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*Research*, part of a Special Feature on Education and Differential Vulnerability to Natural Disasters

# Effects of Educational Attainment on Climate Risk Vulnerability

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ABSTRACT. In the context of still uncertain specific effects of climate change in specific locations, this paper examines whether education significantly increases coping capacity with regard to particular climatic changes, and whether it improves the resilience of people to climate risks in general. Our hypothesis is that investment in universal primary and secondary education around the world is the most effective strategy for preparing to cope with the still uncertain dangers associated with future climate. The empirical evidence presented for a cross-country time series of factors associated with past natural disaster fatalities since 1980 in 125 countries confirms this overriding importance of education in reducing impacts. We also present new projections of populations by age, sex, and level of educational attainment to 2050, thus providing an appropriate tool for anticipating societies' future adaptive capacities based on alternative education scenarios associated with different policies.

Key Words: *adaptive capacity; climate change; education; natural disasters; vulnerability*

## INTRODUCTION

There is little doubt that climate change is already ongoing and more change is to be expected (Solomon et al. 2007). A number of organizations have assessed the costs of adapting to these changes, with the most recent of these estimates being in the range of US$70 to 100 billion each year, and with the greatest losses being associated with increases in magnitude and frequency of extreme weather events (World Bank 2010a). However, the specific effects of climate change that will be experienced in specific locations are highly uncertain, and this creates a challenge for investments into climate-protective infrastructure (Dessai et al. 2009). An increasing number of researchers, both in academia (Agrawal and Perrin 2009, McBean and Rodgers 2010) and in the public sector (Agrawala et al. 2008, Schipper et al. 2008, World Bank 2010b), suggest that the most sensible investments in adaptation, or government interventions, may be those that focus not on directly addressing particular climatic changes, but rather on t hose that improve the resilience and reduce the vulnerability of people to climate risks in general (Eakin and Patt 2011). Here we examine the effects of one particular intervention, education, on losses from extreme weather events.

The idea that social and human development can improve resilience to climate change and extreme weather events is not new. A number of studies have compared losses from climate hazards with a number of development indicators, finding significant correlations with income, population density, access to drinking water, female fertility, and a number of indicators of good governance and public corruption (Yohe and Tol 2002, United Nations Development Programme 2004, Brooks et al. 2005, Kellenberg and Mobarak 2008, Patt et al. 2010). The most recent one of these (Patt et al. 2010) has looked explicitly at the human development index (HDI) as an indicator of disaster vulnerability. HDI is a composite indicator derived from indexes of income, life expectancy at birth, and education. This study has revealed a nonmonotonic relationship that as yet is causally unexplained: initial improvements in HDI correlate with increasing vulnerability to climatic risks, while further improvements then correlate with falling risk levels.

No detailed empirical study to date has broken down HDI into its composite elements to consider education alone, nor has any study compared the effects of different education indicators. A possible reason for this could be the lack of detailed and consistent empirical information on level of education across countries and over time. This situation has recently been improved through the reconstructions and projections of educational attainment distributions by age, sex, and four levels of educational attainment for most countries in the world (Lutz et al. 2007, KC et al. 2010). A critical feature of these data, which has allowed researchers to use them to show the effects of education on economic growth, was their disaggregation of education across age groups.

There are several reasons to expect empowerment to occur through basic literacy and subsequently through secondary education to reduce vulnerability to climate change related risks. Most directly, better education typically implies better access to relevant information, such as early warnings for tropical storms or seasonal prediction of drought (Patt et al. 2007, Moser and Ekstrom 2010). Second, there is evidence that education also enhances cognitive skills and the willingness to change risky behavior while at the same time extending the personal planning horizon (Neisser et al. 1996, Behrman and Stacey 1997, Nisbett 2009). Third, there is scientific evidence that education leads to better health and physical wellbeing at any given age, in virtually every country (Fuchs et al. 2010, KC 2010). Fourth, more education leads to higher income at the individual and household level as well as higher economic growth at the aggregate level (Becker

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1993, Schultz 1993, Lutz et al. 2008). All of these effects ought to play a role in reducing vulnerability to climate hazards.

## MATERIALS AND METHODS

To investigate the link between disaster risk, development in general, and education in particular, we used data from the Emergency Events Data Base (EM-DAT) provided by the Centre for the Research of the Epidemiology of Disasters (Centre for Research on the Epidemiology of Disasters 2004). These data provide information on the number of disasters, as well as the number of deaths caused by these disasters, by country and year since 1900, with the data since 1980 being the more reliable. Although data are available for a broad range of different types of disasters, we concentrated on floods, droughts, storms, mass movements, extreme temperature events, and wildfires because they most closely resemble the kinds of disasters that are expected to increase due to climate change.

Whether a specific event is listed as a disaster in the EM-DAT database is determined by fulfillment of one of the following criteria: (1) 10 or more people were reported killed; (2) 100 or more people were reported affected; (3) a call for international assistance was issued, or; (4) a state of emergency was declared. Due to these specific criteria there is the possibility of sample selection bias. Some countries may have experienced a natural disaster, but because they were so well prepared none of the criteria necessary for being counted as a natural disaster was fulfilled. On the other extreme, in some very poorly developed regions disasters may have killed many people but due to poor information it may not even be registered and hence would not enter this database. In both cases, however, the estimated effects of development indicators on disaster deaths would only be biased downward. For a comparison of EM-DAT with other sources of disaster data, as well as a discussion of the strengths and weaknesses of these data, see Guha-Sapir and Below 2002.

Data on the level of human development and its components were taken from the United Nation's Human Development Report (United Nations Development Programme 2010). The HDI is a composite index measuring progress in the three basic dimensions: health, knowledge, and income. While the methodology of the HDI has been changed slightly in its twentieth anniversary edition, for reasons of compatibility and comparability with previous studies we used the original HDI where the knowledge component was calculated using a combination of school enrollment and rates of adult literacy.

In addition to HDI and its components we also controlled for education using data on the portion of 20 to 39-year-old women with completed secondary education or higher among the total female population aged 20 to 39. Past comprehensive research on the effects of the entire educational distribution (i.e., considering the distribution of educational attainment categories by age and sex) for a whole range of issues, going from economic growth to transition to free democracies, has shown that explicit consideration of that distribution has significant additional explanatory power compared to just taking an average measure of education such as the mean years of schooling (Lutz et al. 2008, Lutz et al. 2010). For practical purposes it is often convenient to have only one education-related variable included in the equation, so the one indicator that still reflects the inequality aspect and has the greatest discriminatory power—as shown by the above cited studies—turns out to be the proportion of younger women with junior secondary or higher education. Due to their key role in family matters, ranging from childbearing to family health to household decision making and changes in labor force participation, this group seems to be of particular importance for social as well as economic development. The data on educational attainment by age and sex was taken from the IIASA/VID data set (Lutz et al. 2007) which offers full education details by age and sex for most countries of the world from 1970 onwards in 5-year intervals.

For the regression analysis we aggregated the data into 5-year and 10-year periods in order to limit the influence of extreme outlier years when certain countries experienced particularly severe disasters with exceptionally high death counts and because some of the social variables were available only for 5-year intervals. We then estimated a number of multivariate models for the given panel of national time series. In all models we used the natural logarithm of the total number of deaths per thousand of population by country and period as our dependent variable. This probability of dying from disaster was then explained by different sets of development indicators—including education—after controlling for some of the usual background variables: real GDP per capita was taken from the Penn World Tables (Heston et al. 2009); data on the degree of democracy were taken from the Polity IV database (Marshall and Jaggers 2002); and data on population size, population density, as well as on infant mortality (IMR) stemmed from the 2008 revision of the World Population Prospects (United Nations Secretariat 2009).

$$deaths_{i,t} = \beta_0 + \beta_1 * hdi_{i,t} + General \quad (1)$$

$$deaths_{i,t} = \beta_0 + \beta_2 * hdi_{i,t}^{GDP} + \beta_3 * hdi_{i,t}^{EDU} + \beta_4 * hdi_{i,t}^{LEX} + General \quad (2)$$

$$deaths_{i,t} = \beta_0 + \beta_2 * hdi_{i,t}^{GDP} + \beta_3 * hdi_{i,t}^{EDU} + \beta_5 * eduF_{i,t} + General \quad (3)$$

$$General = \tag{4}$$

$$\beta_6 * polity2_{i,t} + \beta_7 * nodis_{i,t} + \beta_8 * density_{i,t}$$

$$+ \beta_9 * coastal_i + \beta_{10-28} * region_i$$

Model 1 recurs to earlier findings by Patt et al. (2010) who had used the HDI as an indicator of disaster vulnerability. HDI is a very comprehensive indicator of development outcomes, which in itself neither identifies the primary causes of vulnerability nor suggests a particular policy priority. Hence, in Model 2 we decomposed the HDI into its three constituent subindices, one based on purchasing-power-adjusted per capita income, another one combining school enrollment and literacy rates, and finally an index derived from average life expectancy at birth. Including these three individual components of HDI separately in Model 2 yielded estimates for the relative importance of the three dimensions on the number of deaths from natural disasters. Yet, as discussed above, the education component of the old HDI does not explicitly measure education by the gender and age groups that matter most for vulnerability to disaster. Model 3 therefore uses our alternative education variable ($eduF_{i,t}$) to account for human capital.

All three models also considered the effect of income. Whereas GDP was implicitly included in the HDI in Model 1, Models 2 and 3 controlled for income explicitly by using the GDP component of the HDI ($hdi^{GDP}_{i,t}$). This can help us to address an important question for setting policy priorities, namely whether income matters more than education in reducing a country's disaster death counts.

Furthermore, we assumed that the quality of a country's health system should play a significant role in minimizing human losses from natural disasters. Model 1 includes life expectancy at birth implicitly in the HDI, while Models 2 and 3 included it as a separate index ($hdi^{LEX}_{i,t}$). Because disaster deaths in a given year are also reflected in the life table and hence life expectancy of that year, as a sensitivity analysis we also used the log of the infant mortality rate ($imr_{i,t}$) as an alternative indicator of health system quality. While infant mortality is not necessarily less affected by this possible endogeneity, it would be differently affected (unless the infant deaths as a proportion of all deaths are exactly the same in disasters and under normal conditions). Furthermore, infant mortality is often considered to be more closely related to the quality of the health care system than adult mortality which also includes many life-style-related factors (Fuchs et al. 2010). In any case, as can be seen in Appendix 1, our results were not affected.

In addition to these different development indicators all three models controlled for a set of other variables which are labeled "*General*" in the equations above. The exposure to climate-related risk was accounted for in our models as the log of the total number of disasters in the given period normalized by the total population size in 1000s ($nodis_{i,t}$). We also controlled for population density ($density_{i,t}$), which has been found significant in explaining casualty numbers by Yohe and Tol (2002) and more recently by Patt et al. (2010). In terms of the political system of the country we included the polity score ($polity2_{i,t}$) which has the highest values for modern free democracies. We also control for the geophysical fact of whether a country is landlocked or has a coastline ($coastal_i$), which may affect its expose to tropical storms and flooding. Finally, we controlled for possible regional particularities ($region_i$) in the form of regional fixed effects that could also account for other still-uncontrolled factors in our models.

Due to the availability of population projections by age, sex, and education (KC et al. 2010), we were also able to forecast adaptive capacity based on different education scenarios under the assumption of constant hazard levels.

## RESULTS

Our analysis covers 130 countries over the time period 1980 to 2010. In the regression analysis we have complete data for 125 countries. Fig. 1 depicts the bivariate relationship between the log of disaster deaths per 1000 (on the vertical axis) and the proportion of women with completed junior secondary or higher education in the age group 20 to 39. The hump shape observed in Patt et al. (2010), who have examined the relationship between disaster risk and aggregate HDI, is present when one examines the full sample of countries (left side), but then disappears when we exclude countries that experience very few climate disasters. For all countries that experienced at least 30 disasters over the 30-year period, i.e., one or more disasters on average per year, it shows a clearly negative and almost linear association. As can be seen in Appendix 1, the picture looks the same when using HDI instead of our education variable.

**Fig. 1**. Relationship between the log of disaster deaths (per 1000 of 1980 population) and the mean of female education (proportion with secondary and higher education among women aged 20 to 39) over the period 1980 to 2010 for all 130 countries (left side) and 63 countries with one or more disasters on average per year (right side).

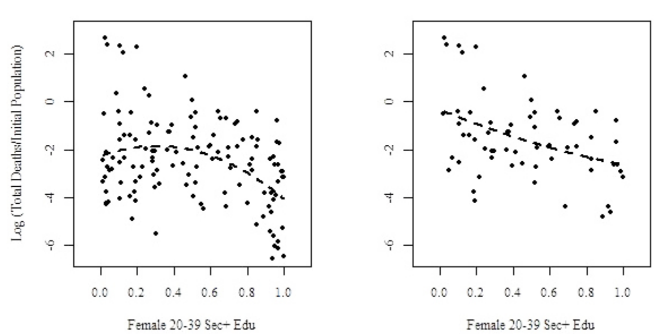


**Table 1**. Determinants of national death from natural disaster. Panel regression for 125 countries over 5-year and 10-year intervals between 1980 and 2010 using time fixed effects. The dependent variable is the log of deaths per capita. Numbers in parentheses are standard errors based on the heteroskedasticity-reistant and autocorrelation-resistant covariance matrix. HDI = human development index. LEX = life expectancy at birth. EDU = education. Other independent variables not reported here are dummy variables for 17 world regions. Significance codes: 0.01 = ***; 0.05 = **; 0.1 = *.

| | 5-yr | 10-yr | 5-yr | 10-yr | 5-yr | 10-yr |
|---|---|---|---|---|---|---|
| Log (disasters/pop., in 1000s) | 0.695*** (–0.075) | 0.698*** (–0.115) | 0.699*** (–0.075) | 0.678*** (–0.114) | 0.729*** (–0.075) | 0.725*** (–0.115) |
| Log (density) | 0.123* (–0.067) | 0.159* (–0.096) | 0.141** (–0.068) | 0.156 (–0.098) | 0.118* (–0.069) | 0.136 (–0.1) |
| Polity score | 0.296** (–0.137) | 0.364* (–0.206) | 0.290** (–0.135) | 0.347* (–0.203) | 0.279** (–0.136) | 0.322 (–0.206) |
| Coastal country | 1.211*** (–0.189) | 1.027*** (–0.272) | 1.174*** (–0.188) | 0.952*** (–0.269) | 1.054*** (–0.19) | 0.826*** (–0.275) |
| HDI | –5.943*** (–0.818) | –6.658*** (–1.176) | | | | |
| LEX component of HDI | | | –2.818** (–1.135) | –1.321 (–1.633) | –3.274*** (–1.113) | –2.346 (–1.629) |
| GDP component of HDI | | | –0.522 (–0.762) | –0.955 (–1.103) | –0.904 (–0.763) | –1.413 (–1.118) |
| EDU component of HDI | | | –3.626*** (–0.741) | –5.125*** (–1.076) | | |
| Females, age 20 to 39 yr, > secondary education | | | | | –1.912*** (–0.423) | –2.239*** (–0.625) |
| F-statistic | 15.67 | 8.8 | 15.49 | 8.89 | 14.96 | 8.21 |
| N | 706 | 355 | 706 | 355 | 706 | 355 |

For the given panel of national time series we specified various multivariate models in which the probability of dying from natural disasters is related to various indicators of risk as well as social and economic background factors. Results of three of them are displayed in Table 1, where two neighboring columns always belong to one model specification. As can be seen from the number of observations, the left column of each model corresponds to 5-year intervals and the right column to 10-year intervals.

Model 1 shows the well-known negative relationship between the HDI and human disaster losses. The linear effect of HDI is highly significant for both panels (representing the 5-year and 10-year intervals). We also tested for nonlinear effects from HDI on disaster losses (results of which are shown in Appendix 1) but they turn out to be insignificant. While the results from Model 1 lend support to earlier findings that negatively related development and disaster death counts, they do not tell us which of the individual components of the HDI are responsible for this decrease. Model 2 reveals that the only truly significant component of the HDI is the education index. The life expectancy component is significant with the 5-year intervals but not with the 10-year intervals, whereas the GDP component shows no significant additional explanatory power whatsoever. Model 3 uses our alternative indicator of educational attainment, yet the results turn out to convey the same story. Female education is most significant in reducing vulnerability to natural disasters.

Most of the parameters for the control variables have the expected signs, while their significance varies among the models. The frequency of disasters as the key variable measuring the exposure of countries to disasters independent of the number of fatalities is, as expected, consistently positive and highly significant under all models. Similarly, the fact that a country has a coastline turns out to have a consistently positive effect on the number of fatalities, and is significant under all models. Also, not surprisingly, a country with higher population density on average seems to have experienced a higher number of casualties. What is rather surprising at first glance, however, is the positive relationship between vulnerability and the democracy score. While the effect is not significant in all model specifications, it still seems to imply that in more authoritarian countries, *ceteris paribus*, the vulnerability to natural disasters is reduced. This may in part be true for cases such as Cuba, Iran, Singapore, and other countries that have efficient disaster control systems, although they are not free democracies. There are also countries labeled as democracies—such as India and Bangladesh— that have serious problems in handling disasters. But there clearly remains a selectivity issue. Democratic governments may be more ready to report disaster deaths than authoritarian ones. Contrary to Costa (2012), we did not find a significant effect when controlling for possible nonlinearity in the relationship between the democracy score and deaths from natural disasters (see Appendix 1). Clearly, this issue warrants further in depth research.

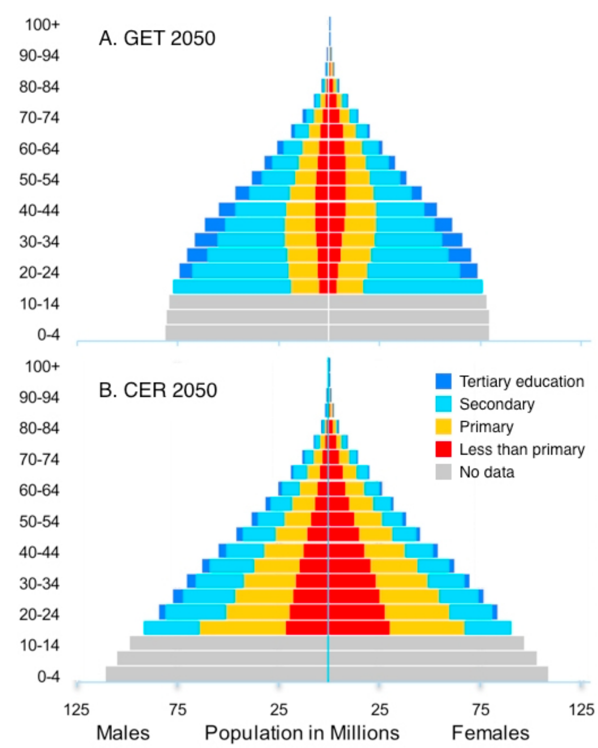
In sum, the results presented in Table 1 clearly show that education (and in particular female education) is the single most important social and economic factor associated with a reduction in vulnerability to natural disasters. Both in the form of the education component of the HDI and as measured by the proportion of the female population aged 20 to 39 with junior secondary and higher education, education has the most significant and consistently positive effects under all models and also when considering 5-year as well as 10-year intervals. In terms of setting policy priorities and in linking this to economic studies of vulnerability, which often uncritically start from the assumption that higher income is the key determinant for reducing vulnerability, it is important to note that in none of the models did income (whether in the form of the income component of the HDI or as conventional GDP per capita or its growth rate) turn out to be significant if education is being considered at the same time. This robust aggregate level finding now needs to be complemented by further microlevel evidence.

## DISCUSSION

It is likely that over the next years, large amounts of money will be spent on adaptation programs through the Kyoto Protocol adaptation fund, national governments, or other donors. But there is not enough of a scientific basis to guide these funds into directions that are meaningful under a long-term perspective. There is serious concern that significant funds might be channeled into “investments” that (given the strong path dependence of, e.g., agricultural policies) lock countries into certain paths that are not tenable under future climates. Alternatively, given the uncertainty about the precise manifestations of climate change in specific areas, it may be better to increase the general flexibility and enhance the human and social capital through massive new investments in universal basic education in order to empower the populations to better cope with climate change in a way that will be to their best long-term benefit. Our results reveal the degree to which climate vulnerability is sensitive to differences in education at the national level.

Given this, new projections of populations by age and level of education (KC et al. 2010) can also be used to anticipate the future adaptive capacities of societies. Fig. 2 shows the population pyramid for Sub-Saharan Africa in 2050 with the colors indicating the level of education. Men and women without any formal education are marked in red, those with some primary education in yellow, those with completed junior secondary education in light blue, and those with tertiary education in dark blue. Today, more than half of young adult women in Africa are still without secondary education. For 2050, Fig. 2-A depicts the results of projections in which age-specific school enrollment rates at all levels are kept constant at their current levels, which means that schools are only expanding in parallel with the growth of the school-age population (CER, constant enrollment rates scenario). In contrast, Fig. 2-B shows a scenario in which school enrollment rates over the coming years increase following the path of other countries that had been at the same level earlier (GET, global education trends scenario). In both cases the 2050 population sizes (1.9 billion in CER and 1.7 in GET) will be a lot bigger than today (0.8 billion), with the difference between CER and GET resulting from the fact that more educated women have lower birth rates. Under the CER scenario the number of young adults (in particular women) will increase dramatically while under the GET scenario most of the added population will be men and women with secondary or higher education (in blue).

**Fig. 2**. Age pyramids by level of education for Sub-Saharan Africa, for 2050. A – under the global education trends (GET) scenario. B – under the constant enrollment rates (CER) scenario.



These are two very different societies projected for 2050. In light of the empirical analysis presented here, the first one would be highly vulnerable to possible increases in natural disasters due to climate change, while the second one would likely have considerably more adaptive capacity to cope with whatever changes the future will bring. While calculating the exact number of lives that can be saved by increasing investments into education is impossible because of the high uncertainty around future risk levels, we can use the upper and lower bounds of past disaster-risk levels to calculate the number of deaths under the CER and the GET scenarios. A first back-of-the-envelope calculation combining the projections shown in Fig. 2 with our regression results from Model 3 in Table 1 reveals that in the time period 2040 to 2050 the number of deaths due to natural extreme events in Sub-Saharan Africa under the CER scenario will be in the range of 7900 to 180,000 while under the GET scenario the predicted number of deaths ranges from 3200 to 72,200. Regardless of the risk level the ratio between the scenarios is relatively stable and important. It can account for between 4700 and 107,800 additional lives saved or lost, which corresponds to a reduction of roughly 60%. Note that this tremendous effect is not only due to the direct effect of education. The portion of women aged 20 to 39 that have completed at least secondary education will have reached almost 70% under the GET scenario, compared to just 30% under the more pessimistic outlook. But the difference between the two scenarios also has indirect effects by means of reducing the affected population size as well as population density in the GET scenario. If in the future there are more disasters than in the past, the effects from education—direct and indirect—would be even stronger.

Which scenario will actually be more likely depends on education policies in the near future. If nothing happens and school expansion does not even keep pace with population growth, the outcome would be even worse than under the CER scenario. There are of course many other important reasons for expanding school enrollment (and at the same time also enhancing the quality of schooling) in terms of positive effects on health and poverty reduction, which has led to the inclusion of universal primary education as a Millennium Development Goal (United Nations 2010). But viewing education as an investment in the adaptive capacity to climate change would be an important new policy focus.

*Responses to this article can be read online at:*
http://www.ecologyandsociety.org/issues/responses.php/5252

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# 1 Controlling for non-linearities

Since previous studies have found significant evidence for deaths from natural catastrophes to be non-linearly related to different measures of development (Brooks et al. 2005, Kellenberg and Mobarak 2008, Patt et al. 2010, Costa 2012), Table A presents the results of our panel regression analysis controlling for quadratic effects. Two neighboring columns always belong to one model specification. As can be seen from the number of observations, the left column corresponds to 5-year intervals and the right column to 10-year intervals. The dependent variable is the logged value of the number of people killed per 1000 of national population.

Model (4) reproduces Model (1) from Table 1 in the main article. As an additional control it includes HDI squared. While the squared term does not turn out to be significant, the linear effect remains unchanged for both panels (the 5-year and 10-year intervals). Model (5) corresponds to Model (2) from Table 1 in the main article and it shows a similar result controlling for the three squared components of the HDI. While there is no additional explanatory power coming from the GDP component of the HDI - neither in linear, nor in non-linear form - there seems to be some evidence for the relationship between life expectancy and death counts to be u-shaped. The education index, however, remains the strongest and most significant component of the HDI in explaining variation in the number of deaths from natural catastrophes and again, there doesn't appear to be a non-linear relationship.

Since we find an unexpected positive relationship between the polity score and our measure of vulnerability, in Model (6) of Table A we also test for non-linearities in democratization. But even in this specification, we find no evidence of a u-shaped pattern.

Finally, Figure A corresponds to Figure 1 in the article showing the bivariate relationship between deaths from natural catastrophes and the share of women aged 20-39 with at least secondary education. As can be seen, we find the same pattern when plotting the total number of deaths against the average HDI-value for each country between 1980 and 2010.

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Figure A: Relationship between the log of disaster deaths (per 1000 of 1980 population) and the 1980-2010 mean value of HDI for all 130 countries (left side) and 63 countries with one or more disasters on average per year (right side).

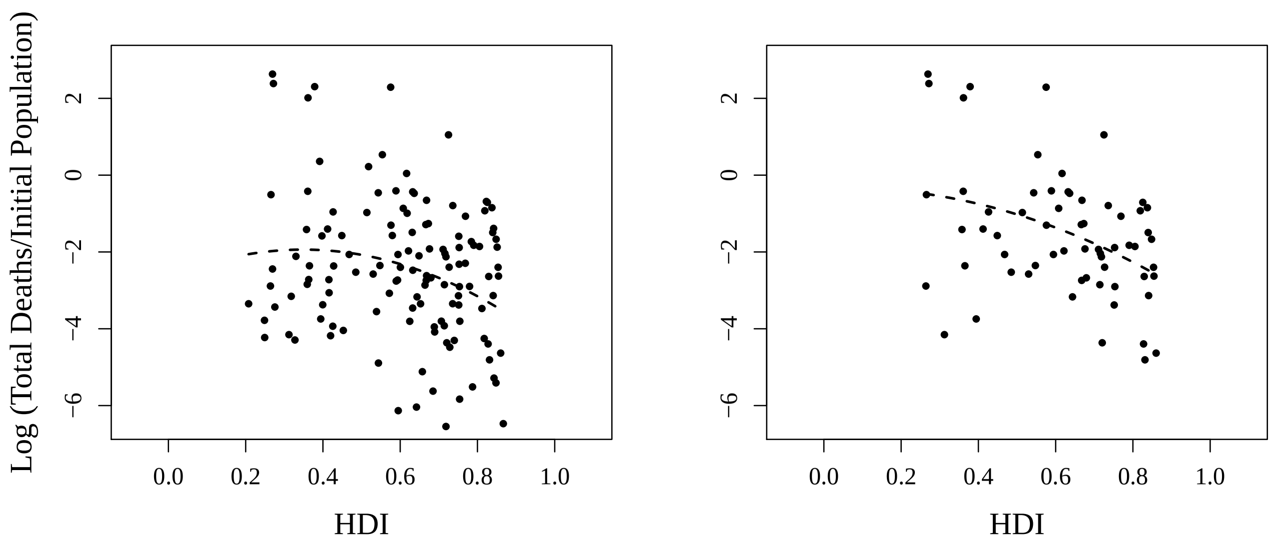

Table A: Determinants of National Death From Natural Disaster. Notes: Panel regression for 125 countries over 5- and 10-year intervals between 1980 and 2010 using time fixed effects. The dependent variable is the log of deaths per capita. Numbers in parentheses are standard errors based on the heteroskedasticity- and autocorrelation-resistant covariance matrix. Other independent variables not reported here are dummy variables for 17 world regions.
Significance codes: 0.01 = '***'; 0.05 = '**'; 0.1 = '*'.

| | Model (4) | | Model (5) | | Model (6) | |
|---|---|---|---|---|---|---|
| | 5-yr | 10-yr | 5-yr | 10-yr | 5-yr | 10-yr |
| Log (Disasters/Pop in 1000) | 0.707*** | 0.715*** | 0.702*** | 0.686*** | 0.698*** | 0.681*** |
| | (0.076) | (0.115) | (0.076) | (0.116) | (0.075) | (0.114) |
| Log (Density) | 0.124* | 0.162* | 0.180** | 0.221** | 0.141** | 0.157 |
| | (0.067) | (0.096) | (0.071) | (0.102) | (0.069) | (0.098) |
| Polity Score | 0.277** | 0.333 | 0.291** | 0.345* | 0.289** | 0.355* |
| | (0.137) | (0.207) | (0.136) | (0.203) | (0.137) | (0.205) |
| Coastal Country | 1.248*** | 1.079*** | 1.186*** | 0.970*** | 1.175*** | 0.946*** |
| | (0.191) | (0.275) | (0.193) | (0.275) | (0.188) | (0.270) |
| HDI | −9.681*** | −11.780*** | | | | |
| | (2.862) | (4.146) | | | | |
| $HDI^2$ | 3.395 | 4.675 | | | | |
| | (2.492) | (3.629) | | | | |
| LEX component of HDI | | | 4.646 | 11.126* | −2.822** | −1.271 |
| | | | (4.455) | (6.436) | (1.141) | (1.642) |
| GDP component of HDI | | | −2.274 | −3.993 | −0.531 | −0.841 |
| | | | (2.314) | (3.335) | (0.796) | (1.160) |
| EDU component of HDI | | | −6.789*** | −10.324*** | −3.623*** | −5.171*** |
| | | | (2.314) | (3.395) | (0.746) | (1.086) |
| LEX component of $HDI^2$ | | | −6.319* | −10.592** | | |
| | | | (3.622) | (5.264) | | |
| GDP component of $HDI^2$ | | | 2.182 | 3.803 | | |
| | | | (2.346) | (3.396) | | |
| EDU component of $HDI^2$ | | | 3.129 | 5.138 | | |
| | | | (2.173) | (3.198) | | |
| Polity $Score^2$ | | | | | 0.011 | −0.126 |
| | | | | | (0.275) | (0.389) |
| F-Statistic | 15.22 | 8.54 | 14.22 | 8.22 | 14.97 | 8.55 |
| N | 706 | 355 | 706 | 355 | 706 | 355 |

Table B: Regional Dummies Used in Table 1 and Table A.

| | South America | Australia/New Zealand | Western Europe | South-Central Asia | Western Asia | Eastern Europe |
|---|---|---|---|---|---|---|
| 1 | Argentina | Australia | Austria | Bangladesh | Armenia | Bulgaria |
| 2 | Bolivia | New Zealand | Belgium | Sri Lanka | Cyprus | Czech Republic |
| 3 | Brazil | | France | India | Jordan | Hungary |
| 4 | Chile | | Germany | Iran (Islamic Republic of) | Saudi Arabia | Poland |
| 5 | Colombia | | Netherlands | Kazakhstan | Syrian Arab Republic | Romania |
| 6 | Ecuador | | Switzerland | Kyrgyzstan | Turkey | Russian Federation |
| 7 | Guyana | | | Nepal | | Slovakia |
| 8 | Paraguay | | | Pakistan | | Ukraine |
| 9 | Peru | | | Tajikistan | | |
| 10 | Uruguay | | | Turkmenistan | | |
| 11 | | | | Uzbekistan | | |
| | South-Eastern Asia | Middle Africa | Northern America | Eastern Asia | Eastern Africa | Central America |
| 1 | Cambodia | Cameroon | Canada | China | Comoros | Costa Rica |
| 2 | Indonesia | Central African Republic | United States of America | Japan | Ethiopia | El Salvador |
| 3 | Lao People's Democratic Republic | Chad | | Republic of Korea | Eritrea | Guatemala |
| 4 | Malaysia | Gabon | | Mongolia | Kenya | Honduras |
| 5 | Philippines | | | | Madagascar | Mexico |
| 6 | Viet Nam | | | | Malawi | Nicaragua |
| 7 | Thailand | | | | Mauritius | Panama |
| 8 | | | | | Mozambique | |
| 9 | | | | | Rwanda | |
| 10 | | | | | Zimbabwe | |
| 11 | | | | | Uganda | |
| 12 | | | | | United Republic of Tanzania | |
| 13 | | | | | Zambia | |
| | Southern Europe | Caribbean | Western Africa | Northern Europe | Northern Africa | Southern Africa |
| 1 | Croatia | Cuba | Benin | Denmark | Morocco | Namibia |
| 2 | Greece | Dominican Republic | Ghana | Estonia | Egypt | South Africa |
| 3 | Italy | Haiti | Guinea | Finland | | |
| 4 | Portugal | | Côte d'Ivoire | Ireland | | |
| 5 | Slovenia | | Mali | Latvia | | |
| 6 | Spain | | Mauritania | Lithuania | | |
| 7 | TFYR Macedonia | | Niger | Norway | | |
| 8 | | | Nigeria | Sweden | | |
| 9 | | | Togo | United Kingdom | | |
| 10 | | | Burkina Faso | | | |

Table C: Regional aggregation of data used in Table 1 and Table A. The regional aggregate is the population-weighted mean of the individual countries' values. Population figures are in 1000s.

| Region | Population | Density | Polity2 | HDI | LEXhdi | GDPhdi | EDUhdi | EDU |
|---|---|---|---|---|---|---|---|---|
| Australia/New Zealand | 16351 | 4 | 1.00 | 0.87 | 0.92 | 0.80 | 0.91 | 0.88 |
| Caribbean | 6651 | 196 | 0.77 | 0.68 | 0.78 | 0.56 | 0.71 | 0.65 |
| Central America | 72353 | 64 | 0.40 | 0.71 | 0.81 | 0.62 | 0.72 | 0.44 |
| Eastern Africa | 33916 | 76 | -0.09 | 0.36 | 0.48 | 0.24 | 0.45 | 0.15 |
| Eastern Asia | 1093327 | 157 | -0.51 | 0.61 | 0.80 | 0.43 | 0.68 | 0.61 |
| Eastern Europe | 85364 | 55 | 0.18 | 0.74 | 0.77 | 0.63 | 0.83 | 0.98 |
| Melanesia | 784 | 43 | 0.39 | 0.65 | 0.74 | 0.49 | 0.75 | 0.72 |
| Middle Africa | 36477 | 21 | -0.23 | 0.34 | 0.46 | 0.22 | 0.45 | 0.20 |
| Northern Africa | 44165 | 45 | -0.52 | 0.56 | 0.70 | 0.48 | 0.52 | 0.29 |
| Northern America | 257255 | 26 | 1.00 | 0.87 | 0.90 | 0.84 | 0.88 | 0.96 |
| Northern Europe | 38939 | 168 | 0.99 | 0.84 | 0.89 | 0.78 | 0.86 | 0.84 |
| South-Central Asia | 742085 | 330 | 0.59 | 0.48 | 0.64 | 0.36 | 0.49 | 0.25 |
| South-Eastern Asia | 133986 | 154 | -0.08 | 0.59 | 0.72 | 0.42 | 0.70 | 0.42 |
| South America | 98505 | 22 | 0.65 | 0.71 | 0.78 | 0.60 | 0.77 | 0.49 |
| Southern Africa | 1576 | 39 | 0.12 | 0.53 | 0.55 | 0.46 | 0.61 | 0.38 |
| Southern Europe | 40248 | 133 | 0.95 | 0.83 | 0.91 | 0.76 | 0.82 | 0.79 |
| Western Africa | 76267 | 98 | -0.02 | 0.39 | 0.46 | 0.33 | 0.43 | 0.19 |
| Western Asia | 39730 | 87 | 0.19 | 0.69 | 0.77 | 0.64 | 0.69 | 0.45 |
| Western Europe | 39421 | 167 | 0.93 | 0.86 | 0.91 | 0.80 | 0.86 | 0.85 |