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Do natural disasters decrease the gender gap in schooling?

by

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Abstract

Rapidly decreasing gender gaps in schooling in developing countries can be a result of a gendered division of child farm labor as a coping response to increased natural disasters. This paper makes a case for this conjecture by analyzing original household survey data from rural Fiji. Boys, not girls, contribute to farming only among cyclone victims with dwelling damage, independent of housing aid receipt. Boys' school enrollment is significantly lower than girls' only among victims who did not receive aid early enough. Boys with no elder brother and an educated father are particularly vulnerable in their progression to higher-level schools.

Keywords: gender gap in schooling; child labor; natural disaster; disaster aid

JEL classification: O15; Q54

I. Introduction

Eliminating gender disparity in education is crucial to promote gender equality and empower women.[1] Although the gender gap in education – measured by the difference in school enrollments or educational attainments between men and women – is still significant, especially in South Asia and Sub-Saharan Africa, in most developing countries women's schooling has been increasing relative to men's (Orazem and King 2008, World Bank 2011). In particular, in about one third of developing countries (45), girls outnumbered boys in secondary education in 2008 (World Bank 2011, p61). World Development Report 2012 (World Bank 2011) attributes this remarkable progress to household responses to market and institutional changes – improved

[1] A strong reason for supporting women's education is the important roles of maternal human capital in reducing fertility, improving infant/child health, developing children's higher cognitive attainment, and promoting their schooling (King and Mason 2001, Schultz 2008).

returns to education for females and reduced cost of schooling – fuelled by government policies, such as school construction, free primary education, conditional cash transfer, and so forth. This paper proposes an alternative mechanism underlying the relative progress in women's education that has received virtually no attention – the gendered division of child farm labor as a coping response to increased natural disasters.

Consider a case where men are more active in farming than women, because of their distinct labor productivities across activities (including home work), labor-market conditions, and/or social norms, as seen in many developing areas (FAO 2011). Suppose that poor farmers rely on child farm labor to cope with adverse shocks. Then, boys at the secondary-school age with physical maturity are more likely to drop out of school for farming than girls. When overall secondary-school enrollment is low, this does not lead to a significant gender gap in schooling; as secondary schooling becomes more and more common, however, it can have such an effect. Then, as market and institutional changes promote schooling, the gender gap in education can decrease as a result of a household coping response that is independent of those changes. This alternative mechanism can be more significant in the developing countries that have been experiencing rapid education development without a comparable transformation in the agricultural economy than in others (and developed countries) that have experienced (much) slower education development. The recent progress of education also coincides with increased natural disasters, especially hydro-meteorological ones, such as floods, cyclones, and droughts (e.g., Cavallo and Noy 2009, Sawada 2007, Strömberg 2007), to which peasant farmers are particularly vulnerable. Natural disasters may be a driving force to decrease the gender gap in schooling, especially in rural developing areas.

Analyzing original household survey data in rural Fiji, this paper makes a strong case that the gendered coping response to natural hazards is a main reason for the progress of women's education there. I show that (1) boys, not girls, contribute to farming, not non-farm activities, among cyclone *victims* (households with dwelling damage), but not *non-victims*; and (2) boys' school enrollment is significantly lower than girls' among victims, but not non-victims.

I explore two critically important questions for policy. First, does disaster aid mitigate school dropout and child labor among disaster victims? I reveal that disaster aid (housing construction materials) mitigates boys' school dropout, if the provision occurs early enough, but not their labor use. In particular, although boys' farm labor is independent of aid, a significant gender gap in schooling exists only among aid *non-recipients*, and not *recipients*. de Janvry et al. (2006) show that conditional cash transfers (Progresa) mitigate school dropout, but not child labor, against various shocks, on which transfers are not conditional. My new finding means that public transfers targeted toward victims, unconditional on schooling, have similar mitigating effects.

Next, which boys are particularly vulnerable among non-recipient victims? I examine four hypotheses: (1) Boys who enter higher-level schools at the same time as disasters and aid are more vulnerable; (2) The oldest brothers are the most vulnerable (because of their physical maturity for farming, Fafchamps and Quisumbing 1999);[2] (3) Boys in poorer households with limited coping capability are more vulnerable (as found in previous works cited shortly); and, (4)

[2] Many extant works report similar birth-order effects – in both genders – not necessarily related to shocks (e.g., Edmonds 2006, Emerson and Souza 2008, Lillard and Willis 1994, Parish and Willis 1993); Thomas et al. (2004) find the opposite after the 1998 Indonesian financial crisis.

Maternal education decreases boys' vulnerability. I find strong evidence for the school-progression and birth-order effects, but not for the wealth and maternal effects.

The gender-risk nexus in schooling and child labor is related to two lines of literature. On one hand, economists extensively study how gender disparity in schooling can be explained by distinct returns to education and opportunity costs of schooling between boys and girls (e.g., Schultz 1987, 2002, 2001). Opportunity costs of schooling are mainly determined by returns to child labor, which can significantly vary in the gender sphere depending on activities, including home work (Edmonds 2008). In rural Ethiopia, for example, child farm labor is more common among boys than girls (Guarcello, et al. 2006). On the other hand, many studies address the potential role of school dropout and child labor as self-insurance. Forgone human capital development for short-run coping responses can have a wide range of adverse consequences in the long run. Supporting empirical evidence has been found in various locales (e.g., Beegle, et al. 2006, Duryea, et al. 2007, Jacoby and Skoufias 1997, Thomas, et al. 2004).

Empirical findings of distinct insurance roles between boys and girls are mixed. Whereas Jensen (2000) finds no gender gap in schooling after rainfall shocks in Côte d'Ivoire, Cameron and Worswick (2001), Chaudhuri et al. (2006), and Skoufias and Parker (2006), respectively, show bias against girls' schooling corresponding to crop loss in Indonesia and Ethiopia and unemployment in Mexico; Duryea et al. (2007) report similar bias in child labor against unemployment in urban Brazil. In rural Mexico, de Janvry et al. (2006) find bias against boys in schooling and labor use in response to unemployment and health shocks, respectively, and bias against girls' schooling following natural disasters (i.e., opposite to my conjecture).

The rest of the paper is organized as follows. Section II describes the study area, livelihoods, and gender gaps in education and employment among adults. Section III describes

cyclone damage, aid, rehabilitation, and gender gap in schooling among youths; evidence for boys' farm labor and school dropout against the damage is offered. Section IV presents the econometric specification to test the alternative mechanism and the questions discussed above, which is followed by the estimation results in Section V. The last section summarizes major findings and offers implications for research and policy.

II. Study Area, Livelihoods, Education, and Employment

A. Study Area and Livelihoods

In June-September 2005, I conducted a livelihood survey among 906 randomly selected households in 43 native Fijian villages in Cakaudrove Province in the northern region of the country, which significantly lags behind the main island Viti Levu, where the state capital, two international airports, and most tourism businesses are situated. (Fiji is divided almost equally between native Fijians and Indo-Fijians, and my study focuses on the former.) Virtually all households in the sample employ traditional farming practices, using no mechanized equipment or animal traction to produce taro, cassava, coconut, and kava plants. Rural land is communally owned by clan (within-village kin group) and is privately used, and by law it cannot be sold. Most households also engage in artisanal fishing and handicraft making. Whereas farming and fishing are conducted by both men and women (Fijian women are active fisherwomen, Chapman 1987), handicrafts are made exclusively by women (Turner 1987). Farming, fishing, and handicraft making, respectively, account for 66%, 11%, and 10% of income earned by sample households in the past one month (the mean total income is F$1,583; F$1 = US$.60).

B. Education and Employment

Fiji's educational system consists of eight-year primary (Class 1-8; Class 1 begins at age 6), which became compulsory in 1997, and four-year secondary (Form 3-6);[3] standardized examinations are at the end of Class 8, Form 4, and Form 6 (Tavola 1992). Although girls were much less educated than boys during the British colonial period, girls' secondary enrollments quickly increased after 1970 independence and outnumbered boys' by 1981; this reversed gender gap has been persistent since that time (Ministry of Finance and National Planning 2004, Tavola 1992).

The progress of women's education is confirmed among 2,115 working adults (age 20-59, excluding a small number of adults still in school) in the sample (see Table 1). Education attainments greatly improved over time. The largest *gender gap* – the simple difference in education attainments between men and women – exists in secondary complete or above, and it reversed over time: Although men's education was higher than women's among old adults (age 40-59) (4 percent gap), women surpassed men among young adults (age 20-39) (12 percent gap).

[3] Almost all primary and secondary schools in the country are private schools managed by community committees and religious organizations (Ministry of Education 2010). Following independence, the Fijian government sought to introduce a new system of six-year primary/four-year secondary/two-year college, but most schools did not make a shift to this new system, and many junior-secondary schools expanded to full secondary schools by adding Forms 5-6. I treat Forms 1 and 2 in this alternative system (which are uncommon in the sample) as Classes 7 and 8.

Although the gender gap in secondary education was not significant among old adults, it became more common among young adults, a 10 percent gender gap emerged.[4]

Fijian society is male dominant (e.g., Aucoin 1990), and women's employment opportunities, especially in rural areas, are weaker than men's. Indeed, permanent employment is strongly biased against women in the sample: 6.5% of working adults had been employed in the past one year and men's employment is almost three times women's. In contrast to the reversed gender gap in schooling, the gender gap in employment is persistent, though it decreases from near 10 percent among old adults to less than 4 percent among young adults. Adults with higher education are much more likely to be employed.[5] As such, the rapid progress of women's education has not been accompanied with a comparable expansion of their labor-market opportunities.

III. Cyclone, Child Labor, and Schooling

A. Cyclone Damage and Aid

On 13 January 2003, i.e., at the beginning of the school year two years before the 2005 survey, Cyclone Ami swept over the northern and eastern regions of the Fiji Islands. According

[4] Although over 90% of male adults were born in the current village, females' marriage migration is common: About 38% of female adults were born in other places. Education attainments of adults who were born in the current village are very similar to those in Table 1.

[5] The education level needed for securing employment differed between men and women over time: Although old men with secondary incomplete could obtain employment, young men needed secondary completion, as both old and young women did. Accordingly, a large gender gap in employment has existed among individuals with high enough education, the level of which increased over time.

to respondents' subjective assessments, 62% of residents' dwellings – a main house and/or free-standing units, such as the kitchen, shower, and toilet (not all households have such units, as these facilities are often located inside the main house) – were damaged, and the mean value of total dwelling damage in the whole sample was F$1,074 (see Table 2); the cyclone caused no casualties, and permanent migration was virtually nonexistent after the disaster. The provision of emergency relief (see Takasaki 2011c for details) was followed by housing reconstruction programs. One quarter of households received construction materials, and the mean amount received in the whole sample was F$686. Although there was at least one victim (with dwelling damage) in each village, a few villages had no recipients (of housing aid). Although almost all recipients were victims (i.e., virtually no leakage), only 40% of victims were recipients (i.e., large under-coverage) (see Takasaki 2011b for details).

None of the means of demographic factors measured at the time of interviews in 2005 – numbers of boys/girls (age 14-19), male/female working adults, children (age 0-13), and elderly (age 60 or above) as well as age of household head – and those of secondary education of any working adults (dummy) and land holdings are significantly different between non-victims and victims or between non-recipients and recipients among victims (see Table 3). This gives evidence that households did not strongly adjust their migration and fertility decisions to dwelling damage or aid receipt and that damage and aid are unlikely to be strongly correlated with these household factors at the time of the disaster, the data of which are lacking (though adults' education and holdings of communal land at that time must have been almost the same as the current levels). In contrast, victims currently hold smaller non-land assets – mainly livestock, fishing capital, and consumer durables – than non-victims, though non-land assets among victims are not strongly differentiated by aid. As discussed below, this pattern can be caused by pre-

disaster asset holdings, asset loss as a result of the cyclone, and/or (dis)investment in response to shocks (these data are also lacking). I repeated these descriptive analyses for 355 households with youths, finding similar results.

B. Rehabilitation

Among victims with a completely destroyed main house (19% of households in the sample), more than half of recipients had built a new house by the time of interviews in 2005, while 20% of non-recipients did so (Table 2); information about repairing is lacking. Thus, provisions of housing aid greatly helped reconstruction, but those for new house building were insufficient and self-reconstruction was relatively common. Indeed, although aid receipt was the most common in 2004, full construction materials were provisioned mostly in 2005; the amount of aid received among recipients in 2005 was more than twice that in 2003 and 2004.

To examine how housing aid helped reconstruction over time, I regress house rebuilding (dummy) on housing aid receipt (dummy) among victims with main house completely destroyed, controlling for village fixed effects, such as village-level aid received. OLS estimation results are reported in Table 4 (probit results are very similar); as villages with no variations in house rebuilding across households are dropped, the number of observations significantly decreases. The probability of rebuilding among recipients in 2003-04 is higher by 0.24 than others (column 1). Adding household controls – demographic factors, working adults' education, and land holdings discussed above – does not strongly alter the estimated aid effect (column 2) (estimation results of household controls are reported in Table A1). Despite the significant increase in the amount of aid provisioned per recipient in 2005, the estimated effect on rebuilding of aid received in 2003-05 is almost the same as that in 2003-04 (column 3). Qualitatively the same results hold for the amount of aid received (log) (columns 4-6). These

findings suggest that the aid in 2005 did not additionally help rebuilding, as non-recipients' self-reconstruction had become common by then; alternatively, some recipients may not have completed rebuilding at the time of interviews.

C. Gendered Division of Adult and Child Labor and Child Labor as Insurance

My conjecture is that as men are more active in farming than women, child farm laborers are mostly boys. Lack of data regarding labor input and time use precludes me from measuring the participation of adults/youths in or the amount of their labor used for specific activities. As an exception, individual-level data about wage labor show that teenagers' employment – both permanent and casual labor – is virtually nonexistent. Hence, child labor, if any, must be exclusively for self-employment (as well as home work). Since hired-in labor is not common for any livelihood activities, I show that male and female labor endowments influence farm and non-farm income in distinct manners, as indirect evidence for the gendered division of labor.

OLS estimates of determinants of household income (log) in the past one month at the time of interviews are reported in Table 5, where only results for numbers of male and female working adults and youths, dwelling damage, and aid recipient in 2003-2005 are shown. Other household controls are numbers of children and elderly, age and age squared of household head, working adults' education, and land and non-land asset holdings (log), whose estimation results are reported in Table A1, and village dummies, which fully control for environmental and market conditions. A gendered division of adult and child labor is evident: In the whole sample (column 1), male adult labor endowment contributes more to farm income than non-farm income, and the converse holds true for female adults (active fisherwomen and craftswomen); boys strongly contribute to farm income, but not non-farm income, and girls contribute to neither of them. It is

thus likely that although non-farm activities are mostly in the adult domain, boys are more active in farming than girls.

Neither dwelling damage nor aid receipt significantly influences farm/non-farm income (and total income). Qualitatively the same results hold for aid receipt in 2003-2004 and for the value of dwelling damage and aid received (results not shown). Hence, more than two years after the disaster, cyclone damage does not directly alter household livelihood patterns (agricultural rehabilitation was intensive in 2003, Takasaki 2011c).

If boys drop out of school for farming in response to cyclone damage and their school dropout is not temporary (as shown below), their current contribution to farming should be still larger among victims than non-victims. Estimating income equations separately for non-victims and victims strongly confirms this pattern: Boys' contribution to farming is significant among victims, but not among non-victims (columns 2 and 3, respectively). This suggests that boys' farming may have mostly emerged among victims as their coping response. Estimating income equations separately for non-recipients and recipients (in 2003-2005) reveals that aid receipt does not differentiate boys' farming among victims (columns 4 and 5, respectively). This suggests that disaster aid does not strongly mitigate boys' farm labor as a coping response (as found by de Janvry, et al. 2006 in Progresa). In contrast, neither dwelling damage nor housing aid strongly alters the insignificance of girls' labor or the gendered division of adult labor.

D. Youths' Schooling

The sample contains 544 youths (in 355 households). A gender gap in youths' schooling is evident: Girls' gross school enrollment rate is higher by about 8 percent than boys'; girls' gross secondary school enrollment rate is higher by almost 12 percent than boys' (see panel A of Table 6). Although girls' stronger school progression relative to boys' is apparent across age

groups, the most striking observation is that gender gaps in school enrollments are concentrated on ages 15, 17, and 18. Although data of youths' enrollment and grade in 2003-04 are lacking, youths at these ages are likely to have made decisions to enter junior-/senior-high schools in 2003-04 (when aid provision strongly affected housing rehabilitation); in contrast, among youths at ages 14, 16, and 19, these two years mainly correspond to their grade progression in the same schools.[6] This suggests that damage and aid mostly affected children's progression to higher-level schools, probably because of the larger cost of higher-level schooling,[7] school performance adversely affected by shocks, and incentives to protect investments made in the current school.[8] School dropout against cyclone damage then is less likely to be temporary.

[6] Consider youths at age 15, the majority of whom were in Form 1 or 2 (junior high) in 2005 and must have been in Class 7 or 8 in 2003. Junior-high-school entry decisions were made in 2003 by those in Class 8 who completed primary school in 2003 and in 2004 by those in Class 7 and 8 who completed primary school in 2004 (those in Class 8 who repeated the grade in 2003 and those in Class 7 who made progress to Class 8 in 2003). In contrast, junior-high-school entry decisions among youths at age 14 were made in 2004 only (among those in Class 7 in 2003 who successfully advanced grades); decisions among youths at age 16 were made in either 2003 or 2004 only among those in Class 8 in 2003. Comparisons of other age groups are analogous.

[7] With limited gendered schooling programs, such as scholarships, schooling costs in the same school should not be significantly different between boys and girls.

[8] Indeed, among working adults with secondary incomplete (Table 1), junior-high completion (Form 4) is more common than junior- or senior-high incomplete (Form 3 or 5).

As tertiary schooling is very uncommon for both boys and girls,[9] among youths not currently in school, a significant gender gap exists in secondary-school completion at ages 18 and 19 (panel B): Girls are more likely to complete secondary school, as found among young adults. Their secondary-school completion status in 2005 is determined by their enrollments (and performance) in 2003-04. Thus, the combination of school enrollment – mostly primary or secondary – and secondary-school completion at the time of interviews in 2005 (henceforth, *adjusted school enrollment*) captures the overall schooling patterns among youths after the 2003 cyclone.[10]

The gender gap in the rate of adjusted school enrollment among youths is 9.4 percent (see Table 7), almost the same as the gender gap in secondary education among young adults. As found in the original school enrollment rates, gender gaps in adjusted enrollment rates at ages 15, 17, and 18 are much larger than others. Gender gaps in adjusted enrollment rates at ages 18 and 19 are larger than those in the original enrollment rates because of girls' higher secondary-school completion than boys'.

E. School Dropout as Insurance

[9] This is partly because youths who enter tertiary school migrate to cities. Although data about those migrants are lacking, they should not be common because the numbers of youths in the sample are similar across age groups.

[10] An alternative measure is the combination of secondary-school enrollment and completion among youths who completed primary school. I repeated all analyses conducted below for this measure. Although selection bias is a potential concern because primary completion status is measured only in 2005, results are qualitatively the same as those reported below.

To capture how youths' schooling is related to cyclone damage and aid, I introduce the following measures of gaps in adjusted school-enrollment rates: *victimization gap* – simple difference between disaster non-victims and victims – and *aid-receipt gap* – simple difference between aid non-recipients and recipients among victims. Table 7 shows that among all youths, victims' schooling is lower than non-victims', and among victims, schooling of non-recipients in 2003-04 is lower than that of recipients; the victimization and aid-receipt gaps, respectively, are 7.8 and 10.6 percent in magnitude, which are in a range similar to that of the gender gap. That is, schooling is as strongly correlated with cyclone damage and aid receipt as gender. Not surprisingly, cyclone damage and aid receipt are uncorrelated with youths' gender.

Now, how is the victimization/aid-receipt gap related with gender? How is the gender gap related with victimization/aid receipt? First, boys' victimization gap is larger than girls' (10 vs. 5 percent) and victims' gender gap is larger than non-victims' (11 vs. 6 percent); for each gap measure, only the larger gap is statistically significant, although the difference between the gender gap and the victimization gap (i.e., difference-in-differences) (5 percent) is statistically nonsignificant. Thus, gender gap in schooling is mostly explained by the gender difference in victimization gap. Second, boys' aid-receipt gap is much larger than girls' (over 18 vs. less 2 percent) and non-recipients' gender gap is much larger than recipients' (over 15 vs. 1 percent); in each gap measure, only the larger gap is statistically significant, and although the difference between the gender gap and the aid-receipt gap among victims is large (almost 17 percent), it is not statistically significant. Put differently, the victimization gap is significant only among non-recipients.

The results for aid receipt in 2003-05 are different as follows. First, girls' aid-receipt gap is the opposite: Non-recipients' schooling is higher than recipients', though the difference is not

statistically significant. Second, boys' aid-receipt gap (about 10 percent) is smaller than that in 2003-04 and statistically nonsignificant. Third, as a result, the aid-receipt gap among all youths is very small (about 3 percent). Consistent with the aid effects on housing rehabilitation found above, the aid in 2005 was probably too late to alter schooling decisions – especially about school progression – made in the previous years.

Combined with the indirect evidence for child labor presented above, these findings support my conjecture that the gender gap in schooling is the result of a gendered division of child farm labor against cyclone damage. Housing aid mitigates boys' school dropout – school non-progression – among victims (again, as found by de Janvry, et al. 2006), if the provision occurs early enough.

IV. Econometric Specification

A. A Base Model

This section constructs an empirical model to estimate gender, victimization, and aid-receipt gaps in youths' schooling. I employ the following model:

$$s_{ij} = \beta_0 + \beta_1 g_{ij} + \beta_2 d_j + \beta_3 g_{ij} d_j + \beta_4 a_j + \boldsymbol{\gamma x_{ij}} + \boldsymbol{\delta z_j} + \boldsymbol{v} + \varepsilon_{ij}, \quad (1)$$

where i and j stand for individual and household, respectively; s_{ij} is a dummy for adjusted school enrollment defined above; g_{ij}, d_j, and a_j are dummies for girl, victimization, and aid receipt, respectively; $\boldsymbol{x_{ij}}$ is a vector of individual controls, captured by youth's age and sibling composition (two dummies for the availability of elder brother and sister at age 14-19 and numbers of younger brothers and sisters);[11] $\boldsymbol{z_j}$ is a vector of household controls, captured by numbers of male and female working adults and elderly, age of household head, and land

[11] In the youth sample, 46% are girls; 23% and 17% have an elder brother and sister, respectively; and the mean numbers of younger brothers and sisters are 1.5 and 1.2, respectively.

holdings (log) (parental education is introduced as additional controls later); $\boldsymbol{\nu}$ is a vector of village dummies, which fully control for school conditions (e.g., access, quality, cost, school damage and rehabilitation), as well as village-level covariate shocks and aid received; and ε_{ij} is an error term. Following the empirical context in Fiji, I assume that there is no leakage of targeting aid to victims and under-coverage of victims is significant, i.e., $(d_j, a_j) = (0, 0), (1, 0), (1, 1)$; then, the aid dummy is effectively an interaction term of the damage and aid dummies, i.e., $a_j = d_j a_j$.

Equation (1) is estimated by OLS (probit results are very similar); villages with no variations in schooling across individuals are dropped. As damage and aid are measured at the household level, standard errors are clustered by household.

B. Identification

In equation (1), is household-level dwelling damage exogenous as a determinant of youths' schooling? Unobserved pre-disaster dwelling quality, which determines idiosyncratic dwelling damage, needs to receive special attention: It is likely to be positively correlated with unobserved wealth at the time of disaster – other than land holdings controlled for – which can positively influence schooling. Then, the estimated damage effect on schooling is biased *downward*; in particular, the estimated negative effect can be an artifact of the omitted variable bias. If aid allocation targets the poor – according to wealth not observed by analysts – among victims, the estimated positive aid effect is also biased downward, though it is qualitatively robust.

To address this potential identification problem, I augment equation (1) by using non-land assets as an additional control as follows. Ignoring gender, individual/household controls, and village dummies for brevity, first consider the following model:

$$s_{ij} = \beta_0 + \beta_2 d_j + \beta_4 a_j + \delta w_j^* + \varepsilon_{ij}, \quad (2)$$

where w_j^* denotes asset holdings right after the disaster, i.e., pre-disaster assets, minus assets lost because of the disaster, which are proportional to pre-disaster holdings. Given that the household cannot borrow (credit is very limited in the sample), current asset holdings w are w^* after depreciation (at a fixed rate τ), plus investment m following the disaster, which is a function of w^*, dwelling damage value D, and the value of housing aid received A:

$$w = (1 - \tau)w^* + m(w^*, D, A). \quad (3)$$

I assume that $\partial m/\partial w^* > 0$, $\partial m/\partial D < 0$, and $\partial m/\partial A > 0$; that is, the larger the damage on assets/dwelling and the smaller the aid received, the more liquidation of or the less investment in assets. Assuming a linear investment function, equation (3) can be empiricized as follows:

$$w_j = \theta_0 + \theta_1 w_j^* + \theta_2 D_j + \theta_3 A_j + \mu_j, \quad (4)$$

where θ_1 (> 0) captures one plus the rate of asset accumulation with no dwelling damage or aid; θ_2 (< 0) and θ_3 (> 0) measure the asset effects of dwelling damage and aid, respectively; and μ_j is a residual. An alternative asset equation is

$$w_j = \pi_0 + \pi_1 w_j^* + \pi_2 d_j + \pi_3 a_j + \rho_j, \quad (5)$$

where interpretation of π_1, π_2, and π_3 is analogous.[12]

Substituting equation (5) into (2) yields

$$s_{ij} = \beta_0 + \beta_2 d_j + \beta_4 a_j + \delta \frac{1}{\pi_1} w_j + \left[\varepsilon_{ij} - \delta \frac{\pi_2}{\pi_1} d_j - \delta \frac{\pi_3}{\pi_1} a_j - \delta \frac{1}{\pi_1}(\pi_0 + \rho_j)\right]. \quad (6)$$

[12] Regressing current non-land asset holdings (log) on dwelling damage and aid (either dummies or log of values), as well as household controls and village dummies, confirms that the estimated coefficients for damage and aid are negative and positive, respectively; though only that for damage value is statistically significant at a 10% significance level (results not shown).

In equation (6) with w_j as a proxy for w_j^*, systematic measurement errors cause *upward* bias in the estimated damage effect and downward bias in the estimated aid effect, if assets positively affect schooling (i.e., $\delta > 0$). Then, in the augmented equation (1) with current non-land assets as an additional control, both the estimated negative damage effect and the positive aid effect are at least qualitatively robust. The estimated damage effects in the augmented and original equation (1), respectively, serve as the upper and lower bounds of the true effect. This is so even if damage effects are distinct between boys and girls.

Although demographic factors at the time of disaster should be controlled for, using current demographic factors as proxies in equation (1) is unlikely to involve a strong bias caused by systematic measurement errors, as discussed above. For a robustness check, I estimate equation (1) without individual/household controls (results not shown); estimated coefficients for four dummies for girl, victimization, girl-victimization interaction, and aid receipt are very similar to (and statistically stronger than) those reported below.

For another robustness check, I also estimate the effects of the magnitude of damage and the amount of aid received using the following model:

$$s_{ij} = \alpha_0 + \alpha_1 g_{ij} + \alpha_2 D_j + \alpha_3 g_{ij} D_j + \alpha_4 A_j + \alpha_5 D_j A_j + \boldsymbol{\gamma x_{ij}} + \boldsymbol{\delta z_j} + \boldsymbol{v} + \varepsilon_{ij}, \quad (7)$$

where D_j and A_j, respectively, are the value of dwelling damage and aid received (log), and the interaction term D_jA_j allows their heterogeneous marginal effects. Potential bias in the estimated damage and aid effects is analogous to equation (1) (based on equation 4). Distinct from damage incidence and aid receipt in which recall errors are minor (Takasaki 2011b), measurement errors in damage and aid values can be significant, causing attenuation bias.

C. Gender, Victimization, and Aid-receipt Gaps in Schooling

Consider a standard enrollment equation with no disasters, i.e., a constrained equation (1) with $\beta_2 = \beta_3 = \beta_4 = 0$. The estimated β_1 captures the gender difference in the probability of school enrollment; positive β_1 is the estimated gender gap in schooling against boys. Consider the damage dummy as an additional control. The estimated β_2 captures the difference in the probability of enrollment between victims and non-victims for both boys and girls; the negative β_2 is the estimated victimization gap in schooling. Adding the gender-victimization interaction term allows heterogeneity in the damage and gender effects. In particular, with positive β_3, boys' victimization gap is larger than girls' in magnitude ($\beta_2 < \beta_2 + \beta_3$) and victims' gender gap is larger than non-victims' ($\beta_1 < \beta_1 + \beta_3$).

In the unconstrained equation (1) with the aid dummy as an additional control, the estimated β_4 captures the difference in the probability of enrollment between recipients and non-recipients among victims (with no leakage) for both boys and girls. Positive β_4 is the estimated aid-receipt gap in schooling; non-recipients' victimization gap is larger than recipients' in magnitude ($\beta_2 < \beta_2 + \beta_4$ for boys).[13] By comparing aid receipts in 2003-04 and 2003-05, I also test whether the aid in 2005 has no additional effect. In equation (7), the gender, victimization, and aid-receipt gaps are estimated in a similar way.

D. Heterogeneity

[13] The aid effect is assumed to be neutral to gender. With a relatively small number of observations in the Fijian data, an additional interaction term of gender and aid is not used (it is effectively a triple interaction term of damage, aid, and gender). With richer data, capturing gendered aid effects is straightforward. Introducing leakage is also a straightforward extension; with significant leakage, the aid-receipt gap among non-victims can be also considered.

In equation (1), the homogenous damage effect on boys' schooling among non-recipient victims is assumed. To capture potentially heterogeneous effects, I augment equation (1) by adding an interaction term of d_j and x^1_{ij} or z^1_j, where x^1_{ij} and z^1_j, respectively, are selected individual and household factors. Let γ_1, δ_1, and β_5, respectively, denote the estimated coefficients for x^1_{ij}, z^1_j, and $d_j x^1_{ij}$ or $d_j z^1_j$. I test the following four hypothesized effects.

1) School-progression effect: Letting x^1_{ij} denote a dummy for ages 15, 17, and 18, negative β_5 indicates that boys are more vulnerable in their progression to higher-level schools than in their grade progression in the same schools, as found above (note that youths' age is separately controlled for).
2) Birth-order effect: Letting x^1_{ij} denote a dummy for the availability of elder brother (age 14-19), positive β_5 indicates that the oldest brothers are more vulnerable than younger ones.
3) Wealth effect: Letting z^1_j denote land holdings or non-land asset holdings, positive β_5 indicates that the richer the household, the less vulnerable are the boys.
4) Maternal effect: Letting x^1_{ij} denote maternal education in the augmented equation (1) with parental (maternal and paternal) education as additional controls, positive γ_1 and β_5 indicate that maternal education promotes youths' schooling and decreases boys' vulnerability.

In equation (7), these effects can be tested in a similar way.

Since the data of parental education are available only for youths with parents currently in the same household (i.e., information about deceased, divorced, and migrated parents are lacking), the numbers of observations significantly decrease. If results of variables other than parental education are similar to those in the original models without parental education controlled for, selection bias in this analysis is unlikely to be a major concern.

V. Estimation Results

A. Gender, Victimization, and Aid-receipt Gaps in Schooling

Estimation results of four dummies for girl, victimization, girl-victimization interaction, and aid receipt in equation (1) with current non-land assets controlled for are reported in columns (1)-(5) in panel A of Table 8. First of all, the signs of all estimated coefficients are the same as those hypothesized above. The estimated gender gap is 9.5 percent (column 1) and the estimated victimization gap for all youths is almost 7 percent (with weak statistical significance) (column 2) (these are almost the same as the simple difference estimates obtained above). The estimated coefficient for the gender-victimization interaction is positive but statistically nonsignificant (column 3) (as in the difference-in-differences estimate obtained above). Boys' victimization gap is almost triple girls' (with weak statistical significance), and victims' gender gap (with statistical significance) is more than twice non-victims'. The estimated aid-receipt gap for 2003-04 among victims is about 7 percent with no statistical significance (column 4); boys' victimization gap among non-recipients (with statistical significance) is more than twice that among recipients. Note that the estimated boys' victimization gap among non-recipients is the same in magnitude as the estimated victims' gender gap (11.5 percent). The results for aid in 2003-05 (column 5) are similar to those for 2003-04, suggesting that only aid received in two years' time affects schooling. These results confirm that gender gap in schooling is mostly explained by the gendered victimization gap in schooling: Boys drop out of school against disaster damage only if victims do not receive disaster aid early enough.

Estimation results of the unconstrained equation (1) without non-land assets controlled for are reported in columns (6) and (7). Although the estimated victimization gaps increase in magnitude from those in columns (4) and (5) as expected, their difference is very small for both

boys and girls (about 1 percent). This suggests that potential bias in these estimated damage effects are likely to be small. The estimated aid effects are also very similar to each other.

Estimation results of equation (7) with damage and aid value reported in panel B are qualitatively the same as those in panel A. The estimated negative marginal effects of damage on boys' schooling among non-recipients are 0.14-0.18 in magnitude for a 10 percent increase in damage value (the results are statistically weak probably because of attenuation bias), and the comparable estimates for girls are close to zero and statistically nonsignificant (columns 4-7).

B. Heterogeneity

Estimation results of heterogeneous damage effects on boys' schooling among non-recipients are reported in Table 9 (the maternal effect is discussed later). Only results for equation (1) with current non-land assets controlled for are reported; those for equation (1) without non-land assets and for equation (7) with and without non-land assets are qualitatively the same. Column (1) replicates column (4) in panel A of Table 8 (results of the remaining individual/household controls are reported in Table A1). The school-progression and birth-order effects are strong (columns 2 and 3): The victimization gap at ages 15, 17, and 18 (almost 15 percent) is near twice that at ages 14, 16, and 19 (only the former is statistically significant); the victimization gap of the oldest brothers is also almost 15 percent, whereas that of younger ones is almost zero.[14] In contrast, the wealth effects of land and non-land assets are weak (columns 4 and 5). The former is probably because among large landholders with high demand for farm

[14] The direct birth-order effect among non-victims is the opposite: the probability of schooling of younger brothers is lower by over 0.13 than the oldest brothers. This probably reflects social norms or inheritance patterns related to sons' birth order.

labor, boys' opportunity cost of schooling is high (Bhalotra and Heady 2003). Distinct from land, non-land assets directly augment boys' and girls' schooling; I return to this result shortly.

Estimation results for schooling effects of parental education are reported in Table 10. To capture potentially heterogeneous effects of parental human capital on boys and girls, two dummies for paternal and maternal secondary education are interacted with the girl dummy (in the sample, 41% and 47% of youths, respectively, have a father and mother with secondary education). Estimation results without damage and aid variables show that although maternal education promotes boys' schooling (the estimated direct maternal effect is about 0.15), its effect on girls is less than half and statistically nonsignficant (column 1);[15] in contrast, paternal education is neutral to both boys' and girls' schooling.

With maternal education controlled for, the estimated coefficient for current non-land assets becomes smaller than that in Table 9 and is statistically nonsignificant. This suggests that maternal education is positively correlated with pre-disaster non-land assets,[16] and the significant effect of current non-land assets found above mostly captures that of uncontrolled maternal education. Combined with the nonsignficant effect of land holdings, this indicates that wealth is

[15] Takasaki (2011a) shows that maternal education augments both male and female adults' secondary education. Thus, after female secondary education surpassed that of males, maternal human capital worked to balance human capital investments between genders.

[16] In the patrilineal Fijian society, educated women may tend to marry wealthy men. Then, female high returns to education in the marriage market could be another reason for the persistent progress in women's education. This conjecture deserves further research.

unlikely to strongly influence youths' schooling (i.e., small δ in equation 2),[17] buttressing confidence that bias in the estimated damage effects is limited. All results other than non-land assets are very similar to those in the models without parental education controlled for; in particular, all results on the gender, victimization, and aid-receipt gaps and the school-progression, birth-order, and wealth effects found above hold (results not shown).

Adding the damage and aid variables hardly changes these results at all (column 2). The estimated coefficient for the interaction term of maternal education and damage is very small and statistically nonsignificant (column 4), indicating that maternal human capital does not decrease boys' vulnerability (i.e., no interacted maternal effect).

In contrast, the estimated coefficient for the interaction term of paternal education and damage is negative and large in magnitude (though it is not statistically significant), and boys' victimization gap among non-recipients is larger with an educated father than without (over 18 vs. less than 6 percent, the former is statistically significant) (column 3). This result, which is opposite to the hypothesized parental effect, can be interpreted as follows. The opportunity cost of farming is high among educated fathers; in particular, those with permanent employment are under severe time constraints. Then, educated fathers substitute boys' labor for farming as a coping response;[18] that is, paternal human capital instead increases boys' vulnerability. With the

[17] This result, which is distinct from empirical findings in other locales (World Bank 2011), may reflect a relatively small wealth disparity within villages in the same province.

[18] About 18% of households with youths have permanent employment, which accounts for about 7% of earned income. Consistent with the significant role of boys' farm labor, permanent employment does not strongly differentiate household farm income; households with permanent employment earn higher non-farm income and thus have higher total income than others.

gendered division of farm labor and very limited female employment, this alternative channel is not significant for mothers.

VI. Conclusion

Rapidly decreasing gender gaps in schooling in developing countries can be a result of the gendered division of child farm labor as a coping response to increased natural disasters. This paper made a case for this conjecture by analyzing original household survey data in rural Fiji, where girls' secondary enrollments have been higher than boys' since the 1980s. I have shown that (1) boys, not girls, contribute to farming, not non-farm activities, among cyclone victims with dwelling damage, independent of housing aid receipt, but not among non-victims, and (2) a significant gender gap in school enrollment exists only among victims who did not receive aid in two years' time. Boys with no elder brother and an educated father (whose opportunity cost of farming is high) are particularly vulnerable in their progression to higher-level schools. Although maternal education promotes boys' schooling independent of shock, it does not decrease their school dropout as insurance. At the same time, however, boys' vulnerability is neutral to household wealth.

These findings lead to the following general implications for research and policy. First of all, the recent progress in women's education in developing countries can be at least partly explained by household response to shocks, not to market and institutional changes (cf. World Bank 2011). This alternative mechanism can be persistent for at least three reasons. First, as maternal human capital does not weaken gendered coping responses, the progress in women's education does not help do so, either. Second, development of the female labor market increases the relative opportunity cost of boys' schooling. Third, without a breakthrough in safety-net policies for poor farmers, they continue to be vulnerable to natural disasters. Research is needed

to see whether gendered coping responses play a significant role in decreasing the gender gap in schooling in other locales, especially in rural developing areas vulnerable to natural hazards.

Timely disaster aid can mitigate school dropout among disaster victims, even if it is neither targeted toward students nor conditional on enrollments. Effective post-disaster management is thus critically important for protecting children's human capital. Policymakers can target vulnerable children according to their attributes, such as gender, school grade, sibling composition, and parents' occupation. Welfare targeting toward landless and small holders may not be effective to combat child farm labor. A similar caveat is that agricultural rehabilitation in rural areas, which is important for food security and livelihood recovery, can at the same time increase child farm labor. Livelihood rehabilitation needs to include programs without involving child labor, such as public work for community rehabilitation.

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Table 1. Working adults' education attainment and employment by gender.

	Age 20-59			Age 20-39			Age 40-59		
	Male	Female	*Gender gap*	Male	Female	*Gender gap*	Male	Female	*Gender gap*
	(1)	(2)	(1) - (2)	(3)	(4)	(3) - (4)	(5)	(6)	(5) - (6)
Education attainment (percentage):									
Primary incomplete or below	16.6	13.8	2.7 *	14.8	10.6	4.2 **	19.1	18.5	0.6
Primary complete	29.5	26.3	3.3 *	23.0	17.0	6.0 ***	38.8	39.7	-0.8
Secondary incomplete	36.5	37.0	-0.5	40.5	38.6	2.0	30.8	34.8	-4.0
Secondary complete or above	17.4	22.9	-5.5 ***	21.7	33.8	-12.1 ***	11.3	7.1	4.2 **
Secondary education	53.9	59.9	-6.0 ***	62.2	72.4	-10.1 ***	42.1	41.8	0.2
Permanent wage employment by education attainment (percentage):									
All	9.5	3.3	6.1 ***	7.3	3.7	3.7 ***	12.4	2.9	9.6 ***
Primary incomplete or below	3.8	2.2	1.6	4.2	4.8	-0.6	3.4	0.0	3.4
Primary complete	7.6	0.8	6.9 ***	4.7	1.0	3.7	10.1	0.6	9.4 ***
Secondary incomplete	9.4	2.2	7.2 ***	4.2	0.9	3.3 **	19.0	4.2	14.8 ***
Secondary complete or above	18.1	8.7	9.4 ***	17.7	8.0	9.8 ***	19.2	13.8	5.4
No. observations	1110	1005		649	594		461	411	

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 2. Household means of cyclone damage, aid, and rehabilitation.

	All households	Households with youths (age 14-19)
Cyclone damage in January 2003:		
Dwelling damage (*victim*) (0/1)	0.62	0.66
Dwelling damage value (F$)	1074 (2139)	1115 (2287)
Disaster aid through time:		
Construction materials receipt (*recipient*) (0/1)	0.25	0.28
2003	0.05	0.05
2004	0.14	0.16
2005	0.06	0.07
Construction materials received (F$)	686 (1984)	681 (1973)
2003	100 (782)	71 (635)
2004	317 (1379)	283 (1300)
2005	267 (1310)	321 (1437)
No. observations	902	355
Rehabilitation at the time of interviews in 2005:		
Main house rebuilding (0/1) among victims with main house completely destroyed (0/1)	0.40	0.38
Non-recipients	0.20	0.21
Recipients	0.51	0.47

Note: Standard deviations are shown in parentheses.

Table 3. Means of household characteristics by cyclone damage and aid.

	All households	Non-victims (1)	Victims (2)	(1) - (2)	Non-recipients (3)	Recipients (4)	(3) - (4)	Households with youths (age 14-19)
No. boys (age 14-19)	0.33 (0.64)	0.29 (0.65)	0.35 (0.64)	-0.06	0.36 (0.67)	0.34 (0.59)	0.01	0.83 (0.80)
No. girls (age 14-19)	0.28 (0.54)	0.25 (0.50)	0.29 (0.56)	-0.04	0.30 (0.57)	0.27 (0.54)	0.03	0.70 (0.66)
No. male working adults (age 20-59)	1.26 (0.93)	1.21 (0.88)	1.29 (0.97)	-0.09	1.29 (0.99)	1.30 (0.94)	-0.02	1.42 (0.99)
No. female working adults (age 20-59)	1.15 (0.76)	1.15 (0.78)	1.15 (0.75)	0.00	1.14 (0.78)	1.16 (0.69)	-0.02	1.35 (0.80)
No. children (age 0-13)	1.93 (1.77)	1.83 (1.79)	1.99 (1.76)	-0.16	1.92 (1.77)	2.10 (1.75)	-0.17	2.22 (1.86)
No. elderly (age 60 or above)	0.54 (0.77)	0.52 (0.74)	0.55 (0.78)	-0.03	0.56 (0.77)	0.55 (0.81)	0.01	0.43 (0.70)
Age of household head	51.4 (14.6)	51.6 (15.7)	51.4 (13.9)	0.19	51.4 (14.1)	51.3 (13.7)	0.15	51.0 (11.8)
Working adults' secondary education (0/1)	0.73 (0.44)	0.76 (0.43)	0.72 (0.45)	0.04	0.73 (0.44)	0.69 (0.46)	0.04	0.77 (0.42)
Land (acre)	2.86 (4.84)	2.83 (4.30)	2.87 (5.15)	-0.04	2.73 (4.02)	3.09 (6.52)	-0.36	3.03 (6.11)
Non-land assets (F$)	1846 (4457)	2266 (5428)	1588 (3720)	678 **	1489 (3882)	1739 (3460)	-249	2193 (5438)
No. observations	902	343	559		338	221		355

Note: Standard deviations are shown in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 4. Determinants of house rebuilding among victims with main house completely destroyed.

	(1)	(2)	(3)	(4)	(5)	(6)
Recipient in 2003-04 (0/1)	0.240 **	0.273 **				
	(0.120)	(0.123)				
Recipient in 2003-05 (0/1)			0.264 *			
			(0.134)			
Log of aid in 2003-04 (F$)				0.034 **	0.036 **	
				(0.016)	(0.016)	
Log of aid in 2003-05 (F$)						0.036 **
						(0.016)
Household controls	No	Yes	Yes	No	Yes	Yes
R-squared	0.226	0.290	0.283	0.235	0.295	0.298
No. observations	135	134	134	131	130	130

Notes: Dependent vaiables are a dummy for house rebuilding. OLS estimates are shown. Robust standard errors are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Household controls are no. boys (age 14-19), no. girls (age 14-19), no. male adults (age 20-59), no. female adults (age 20-59), no. children (age 0-13), no. elderly (age 60 or above), age of household head, working adults' secondary education (0/1), and log of land (m^2). Village dummies and constant are also included in all columns.

Table 5. Determinants of household earned income.

	All	Non-victims	Victims	Non-recipients	Recipients
	(1)	(2)	(3)	(4)	(5)
A. Farm income					
No. boys (age 14-19)	0.280 ***	0.122	0.305 ***	0.318 **	0.313 *
	(0.079)	(0.131)	(0.094)	(0.133)	(0.180)
No. girls (age 14-19)	0.014	0.088	-0.002	0.054	-0.095
	(0.098)	(0.177)	(0.127)	(0.188)	(0.203)
No. male adults (age 20-59)	0.149 **	0.204	0.159 **	0.173 *	0.130
	(0.062)	(0.132)	(0.071)	(0.099)	(0.115)
No. female adults (age 20-59)	0.029	0.125	-0.032	0.067	-0.109
	(0.077)	(0.152)	(0.083)	(0.110)	(0.150)
Victim (0/1)	-0.086				
	(0.124)				
Recipient (0/1)	-0.016		-0.070		
	(0.137)		(0.145)		
R-squared	0.462	0.552	0.456	0.531	0.412
No. observations	884	335	544	326	212
B. Non-farm income					
No. boys (age 14-19)	0.051	0.188 *	-0.056	-0.081	0.078
	(0.066)	(0.103)	(0.083)	(0.112)	(0.109)
No. girls (age 14-19)	0.089	0.082	0.050	0.153	-0.073
	(0.078)	(0.147)	(0.092)	(0.141)	(0.115)
No. male adults (age 20-59)	0.050	0.044	0.078	0.052	0.117
	(0.041)	(0.079)	(0.052)	(0.071)	(0.086)
No. female adults (age 20-59)	0.197 ***	0.243 **	0.144 **	0.141 *	0.224 *
	(0.058)	(0.124)	(0.061)	(0.075)	(0.115)
Victim (0/1)	0.021				
	(0.100)				
Recipient (0/1)	0.120		0.064		
	(0.100)		(0.098)		
R-squared	0.245	0.350	0.244	0.271	0.434
No. observations	893	337	551	333	212

Notes: Dependent variables are log of monthly earned income (F$). OLS estimates are shown. Robust standard errors are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Controls not shown here are no. children (age 0-13), no. elderly (age 60 or above), age of household head, working adults' secondary education (0/1), log of land (m2), log of non-land assets (F$), village dummies, and constant.

Table 6. Youths' school enrollment and attainment.

A. Enrollment rates by gender, age, and school (percentage)

	Boys					Girls					
	No. obs.	Not enrolled (1)	Primary	Secondary	Tertiary	No. obs.	Not enrolled (2)	Primary	Secondary	Tertiary	*Gender gap* (1) - (2)
Age 14-19	295	37.2	17.1	41.6	4.1	249	29.2	15.8	53.4	1.6	8.1 **
Age 14	56	3.6	64.3	32.1	0.0	44	2.3	56.8	40.9	0.0	1.3
Age 15	42	26.2	16.7	57.1	0.0	50	8.0	24.0	68.0	0.0	18.2 **
Age 16	57	26.8	7.1	64.3	1.8	40	25.0	5.0	70.0	0.0	1.8
Age 17	51	43.1	5.9	49.0	2.0	30	33.3	0.0	66.7	0.0	9.8
Age 18	44	68.2	0.0	22.7	9.1	47	51.1	0.0	48.9	0.0	17.1 *
Age 19	45	65.9	0.0	20.5	13.6	38	63.2	0.0	26.3	10.5	2.8

B. Education attainment among the not-enrolled by gender and age (percentage)

	Boys					Girls					
	No. obs.	Primary incomplete or below	Primary complete	Secondary incomplete	Secondary complete or above (3)	No. obs.	Primary incomplete or below	Primary complete	Secondary incomplete	Secondary complete or above (4)	*Gender gap* (3) - (4)
Age 14-19	108	26.9	22.2	47.2	3.7	72	18.1	23.6	48.6	9.7	-6.0 *
Age 14	2	100.0	0.0	0.0	0.0	1	100.0	0.0	0.0	0.0	0.0
Age 15	11	36.4	54.6	9.1	0.0	4	50.0	50.0	0.0	0.0	0.0
Age 16	15	26.7	20.0	46.7	6.7	10	20.0	40.0	40.0	0.0	6.7
Age 17	21	23.8	14.3	61.9	0.0	10	20.0	20.0	60.0	0.0	0.0
Age 18	30	26.7	20.0	53.3	0.0	23	13.0	21.7	56.5	8.7	-8.7 *
Age 19	29	20.7	20.7	48.3	10.3	24	12.5	16.7	50.0	20.8	-10.5

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 7. Youths' schooling by age, gender, cyclone damage, and aid.

	No. obs.	School enrollment or secondary school completion in 2005 (0/1)			
		All	Boys (1)	Girls (2)	*Gender gap* (1) - (2)
Age 14-19	544	68.4	64.1	73.5	-9.4 **
Age 14	100	97.0	96.4	97.7	-1.3
Age 15	92	83.7	73.8	92.0	-18.2 **
Age 16	97	74.2	73.7	75.0	-1.3
Age 17	81	60.5	56.9	66.7	-9.8
Age 18	91	42.9	31.8	53.2	-21.4 **
Age 19	83	45.8	42.2	50.0	-7.8
Victims vs. non-victims:					
Non-victims (a)	185	73.5	70.7	76.7	-6.0
Victims (b)	359	65.7	60.7	71.8	-11.1 **
Victimization gap (a) - (b)		7.8 *	10.0 *	5.0	5.0
Recipients vs. non-recipients in 2003-04 among victims:					
Non-recipients (c)	257	62.7	55.4	71.2	-15.8 ***
Recipients (d)	101	73.3	73.7	72.7	1.0
Aid-receipt gap (c) - (d)		-10.6 *	-18.3 **	-1.5	-16.7
Recipients vs. non-recipients in 2003-05 among victims:					
Non-recipients (e)	223	64.6	56.7	73.8	-17.1 ***
Recipients (f)	136	67.6	67.1	68.3	-1.2
Aid-receipt gap (e) - (f)		-3.1	-10.4	5.5	-15.9

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 8. Gender, victimization, and aid-receipt gaps in youths' schooling.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
A. Dwelling damage							
Girl (0/1)	0.095 **	0.094 **	0.050	0.050	0.051	0.052	0.053
	(0.038)	(0.038)	(0.069)	(0.069)	(0.069)	(0.070)	(0.070)
Victim (0/1)		-0.069	-0.101	-0.115 *	-0.115 *	-0.126 *	-0.125 *
		(0.045)	(0.065)	(0.066)	(0.067)	(0.067)	(0.068)
Victim × Girl			0.067	0.065	0.066	0.064	0.065
			(0.084)	(0.084)	(0.084)	(0.084)	(0.084)
Recipient (0/1)				0.074	0.047	0.072	0.044
				(0.061)	(0.056)	(0.061)	(0.056)
Recipient in:				2003-04	2003-05	2003-04	2003-05
Non-land assets	Yes	Yes	Yes	Yes	Yes	No	No
Marginal effects:							
Victimization among girls			-0.034				
			(0.058)				
Girl with victimization			0.117 **	0.115 **	0.117 **	0.116 **	0.118 **
			(0.047)	(0.047)	(0.047)	(0.046)	(0.046)
Victimization among non-recipient girls				-0.050	-0.049	-0.062	-0.060
				(0.059)	(0.060)	(0.060)	(0.061)
Victimization among recipient boys				-0.041	-0.068	-0.054	-0.081
				(0.079)	(0.074)	(0.080)	(0.075)
R-squared	0.281	0.284	0.285	0.288	0.287	0.281	0.281
No. observations	525	525	525	524	525	524	525

(continued)

B. Dwelling damage value							
Girl (0/1)	0.095 **	0.093 **	0.048	0.048	0.047	0.049	0.048
	(0.038)	(0.038)	(0.066)	(0.065)	(0.065)	(0.066)	(0.066)
Log of damage (F$)		-0.008	-0.013	-0.014	-0.016	-0.015	-0.018 *
		(0.007)	(0.009)	(0.010)	(0.010)	(0.010)	(0.010)
Log of damage × Girl			0.011	0.010	0.011	0.010	0.011
			(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Log of aid (F$)				0.0022	-0.017	0.0011	-0.020
				(0.039)	(0.036)	(0.039)	(0.036)
Log of damage × Log of aid				0.0006	0.0033	0.0008	0.0036
				(0.005)	(0.005)	(0.005)	(0.005)
Aid received in:				2003-04	2003-05	2003-04	2003-05
Non-land assets	Yes	Yes	Yes	Yes	Yes	No	No
Marginal effects:							
Damage among girls			-0.002				
			(0.009)				
Girl with mean damage			0.093 **	0.089 **	0.092 **	0.090 **	0.092 **
			(0.038)	(0.038)	(0.039)	(0.038)	(0.039)
Damage among non-recipient girls				-0.004	-0.005	-0.005	-0.007
				(0.009)	(0.009)	(0.010)	(0.009)
Damage among boys with mean aid				-0.013	-0.011	-0.014	-0.012
				(0.010)	(0.011)	(0.010)	(0.011)
R-squared	0.281	0.283	0.284	0.289	0.289	0.282	0.284
No. observations	525	525	525	516	517	516	517

Notes: Dependent variables are a dummy for school enrollment or secondary school completion in 2005. OLS estimates are shown. Standard errors clustered by household are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Other controls not shown here are age, elder brother (age 14-19) (0/1), elder sister (age 14-19) (0/1), no. younger brothers, no. younger sisters, no. male adults (age 20-59), no. female adults (age 20-59), no. elderly (age 60 or above), age of household head, log of land (m^2), village dummies, and constant.

Table 9. School-progression, birth-order, and wealth effects on non-recipient boys' victimization gap in schooling.

	(1)	(2)	(3)	(4)	(5)
Girl (0/1)	0.050	0.053	0.043	0.050	0.049
	(0.069)	(0.069)	(0.069)	(0.069)	(0.069)
Victim (0/1)	-0.115 *	-0.083	-0.147 **	-0.095	0.031
	(0.066)	(0.068)	(0.070)	(0.242)	(0.202)
Victim × Girl	0.065	0.063	0.070	0.065	0.066
	(0.084)	(0.084)	(0.084)	(0.084)	(0.084)
Recipient in 2003-04 (0/1)	0.074	0.063	0.077	0.075	0.073
	(0.061)	(0.060)	(0.060)	(0.061)	(0.060)
Age	-0.118 ***	-0.115 ***	-0.118 ***	-0.118 ***	-0.118 ***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
With elder brother (age 14-19)	-0.043	-0.042	-0.136 **	-0.043	-0.043
(0/1)	(0.048)	(0.048)	(0.061)	(0.048)	(0.048)
Log of land (m^2)	-0.0009	-0.001	-0.001	0.001	0.000
	(0.010)	(0.010)	(0.010)	(0.024)	(0.010)
Log of non-land assets (F$)	0.029 *	0.027 *	0.029 *	0.029 *	0.042 *
	(0.015)	(0.015)	(0.015)	(0.015)	(0.024)
Victim × At age 15, 17, 18 (0/1)		-0.065			
		(0.050)			
Victim × With elder brother			0.141 *		
			(0.082)		
Victim × Log of land				-0.002	
				(0.027)	
Victim × Log of non-land assets					-0.021
					(0.027)
Non-recipient boys' victimization gap:					
At age 15, 17, 18		-0.148 **			
		(0.073)			
With elder brother			-0.006		
			(0.088)		
With mean land				-0.115 *	
				(0.066)	
With mean non-land assets					-0.113 *
					(0.066)
R-squared	0.288	0.291	0.291	0.288	0.289
No. observations	524	524	524	524	524

Notes: Dependent variables are a dummy for school enrollment or secondary school completion in 2005. OLS estimates are shown. Standard errors clustered by household are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Other controls not shown here are elder sister (age 14-19) (0/1), no. younger brothers, no. younger sisters, no. male adults (age 20-59), no. female adults (age 20-59), no. elderly (age 60 or above), age of household head, village dummies, and constant.

Table 10. Effects of parental education on youths' schooling.

	(1)	(2)	(3)	(4)
Father's secondary education (0/1)	-0.028	-0.042	0.044	-0.042
	(0.067)	(0.066)	(0.099)	(0.066)
Mother's secondary education (0/1)	0.152 **	0.151 **	0.142 **	0.162
	(0.067)	(0.067)	(0.067)	(0.102)
Father's secondary education × Girl	0.026	0.042	0.035	0.043
	(0.094)	(0.094)	(0.095)	(0.094)
Mother's secondary education × Girl	-0.085	-0.082	-0.072	-0.081
	(0.094)	(0.093)	(0.094)	(0.093)
Girl (0/1)	0.095	0.028	0.031	0.027
	(0.074)	(0.106)	(0.106)	(0.106)
Victim (0/1)		-0.116	-0.056	-0.108
		(0.074)	(0.086)	(0.094)
Victim × Girl		0.088	0.083	0.088
		(0.099)	(0.098)	(0.099)
Recipient in 2003-04 (0/1)		0.031	0.024	0.029
		(0.067)	(0.067)	(0.068)
Victim × Father's secondary education			-0.127	
			(0.097)	
Victim × Mother's secondary education				-0.017
				(0.104)
Log of non-land assets (F$)	0.021	0.017	0.017	0.017
	(0.017)	(0.017)	(0.017)	(0.017)
Marginal effects:				
Father's secondary education for girls	-0.0017	0.0001		
	(0.063)	(0.064)		
Mother's secondary education for girls	0.067	0.069		
	(0.068)	(0.068)		
Victimization with father's secondary education for non-recipient boys			-0.183 **	
			(0.089)	
Victimization with mother's secondary education for non-recipient boys				-0.125
				(0.087)
R-squared	0.297	0.302	0.306	0.302
No. observations	396	396	396	396

Notes: Dependent variables are a dummy for school enrollment or secondary school completion in 2005. OLS estimates are shown. Standard errors clustered by household are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Other controls not shown here are age, elder brother (age 14-19) (0/1), elder sister (age 14-19) (0/1), no. younger brothers, no. younger sisters, no. male adults (age 20-59), no. female adults (age 20-59), no. elderly (age 60 or above), age of household head, log of land (m^2), village dummies, and constant.

Appendix

Table A1. Determinants of household earned income, house rebuilding, and youths' schooling not shown in Tables 4, 5, and 9.

	House rebuilding (0/1)	Household earned income (F$)		Youths' schooling (0/1)
		Farm	Non-farm	
Corresponding tables and columns	Table 4 Column (2)	Table 5 Column (1) Panel A	Panel B	Table 9 Column (1)
No. boys (age 14-19)	-0.087			
	(0.108)			
No. girls (age 14-19)	0.012			
	(0.132)			
No. male adults (age 20-59)	-0.065			0.008
	(0.066)			(0.023)
No. female adults (age 20-59)	-0.018			-0.038
	(0.069)			(0.030)
No. children (age 0-13)	0.061 *	-0.004	-0.008	
	(0.032)	(0.033)	(0.028)	
No. eldery (age 60 or above)	-0.065	0.045	0.000	-0.110 ***
	(0.073)	(0.080)	(0.079)	(0.038)
Age of household head	0.000	0.045 **	0.014	0.002
	(0.005)	(0.023)	(0.024)	(0.002)
Age of household head squared		-0.0005 **	-0.0002	
		(0.0002)	(0.0002)	
Working adults' secondary education (0/1)	0.093	0.105	0.202 **	
	(0.111)	(0.120)	(0.096)	
Log of land (m^2)	-0.010	0.472 ***	0.103 ***	
	(0.020)	(0.036)	(0.029)	
Log of non-land assets (F$)		-0.048	0.040	
		(0.030)	(0.029)	
Elder sister (age 14-19) (0/1)				0.000
				(0.054)
No. younger brothers				0.000
				(0.017)
No. younger sisters				-0.035 *
				(0.018)

Notes: OLS estimates are shown. Robust standard errors for household earned income and house rebuilding and standard errors clustered by household are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Other controls not shown here are village dummies and constant, as well as those shown in the corresponding tables.