470
Village mean wages 1997 (2004 Taka)	71.23	17.43	1470
April dummy	0.53	0.50	1470
Year 1999 dummy	0.52	0.50	1470
Year 2004 dummy	0.23	0.42	1470
Madaripur dummy	0.15	0.36	1470
Mohammedpur dummy	0.13	0.33	1470
Muladi dummy	0.13	0.33	1470
Saturia dummy	0.13	0.33	1470
Shibpur dummy	0.14	0.35	1470
Sharasti dummy	0.12	0.33	1470
Percent irrigated land	0.57	0.30	1385
Land over 50 percent clay dummy	0.05	0.21	1470
Own mahajan credit dummy	0.79	0.41	1160
Value of mahajan loans (1000s) per capita	0.03	0.05	1393
Distance from weekly market (km)	2.46	2.03	1329
Distance from bazar (km)	2.03	2.14	1302

Note: The Derai thana is omitted from the table.

Table 2: 1998 Flood Impact on Individual Wages

	Pooled OLS	RE GLS	Pooled OLS	RE GLS
1998 Flood shock	-0.019*	-0.017*	-0.009	-0.007
	(0.009)	(0.009)	(0.010)	(0.012)
1998 Flood shock*Year 1999 dummy			-0.021	-0.02
			(0.018)	(0.019)
1998 Flood shock*Year 2004 dummy			-0.047*	-0.044*
			(0.022)	(0.026)
April dummy	0.004	0.002	-0.078	-0.073
	(0.089)	(0.091)	(0.072)	(0.078)
1998 Flood shock*April dummy	0.032*	0.032*	0.054***	0.054***
	(0.016)	(0.018)	(0.016)	(0.018)
Year 1999 dummy	0.080***	0.082***	0.153*	0.154*
	(0.022)	(0.027)	(0.075)	(0.083)
Year 2004 dummy	0.049	0.048	0.212**	0.202**
	(0.043)	(0.042)	(0.069)	(0.086)
Female dummy	-0.708***	-0.680***	-0.709***	-0.682***
	(0.138)	(0.132)	(0.138)	(0.132)
Age	0.022***	0.023***	0.022***	0.023***
	(0.005)	(0.005)	(0.005)	(0.005)
Age-squared (divided by 100)	-0.028***	-0.029***	-0.028***	-0.028***
	(0.008)	(0.007)	(0.008)	(0.007)
Agricultural labor dummy	-0.097	-0.089*	-0.096	-0.088*
	(0.052)	(0.050)	(0.052)	(0.050)
Ln(Village mean wages 1997)	0.227***	0.221***	0.230***	0.223***
	(0.060)	(0.058)	(0.060)	(0.058)
Constant	2.935***	2.926***	2.892***	2.887***
	(0.287)	(0.280)	(0.283)	(0.278)
Sigma_u		0.15		0.15
Sigma_e		0.31		0.31
Rho		0.20		0.20
Observations	1470	1470	1470	1470
R-squared	0.30	0.30	0.30	0.30

Thana clustered standard errors are reported in parentheses. *** p≤0.01, ** p≤0.05, * p≤0.10.

Thana fixed effects are included in all models.

Table 3: 1998 Flood Impact on Wages by Labor Market

	(1) Pooled OLS	(2) RE GLS	(3) Pooled OLS	(4) RE GLS
1998 Flood shock	-0.009	-0.009	0.014	0.014
	(0.013)	(0.013)	(0.014)	(0.014)
1998 Flood shock*Year 1999 dummy			-0.036	-0.036
			(0.023)	(0.025)
1998 Flood shock*Year 2004 dummy			-0.069**	-0.065***
			(0.023)	(0.025)
Year 1999 dummy	0.080***	0.082***	0.151*	0.153*
	(0.022)	(0.027)	(0.073)	(0.086)
Year 2004 dummy	0.049	0.048	0.226**	0.214***
	(0.042)	(0.041)	(0.072)	(0.086)
Agricultural labor dummy	-0.047	-0.044	-0.038	-0.038
	(0.050)	(0.044)	(0.045)	(0.035)
1998 Flood shock* Agricultural labor dummy	-0.015	-0.013	-0.038**	-0.036***
	(0.018)	(0.018)	(0.014)	(0.015)
1998 Flood shock*Year 1999 dummy*			0.027	0.027
Agricultural labor dummy			(0.017)	(0.017)
1998 Flood shock*Year 2004 dummy*			0.034***	0.032***
Agricultural Labor dummy			(0.006)	(0.007)
Observations	1470	1470	1470	1470
R-squared	0.30	0.30	0.31	0.31

Note: All models include season and thana fixed effects, a variable that interacts
the shock and season variables, the log of village mean wages in 1997 variable, a female dummy,
and age and age-squared variables. Thana clustered standard errors are reported in parentheses.
*** p≤0.01, ** p≤0.05, * p≤0.10.

Table 4: 1998 Flood Impact on Wages Accounting for Irrigation Status

	(1) Pooled OLS	(2) RE GLS	(3) Pooled OLS	(4) RE GLS
1998 Flood shock	-0.010	-0.004	-0.001	0.005
	(0.023)	(0.022)	(0.025)	(0.027)
1998 Flood shock*Year 1999 dummy			-0.016	-0.015
			(0.022)	(0.024)
1998 Flood shock*Year 2004 dummy			-0.053*	-0.050
			(0.027)	(0.031)
Year 1999 dummy	0.084***	0.089***	0.151	0.156*
	(0.022)	(0.028)	(0.080)	(0.092)
Year 2004 dummy	0.055	0.056	0.206**	0.200**
	(0.039)	(0.038)	(0.070)	(0.090)
Percent irrigated land	0.032	0.065	0.033	0.067
	(0.161)	(0.161)	(0.159)	(0.159)
1998 Flood shock*Percent irrigated land	-0.018	-0.025	-0.018	-0.025
	(0.034)	(0.032)	(0.031)	(0.032)
1998 Flood shock*Year 1999 dummy*			-0.007	-0.007
Percent irrigated land			(0.032)	(0.033)
1998 Flood shock*Year 2004 dummy*			0.017	0.016
Percent irrigated land			(0.031)	(0.031)
Observations	0.32	0.31	0.32	0.32
R-squared	1385	1385	1385	1385

Note: All models include season and thana fixed effects, a variable that interacts the shock and season variables, the log of village mean wages in 1997 variable, a female dummy, an agricultural labor dummy, and age and age-squared variables. Thana clustered standard errors are reported in parentheses. *** p≤0.01, ** p≤0.05, * p≤0.10.

Table 5: 1998 Flood Impact on Wages Accounting for Drainage Capacity

	(1) Pooled OLS	(2) RE GLS	(3) Pooled OLS	(4) RE GLS
1998 Flood shock	-0.016	-0.014	-0.003	-0.002
	(0.010)	(0.011)	(0.014)	(0.016)
1998 Flood shock*Year 1999 dummy			-0.026	-0.025
			(0.019)	(0.021)
1998 Flood shock*Year 2004 dummy			-0.053*	-0.049*
			(0.024)	(0.027)
Year 1999 dummy	0.080**	0.082***	0.167*	0.166*
	(0.024)	(0.030)	(0.081)	(0.091)
Year 2004 dummy	0.050	0.048	0.232**	0.218**
	(0.045)	(0.044)	(0.078)	(0.094)
Land over 50 percent clay dummy	0.167*	0.143**	0.167*	0.138*
	(0.073)	(0.069)	(0.080)	(0.078)
1998 Flood shock*Land over 50 percent	-0.036*	-0.033**	-0.039*	-0.035**
clay dummy	(0.017)	(0.015)	(0.017)	(0.017)
1998 Flood shock*Year 1999 dummy*			0.035	0.043*
Land over 50 percent clay dummy			(0.026)	(0.026)
1998 Flood shock*Year 2004 dummy*			0.006	0.004
Land over 50 percent clay dummy			(0.017)	(0.017)
Observations	1470	1470	1470	1470
R-squared	0.30	0.30	0.30	0.30

Note: All models include season and thana fixed effects, a variable that interacts the shock and season variables, the log of village mean wages in 1997 variable, a female dummy, an agricultural labor dummy, and age and age-squared variables. Thana clustered standard errors are reported in parentheses. *** p≤0.01, ** p≤0.05, * p≤0.10.

Table 6: 1998 Flood Impact on Wages Accounting for Informal Credit Access

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Credit Variable	Own mahajan credit dummy				Value of mahajan loans (1000s) per capita			
Model	Pooled OLS	RE GLS	Pooled OLS	RE GLS	Pooled OLS	RE GLS	Pooled OLS	RE GLS
1998 Flood shock	-0.039*	-0.040**	-0.022	-0.025	-0.024*	-0.021*	-0.021	-0.018
	(0.021)	(0.018)	(0.017)	(0.017)	(0.011)	(0.011)	(0.014)	(0.016)
1998 Flood shock*Year 1999 dummy			-0.038**	-0.036**			-0.016	-0.015
			(0.014)	(0.017)			(0.021)	(0.022)
1998 Flood shock*Year 2004 dummy			-0.066**	-0.057*			-0.044	-0.043
			(0.027)	(0.034)			(0.027)	(0.029)
Year 1999 dummy	0.088***	0.094***	0.211***	0.215***	0.083***	0.088***	0.157*	0.160*
	(0.025)	(0.031)	(0.057)	(0.070)	(0.021)	(0.028)	(0.077)	(0.090)
Year 2004 dummy	0.053	0.052	0.290***	0.273***	0.056	0.057	0.260***	0.247***
	(0.042)	(0.041)	(0.072)	(0.099)	(0.040)	(0.037)	(0.070)	(0.087)
Credit	-0.124	-0.139	-0.127	-0.142	-1.315	-1.015	-1.056	-0.962
	(0.131)	(0.120)	(0.127)	(0.117)	(0.790)	(0.996)	(0.772)	(0.910)
1998 Flood shock*Credit	0.018	0.022	0.016	0.023	0.395	0.298	0.677**	0.618**
	(0.026)	(0.023)	(0.026)	(0.023)	(0.216)	(0.266)	(0.259)	(0.267)
1998 Flood shock*Year 1999 dummy*Credit			0.005	0.002			-0.008	-0.062
			(0.012)	(0.013)			(0.213)	(0.199)
1998 Flood shock*Year 2004 dummy*Credit			-3.051E-4	-0.006			-0.437**	-0.386***
			(0.022)	(0.024)			(0.133)	(0.137)
Observations	1160	1160	1160	1160	1393	1393	1393	1393
R-squared	0.33	0.32	0.33	0.33	0.32	0.32	0.33	0.32

Note: All models include season and thana fixed effects, a variable that interacts the shock season variables, the log of village mean wages in 1997 variable, a female dummy, an agricultural labor dummy, and age and age-squared variables. Thana clustered standard errors are reported in parentheses. *** $p \leq 0.01$, ** $p \leq 0.05$, * $p \leq 0.10$.

Table 7: 1998 Flood Impact on Wages Accounting for Distance to the Nearest Market

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Credit Variable	Distance from weekly market				Distance from bazar			
Model	Pooled OLS	RE GLS	Pooled OLS	RE GLS	Pooled OLS	RE GLS	Pooled OLS	RE GLS
1998 Flood shock	0.006	0.006	0.027	0.029	0.005	0.007	0.018	0.020
	(0.019)	(0.018)	(0.021)	(0.022)	(0.019)	(0.019)	(0.024)	(0.026)
1998 Flood shock*Year 1999 dummy			-0.037*	-0.039**			-0.023	-0.024
			(0.019)	(0.020)			(0.020)	(0.022)
1998 Flood shock*Year 2004 dummy			-0.067***	-0.065**			-0.057**	-0.058**
			(0.026)	(0.027)			(0.021)	(0.024)
Year 1999 dummy	0.088**	0.095***	0.159*	0.165*	0.077**	0.084***	0.133	0.140
	(0.025)	(0.031)	(0.082)	(0.088)	(0.025)	(0.030)	(0.081)	(0.092)
Year 2004 dummy	0.061	0.063	0.247***	0.239***	0.042	0.049	0.213**	0.220***
	(0.045)	(0.042)	(0.067)	(0.081)	(0.035)	(0.037)	(0.072)	(0.084)
Distance	0.031**	0.027***	0.031**	0.027**	0.032**	0.030***	0.032**	0.030***
	(0.012)	(0.010)	(0.013)	(0.011)	(0.011)	(0.011)	(0.049)	(0.011)
1998 Flood shock*Distance	-0.009**	-0.008***	-0.014**	-0.014***	-0.007*	-0.007**	-0.010**	-0.010***
	(0.004)	(0.003)	(0.004)	(0.004)	(0.003)	(0.003)	(0.004)	(0.004)
1998 Flood shock*Year 1999 dummy*Distance			0.007***	0.008***			0.003***	0.003***
			(0.001)	(0.001)			(0.001)	(0.001)
1998 Flood shock*Year 2004 dummy*Distance			0.005*	0.006***			0.004	0.004
			(0.002)	(0.002)			(0.003)	(0.003)
Observations	1329	1329	1329	1329	1302	1302	1302	1302
R-squared	0.31	0.31	0.31	0.31	0.29	0.29	0.29	0.29

Note: All models include season and thana fixed effects, a variable that interacts the shock season variables, the log of village mean wages in 1997 variable, a female dummy, an agricultural labor dummy, and age and age-squared variables. Thana clustered standard errors are reported in parentheses. *** p≤0.01, ** p≤0.05, * p≤0.10.