The Death Toll From Natural Disasters: The Role of Income, Geography, and Institutions[1]

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ABSTRACT

Using a new data set on annual deaths from disasters in 48 nations from 1980 to 1999, this paper tests several hypotheses concerning natural disaster mitigation. While richer nations do not experience fewer natural disaster events than poorer nations, richer nations do suffer less death from disaster. Democracies and nations with higher quality institutions suffer less death from natural disaster. The results are relevant for judging the incidence of a Global Warming induced increased in the count of natural disaster shocks.

JEL Code: O1, P5

I. Introduction

Between 1980 and 1999, India experienced fourteen earthquakes that killed a total of 12,137 people while the United States experienced nine earthquakes that killed only 137 people. A disproportionate share of the deaths caused by such environmental shocks as earthquakes, floods, cyclones, hurricanes, and extreme temperature events are borne by people in developing countries. The Intergovernmental Panel on Climate Change (IPCC 2001) reports that 65% of world deaths from natural disasters between 1985 and 1999 took place in nations whose incomes were below $760 per-capita.[2]

Using a new data set on annual deaths from natural disasters in 48 nations from 1980 to 1999, this paper tests four hypotheses concerning natural disasters. First, do richer nations experience fewer natural disaster shocks? Second, when natural disasters take place how many fewer fatalities do they cause in richer nations versus poorer nations? Third, what role does national geography play in determining the death toll from natural disasters? Fourth, controlling for other national attributes, do institutions matter in mitigating the consequences of natural disasters? I test whether democracies suffer lower death counts and use settler mortality risk (from Acemoglu, Johnson and Robinson (2001)) as a measure of institutional quality to test whether institutions matter in minimizing death from disaster.

Determining the relative importance of income, geography and institutions in insulating nations from nature's shocks is important for three reasons. First, if richer

[2] "Ninety percent of the disaster victims worldwide live in developing countries where poverty and population pressures force growing numbers of poor people to live in harm's way on flood plains, in earthquake prone zones and on unstable hillsides. Unsafe buildings compound the risks. The vulnerability of those living in risk prone areas is

nations are sufficiently insulated from nature's shocks relative to poorer countries, then this finding contributes to cross-national living standards comparisons. Second, the growing comparative economics literature has attempted to measure the quantitative importance of "good institutions" in explaining differences in cross-national economic performance (Acemoglu, Johnson and Robinson 2001, Gallop, Easterly and Levine 2001, and Rodrik, Subramanian, and Trebbi 2002). Death from natural disaster offers a new outcome measure for testing hypotheses. Finally, many environmentalists care about the equity consequences of Global Warming. Scientists have predicted that Global Warming will accelerate the count of natural disaster shocks. It is important to have estimates of what is the human toll caused by such events and how these expected death counts differ across nations. The political economy of who supports costly climate change policy hinges on the expected benefits of mitigating climate change.

To preview the paper's results, national income plays little role in explaining which nations experience a natural disaster. But, richer nations suffer less death from natural disaster. Nations in Asia and the Americas suffer more deaths from natural disaster than similar nations in Africa but other measures of national geography are not statistically significant in explaining death from disaster. Institutions are found to play an important role. Democracies and colonies with low settler mortality risk (the Acemoglu, Johnson and Robinson (AJR) institutions measure) suffer much less death from natural disaster.

The paper's next section presents the data sources used in the empirical analysis. Section III examines which nations experience the most natural shocks. Section IV

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perhaps the single most important cause of disaster casualties and damage" (Secretary

presents estimates of zero inflated negative binomial count models of deaths from natural disaster to test for the importance of income, geography and institutions in explaining death from disaster.

II. Data

The raw data on annual national death counts from natural disasters comes from the Centre for Research on the Epidemiology of Disasters (CRED) (see World Disasters Report 2002). Since 1988, it has maintained the Emergency Events Database (EM-DAT). The International Disaster Database is accessible at http://www.cred.be/emdat/intro.html. This web page provides the rationale for why the data set has been collected.

"In recent years, natural and man-made disasters have been affecting increasing numbers of people throughout the world. Budgets for emergency and humanitarian aid have sky-rocketed. Efforts to establish better preparedness for and prevention of disasters have been a priority concern of donor agencies, implementing agencies and affected countries. For this reason, demand for complete and verified data on disasters and their human and economic impact, by country and type of disaster has been growing. ….The database is compiled from various sources, including UN agencies, non-governmental organizations, insurance companies, research institutes and press agencies."

The data set provides indicators of disaster type. I focus on just the subset of environmental disasters in the EM-DAT database. I exclude man made disasters such as famines and industrial accidents because such events are likely to be caused by a nation's income level and its political structure (Sen 1989).[3]

General of the United Nations, Kofi Annan 1999).

[3] Man made disasters such as the Union Carbide plant disaster in Bhopal, India can hardly be called "exogenous". An extreme version of the pollution havens hypothesis would posit that poor nations compete for industrial plant openings built by multinational corporations. In this case, the nation's poverty led to the opening of a plant that has a positive probability of experiencing an industrial disaster. Such "reverse causality" would lead to the statistical finding that deaths from disasters are higher in poorer nations but this finding would be generated by the fact that poor nations attract disasters rather than that richer nations are better at coping with an exogenous shock.

Earthquakes are sudden breaks within the upper layers of the earth, sometimes breaking the surface, resulting in the vibration of the ground. Extreme temperature events are heat waves and cold waves. Floods are significant rise of water level in a stream, lake, reservoir or coastal region. Slides represent avalanches and landslides. Wind storms consist of cyclones, hurricanes, storms, tornados, tropical storms and typhoons and winter storms. While the data set provides counts of disasters it does not provide information on the physical severity of the shock such as a Richter scale reading of an earthquake's intensity.

Table One reports the three biggest disasters by disaster type for the 48 nations. Turkey suffered the largest human loss from earthquakes in 1999 while Bangladesh suffered the largest count of deaths from wind storms in 1991.

In this study, the dependent variable will be either the count of natural disasters or the total dead from natural disasters for a given nation in a given year. The explanatory variables are merged in from three separate data sources. National data on annual population and GNP is from the U.S Energy Information Administration (see http://www.eia.doe.gov/emeu/international/total.html#Carbon). National geography data and population density is from Gallop, Sachs and Warner (2001). Institutional quality is proxied for using two data sets. The first data source is Polity 4 (http://www.bsos.umd.edu/cidcm/polity/index.html). This data set includes a variable called "democracy" which takes on the values 0-10 that represents a nation's general openness of political institutions. The second indicator of national institutional quality is the settler mortality risk variable reported in Acemoglu, Johnson and Robinson (2001). I am able to merge this variable on for a subset of 27 former colonies in my data set.

While the EM-DAT database's unit of analysis is a disaster, I aggregate the data by disaster type by nation by year. Thus, one data point is the count of how many people died in earthquakes in 1987 in Chile. If nobody died in a nation in a given year in a particular disaster category, then the death count equals zero. The final data set includes information on five types of natural disasters (earthquakes, extreme temperature, floods, slides and wind storms), for 48 nations across twenty years from 1980 to 1999. I choose to focus on this subset of the world's nations because there are a suspicious number of zero deaths for excluded nations. For example, the EM-DAT data reports that nobody died from a natural disaster in Bhutan or Guyana during the years 1980 to 1993. I chose to drop from the sample those nations that report zero deaths from natural disaster in almost every year.

Table Two reports the national summary statistics. Each year, the average nation experiences 2.6 natural disasters per year and suffers 537 deaths from natural disaster. Roughly half of these deaths are from wind storms. Floods and earthquakes also represent a large fraction of deaths while land slides and extreme temperature events cause relatively few deaths.

To provide more facts about the final data set, Table Three lists the 48 nations included in the estimation. For each nation, I report the average annual total dead and the average annual count of natural disasters. China and the United States experience the most natural disasters. China averages 2,172 deaths per year from natural disaster. On average, Bangladesh, India, Venezuela and Iran experience more death with Bangladesh averaging 8,367 dead per year from natural disasters. Relative to population size, Honduras, Venezuela, Nigeria and Bangladesh suffer the most death from disaster. The

final right columns of Table Three calculate average dead per natural disaster in the 1980s versus the 1990s. Surprisingly, the correlation of average dead per natural disaster in the 1980s and average dead per natural disasters in the 1990s is only 0.25. Some nations, such as Bangladesh, India, Nicaragua, Taiwan, Turkey and Venezuela, have experienced dramatic increases in average dead per disaster over time while other nations, such as Algeria, Italy and Mexico have experienced a reduction in deaths per disaster.

III. What Types of Nations Suffer Natural Disasters?

One possible explanation for why poorer nations suffer more death from natural disasters is that these nations experience more shocks. To test this, I estimate probit models of the form:

$$\text{Prob}(\text{Disaster}_{ijt}) = f(\text{Democracy}_{jt}, \text{Geography}_{j}, \text{Population}_{jt}, \text{GNP Per-Capita}_{jt}, \text{Trend}_{t}) \quad (1)$$

In equation (1), "Disaster" is a dummy variable that equals one if a natural disaster in category i in nation j in year t took place. Table Four presents six estimates of equation (1). The average nation's probability of experiencing a disaster in a given year is 73%. To ease the interpretation of the probit models, each column presents estimates of the marginal probabilities.

Democracies experience more natural disasters. A one unit increase in the Polity variable, increases the probability of experiencing any natural disaster by 0.84 percentage

points. Columns (2) through (6) disaggregate disasters by category. Democracies are more likely to experience extreme temperature events.

The next five rows of the table explore the role of geography. I include continent dummies where the omitted category is Africa and I include a measure of the nation's elevation and the absolute value of its latitude. Nations in the American continent and in Asia are much more likely to experience natural disasters. Relative to African nations, the average Asian nation in the sample is 23 percentage points more likely to experience a natural disaster in a given year. While overall, national elevation is not a statistically significant correlate of the propensity to experience a natural disaster, elevation does increase the probability of experiencing land slides and earthquakes. Nations closer to the equator do not experience more overall shocks but such nations do experience more wind storms, and extreme temperature events. Such nations experience fewer land slides and earthquakes.

The two measures of an economy's development are GNP per-capita and average population density. Average population density proxies for a nation's urbanization level. GNP per-capita is statistically insignificant in four of the six regressions and only borderline statistically significant in the other two regressions. Columns (3) and (4) show that higher GNP per-capita nations actually face more land slides but less floods. An extra $1,000 of GNP per-capita reduces the probability of a flood by 0.7 percentage points. It is important to note that the overall GNP per-capita coefficient presented in Column (1) is statistically insignificant and quantitatively insignificant. Turning to the urbanization proxy, an extra standard deviation of population density (.71 see Table Two) raises the probability of experiencing a natural disaster by 7 percentage points. Nations

with higher population densities experience more wind storms. Nations with larger populations are more likely to experience at least one natural disaster. Doubling a nation's population increases its probability of experiencing a natural disaster by 10 percentage points.

The two most interesting points established in Table Four relate to GNP per-capita's coefficients and the time trend. Richer nations are exposed to roughly the same number of natural shocks as poorer nations. This finding stands in contrast to a pure geographic theory of development that would state that certain areas are cursed due to their physical location. Such areas would suffer from poor endowments, higher disease exposure and would suffer more negative natural disaster shocks. This geography theory would then conclude that we will see low income and deaths from natural disaster in the same nations. In this case, while poverty and natural disaster deaths would be positively correlated across nations there would be no causal link between the two outcomes.

The final interesting point presented in Table Four is the time trend's coefficient is positive and statistically significant. Natural disaster probabilities are increasing over time by .5 percentage points per year. While earthquake probabilities are falling over time, land slides, floods and extreme temperature events are increasing over time.

IV. The Role of Income, Geography and Institutions in Minimizing Death Counts

Annual national total death from natural disasters is a non-negative count. A poisson model is not used due to the over-dispersion of the death data. In 37% of the

nation/year observations, total death from natural disaster sums to zero.[4] To take into account this large number of zeroes, I estimate a zero inflated negative binomial model where the log-likelihood function L is defined by:

$$L = \Sigma_{i \in S} \ln[F(z_i\gamma)+\{1- F(z_i\gamma)\}p_i^m] + \Sigma_{i \notin S}[\ln\{1-F(z_i\gamma)\}+ \ln\Gamma(m+y_i) - \Gamma(y_i+1) - \ln\Gamma(m) + m\ln p_i + y_i \ln(1-p_i)$$

$$m = 1/\alpha$$
$$p_i = 1/(1+\alpha\exp(x_i\beta))$$

where F is the logit link and Γ is the gamma distribution and S is the set of nation/year observations where nobody died from natural disaster.

Each column of Table Five reports a separate estimate of this model. There are two pieces of this estimator, a logit is estimated to predict the probability that zero deaths take place in a given nation in a given year. In this logit, the z vector, includes as explanatory variables the count of disasters that take place in a nation in a given year, the log of the nation's population and its per-capita GNP. In the x vector, I include the same measures of income, geography and institutions as were presented in Table Four.[5]

To ease the analysis of the results, I group the results into three hypotheses to focus on the role of income, geography and institutions.

[4] If EM-DAT data does not report any deaths, I infer that nobody died. CRED uses specific criteria for determining whether an event is classified as a natural disaster: 1. 10 or more people were killed, 100 or more people were affected/injured/homeless, 3. significant damages were incurred, 4. a declaration of a state of emergency and/or an appeal for international assistance was made (Skidmore and Toya 2002).

[5] Unfortunately, economic theory provides few guidelines for determining what explanatory variables to include in the logit equation and the death count equation. The results I present in Table Five represent a parsimonious attempt to simultaneously test the relative importance of income, geography and institutions.

Hypothesis #1 Richer Nations Suffer Less Death from Disaster

In Table Five's specification (1), I estimate the zero inflated negative binomial model while excluding variables that measure geography and institutional quality. I find that GNP per-capita has two statistically significant effects. The bottom panel presents the logit estimates where the dependent variable equals one if no deaths took place. As expected, the total count of disasters sharply reduces the probability that no deaths take place. But, controlling for the count of disasters, national income has a statistical significant positive coefficient. Richer nations are more likely to experience a zero death event. Conditional that deaths do take place, the top panel of specification (1) shows that richer nations have a lower death count. Column (2) shows that this finding is robust to controlling for national geography.

There are several pathways through which richer nations are insured against death from shocks. Richer nations will be able to invest and enforce zoning codes. For certain natural disasters such as hurricanes, richer nations have invested in computer modeling of storms. Spreading this early warning information before the storm hits shore leads to mass evacuation and this saves lives (Sheets and Williams 2001). Conditional that a natural disaster has taken place, the probability that a person dies in this event will depend on the quality of homes and roads built in the affected area. If many poor people are living on marginal land that is flood prone, then this increases the risk of disaster.

A recent study by La Porta, Vishny and Shleifer (2001) found, based on a range of good governance indicators, that government quality rises as national income increases. If government is not able or willing to take pro-active steps to reduce environmental impacts through enforcing zoning and housing codes then the same shock

is likely to cause more death. Richer nations often provide the resources so that government can recruit more skilled people and enforce regulation. Once the shock has taken place, death counts can be higher if the nation does not have access to good medical care and emergency treatment and crisis management (Athey and Stern 2000).

To provide a sense of the size of these income coefficients, in Table Six I predict death from natural disaster for poor, middle income, and a rich nation. Holding population at 100 million, the year at 1990 and using the actual shock patterns for each nation, I use the results from specification (1) and predict the probability that a nation experiences no deaths from natural disaster, and predict the count of deaths. The average nation with a GNP per-capita experiences 774 deaths from natural disaster per year. If this nation's GNP per-capita grew to $14,000 its death toll would fall to 230 per year.[6] In a nation of 100 million, this "savings" of 534 certainly is small in percentage terms but the percentage reduction in overall deaths due to economic development is large.

Hypothesis #2 Geography is a Key Determinant of Death From Disaster

Column (2) reports the estimate of the zero inflated negative binomial model including geography variables. Relative to African nations, deaths are higher in the Americas, Asia and Europe. Both the elevation measure and the distance from the zero latitude variables are statistically insignificant. A F-test for the joint hypothesis that all of the geography variables have a coefficient of zero is rejected at the 10% statistical

[6] It is important to distinguish my question from recent research on natural disasters. I am focusing on the short run consequences of natural disaster. This is clearly not the only impact of a disaster. Recent papers have examined how natural disasters affect resources prices (Prestemon and Holmes 2000) and national long run growth is affected by natural

significance level (p-value of 0.099). I conclude that geography matters due to the continent dummies and that the income relationship is robust to controlling for geography.

Hypothesis #3 Institutional Quality Insulates Against Death

Democracies may be better suited to achieve political accountability so that the government takes proactive steps to adapt to such shocks and to mitigate their impact when they do occur. In a democracy, free media flourishes and this contributes to greater political accountability. In such a setting, politicians who want to be re-elected and know that their constituents are informed about their activities have a greater incentive to take actions that protect their constituents. (Besley and Burgess 2002). A government that enforces building codes, and zones flood planes is likely to reduce deaths from earthquakes and floods.

To test the hypothesis that there is less death from disaster in democracies, in specification (3), I add the Polity measure to the specification. All else equal, democracies do experience less death from disaster. Based on the coefficient estimates, holding all else constant, a one point higher score on the Polity index has the same "death reduction" effect as if the nation's GNP per-capita was $2,430 higher. This seems to be a large effect. It is also of interest to note that including democracy as a regressor shrinks the coefficient on GNP per-capita by roughly 50%. The correlation of these two variables is 0.50.

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disasters (Skidmore and Toya 2002). Skidmore and Toya (2002) conclude that higher frequencies of climatic disasters are correlated with economic growth.

Democracy is just one indicator of a nation's institutional structure. Ideally, we want to identify empirical proxies for national institutional that insulate the nation from negative shocks to physical and human capital. In recent work, Acemoglu, Johnson and Robinson (AJR 2001) have documented that one empirical proxy for national institutional quality that predicts national income is the logarithm of the settler mortality rate per thousand from over 100 years ago. AJR (2001) argue that settler mortality in the past affected the types of settlements created in these colonies and this turn determined such nations' early institutional quality. If institutional quality persists over time, then settler mortality represents an exogenous measure of institutional quality. In specifications (4) and (5), I build upon their work by testing whether, controlling for GNP per-capita, former colonies with better institutions have lower death counts from natural disasters.

To measure the importance of "good institutions" in reducing death from natural disaster, in specifications (4 and 5) in Table Five, I augment my zero inflated negative binomial models to include the AJR (2001) mortality variable. Since I can only merge in their variable for 27 nations, in specification (4), I re-estimate specification (1) to present baseline estimates for this sub-sample. The results are basically the same. In specification (5), I include the AJR institutions proxy in both the logit model and the negative binomial model. All else equal, settler mortality risk lowers the probability that nobody dies from disaster. This coefficient is statistically significant and intuitive. Settler mortality risk is a measure of bad institutions as it increases the likelihood that nobody dies falls. The top panel of specification (5) shows that settler risk has a positive but statistically insignificant effect on raising deaths from disaster. A F-test for the joint

hypothesis that both settler mortality risk coefficients are zero can be rejected at the 5% significance level (p-value of .013). In the logit model, this institution's coefficient is very large relative to the GNP per-capita coefficient. Evaluated at its mean, an extra standard deviation of settler mortality would require a nation to have an extra $20,000 in GNP per-capita to offset the worse institutions.

V. Conclusion

Between 1990 and 2001, each year on average 225 natural disasters took place and on average 38,522 people died in these disasters.[7] This paper has examined a national panel data to test hypotheses concerning the role of income, geography and institutions in protecting people from these shocks.

Perhaps surprisingly, richer nations experience the same number of natural disasters as poorer nations. While income helps to reduce the death count from natural disasters, the slope is relatively flat. As shown in Table Six, if a nation developed such that its GNP per-capita increased from $2,000 to $14,000, a nation of 100 million people would experience 530 less natural disaster deaths a year. While some evidence supporting the role of geography was reported, the major geographical differences are across continents. Asia experiences more death from natural disaster than Africa.

Institutions are the most important determinant of deaths from disasters. Democracy and setter mortality risk's statistically significant and quantitatively large estimates suggests that institutions are more important than geography in insulating nations from such shocks.

[7] These facts are based on the entire EM-DAT data base.

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Table One: Major Disasters from 1980 to 1999

	Death Count		
Earthquake	17980 in Turkey in 1999	9782 in India in 1993	8776 in Mexico in 1985
Extreme Temperature	2641 in India in 1998	1000 in Greece in 1987	710 in the United States in 1995
Flood	30005 in Venezuela in 1999	6303 in China in 1980	4146 in China in 1998
Slide	690 in India in 1995	653 in Colombia in 1987	531 in China in 1996
Wind	138987 in Bangladesh in 1991	14600 in Honduras in 1998	10205 in India in 1999

Table Two: National Summary Statistics

Variable	Mean	Std. Dev.
Population in Millions	83.9334	201.5657
Elevation (1,000s of Meters Above Sea Level)	0.7389	0.5047
Absolute Value of Latitude	25.8431	15.4956
Average Population Density	0.6807	0.7125
Democracy	6.2885	3.8531
GNP Per-Capita ($1,000s of 1990 dollars)	6.4661	8.3253
Annual Total Count	2.6095	3.7777
Annual Count of Earthquakes	0.3341	0.7302
Annual Count of Extreme Temperature Events	0.1139	0.3829
Annual Count of Floods	0.9273	1.4035
Annual Count of Land Slides	0.2115	0.5667
Annual Count of Wind Storms	1.0228	2.4708
Annual Total Dead	537.0466	5012.3690
Annual Total Dead From Earthquakes	121.4241	1534.9660
Annual Total Dead From Extreme Temperature	13.4382	106.4465
Annual Total Dead From Floods	138.1443	1067.9590
Annual Total Dead From Land Slides	13.1996	55.5143
Annual Total Dead From Wind Storms	250.8406	4629.7820

The summary statistics are calculated for a sample of 960 observations.
The sample covers 48 nations over 20 years.
Democracy takes on the values 0 to 10 with 10 being the highest democracy level.
Latitude is determined by the country's centroid. Elevation is measured in 1000s of meters above sea level.
Average Population Density is typical population density experienced by an individual (persons/km^2)

Table Three: Annual Averages for Sample Nations

country	Annual Total Dead	Annual Disaster Count	Total Dead per Million Population	GNP Per-Capita	Deaths Per Disaster 1980-1989	Deaths Per Disaster 1990-1999
Algeria	223.7143	1.5000	11.5201	2.4162	282.4000	28.0000
Argentina	17.8571	2.0000	0.5686	4.6003	10.2857	7.5714
Australia	13.6316	4.1053	0.8072	17.9032	3.9412	2.8409
Austria	9.2500	1.5833	1.1891	19.0048	6.0000	5.6250
Bangladesh	8366.5000	5.9500	76.9789	0.1989	522.1429	1888.3120
Bolivia	44.4615	1.3077	6.8988	0.8007	40.5000	28.2222
Brazil	143.4737	3.4211	1.0235	3.2982	57.3529	25.0323
Canada	5.6471	1.3529	0.2013	20.7124	4.1000	4.2308
Chile	65.4615	1.8462	5.1369	2.3362	44.5000	26.4167
China	2172.4500	12.2500	1.9139	0.3831	191.1980	167.6250
Colombia	232.7778	2.9444	6.9264	1.1804	98.1905	66.5000
Costa Rica	16.1818	1.7273	5.1693	2.0429	7.6000	10.0000
Ecuador	158.6667	1.6667	16.1463	0.9905	110.0000	80.4000
El Salvador	239.2222	1.1111	46.9998	1.1480	407.5000	87.1667
France	21.1500	2.9000	0.3687	20.5671	4.5769	9.5000
Greece	99.2857	1.4286	9.8493	8.1477	116.7000	22.3000
Guatemala	91.7778	1.4444	11.9437	0.8604	104.8571	15.3333
Haiti	194.0000	2.1000	29.6182	0.4070	37.4667	229.6667
Honduras	1397.1820	1.3636	228.6841	0.6347	22.7143	1901.2500
India	3351.9500	9.4000	3.8916	0.3510	206.4286	520.1000
Indonesia	335.9000	4.5500	1.8977	0.6474	49.7959	101.8571
Iran, Islam Rep	2693.5630	4.1875	49.6401	10.6372	91.3043	931.7500
Ireland	6.3333	1.3333	1.8124	12.0673	7.0000	3.4000
Italy	365.7857	2.4286	6.4740	18.2942	252.6316	21.4000
Japan	382.4500	4.1500	3.0792	22.5398	30.8222	164.7895
Madagascar	81.1818	1.3636	6.8916	0.2406	66.0000	53.8750
Malawi	71.2857	1.2857	8.3369	0.2216	7.3333	79.5000
Mexico	741.2105	4.2105	9.0928	3.1855	371.3333	76.5472
Mozambique	60.4000	1.1000	4.0088	0.0485	36.5000	77.0000
Nepal	297.3889	1.8889	16.4263	0.1907	128.3500	199.0000
New Zealand	1.0625	1.7500	0.3134	12.9817	0.7647	0.3636
Nicaragua	404.4445	1.0000	86.9813	3.1951	67.0000	573.1667
Nigeria	88.0000	2.2500	0.8714	0.3649	65.0000	31.7143
Pakistan	386.6111	3.2778	3.2289	0.3441	51.0500	152.2564
Papua New Guinea	40.2500	1.3333	10.8261	0.6611	20.4286	37.7778
Peru	171.6500	2.6000	8.4020	1.8627	74.6786	55.9167
Philippines	833.3684	8.6842	14.1989	0.7166	96.0455	95.8701
South Africa	89.9286	1.7857	2.4648	3.0198	82.5556	32.2500
Spain	30.5385	1.9231	0.7891	12.0194	15.7857	16.0000
Sri Lanka	40.1250	1.6875	2.4094	0.5009	43.9091	9.9375
Switzerland	2.5455	2.0000	0.3604	31.5344	0.2143	3.1250
Taiwan	195.1429	1.6429	8.9945	8.2665	33.8889	173.3571
Thailand	129.7059	2.2941	2.3265	1.5291	134.3000	29.7241
Turkey	1310.7500	2.3750	20.9596	2.5922	116.9167	752.6539
United Kingdom	15.8000	2.0667	0.2744	17.0293	11.7778	5.9545
United States	360.0500	16.6000	1.4538	22.7041	33.4483	15.3750
Venezuela	3051.7000	1.8000	129.2158	2.6196	32.0000	3358.7780

Each entry reports a national average.

Table Four: Determinants of Whether a Nation Experienced A Natural Disaster

The dependent variable is a dummy variable that equals one if a nation experiences a disaster in that category in a given year.

	All	Wind Storms	Land Slides	Floods	Extreme Temperature	Earthquakes
Column	(1)	(2)	(3)	(4)	(5)	(6)
Democracy Index	0.0084	0.0121	0.0020	0.0032	0.0065	-0.0010
	(0.0037)	(0.0084)	(0.0034)	(0.0063)	(0.0032)	(0.0078)
America Dummy	0.1451	-0.0149	0.1014	0.2725	0.0559	0.1110
	(0.0560)	(0.1254)	(0.0575)	(0.0765)	(0.0329)	(0.1096)
Asia Dummy	0.2292	0.1410	0.1324	0.3607	0.0324	0.1576
	(0.0511)	(0.1327)	(0.0653)	(0.0792)	(0.0383)	(0.1294)
Europe Dummy	0.0204	-0.1811	0.3067	-0.0173	0.0563	0.2003
	(0.0598)	(0.1234)	(0.1245)	(0.0970)	(0.0466)	(0.1812)
Elevation	0.0381	-0.0509	0.1380	-0.0099	-0.0063	0.1441
	(0.0339)	(0.0552)	(0.0245)	(0.0486)	(0.0279)	(0.0650)
Absolute Value of Latitude	0.0017	0.0070	-0.0077	0.0032	0.0020	-0.0052
	(0.0019)	(0.0039)	(0.0015)	(0.0026)	(0.0010)	(0.0026)
Average Population Density	0.0505	0.1161	0.0037	-0.0612	0.0153	0.0214
	(0.0374)	(0.0397)	(0.0190)	(0.0389)	(0.0116)	(0.0348)
Log of Population	0.0988	0.1017	0.0706	0.1415	0.0411	0.0804
	(0.0162)	(0.0252)	(0.0110)	(0.0250)	(0.0085)	(0.0200)
GNP Per-Capita	-0.0004	0.0036	0.0043	-0.0072	-0.0028	0.0012
	(0.0027)	(0.0062)	(0.0026)	(0.0042)	(0.0021)	(0.0051)
Time Trend	0.0051	0.0023	0.0033	0.0061	0.0029	-0.0049
	(0.0027)	(0.0029)	(0.0015)	(0.0032)	(0.0013)	(0.0021)
Observations						
pseudo R2						

Each column in this table reports a separate probit model.
Column (1) aggregates all five disaster categories while columns (2-6)
disagregate the disasters by category. Thus, in column (6) the dependent variable equals one
if at least one earthquake took place within a nation in a given year. The table reports marginal probabilities
and robust standard errors in parentheses. The standard errors have been adjusted for clustering within nation.

** indicates statistical significance at the 1% level.
* indicates statstical significance at the 5% level.
Africa is the omitted continent

Table Five: Determinants of Annual National Total Death From Natural Disaster

Zero Inflated Negative Binomial Regressions

	48 Nation Sample			27 Nation Sub-Sample	
Specification	(1)	(2)	(3)	(4)	(5)
Log(Settler Mortality Risk)					0.2010
					(0.7445)
Democracy Index			-0.1377		
			(0.0604)		
America Dummy		1.3302	1.4790		
		(0.5879)	(0.5030)		
Asia Dummy		1.6330	1.3787		
		(0.6533)	(0.5274)		
Europe Dummy		0.5401	1.3729		
		(0.6392)	(0.6923)		
Elevation		-0.3350	-0.3451		
		(0.4170)	(0.3548)		
Absolute Value of Latitude		0.0176	-0.0134		
		(0.0397)	(0.0455)		
Average Population Density		-0.3314	-0.2973		
		(0.2208)	(0.2095)		
Log of Population	0.7798	0.6757	0.7684	0.7951	0.8102
	(0.1915)	(0.2494)	(0.2424)	(0.2127)	(0.2249)
GNP Per-Capita	-0.0958	-0.1017	-0.0566	-0.1373	-0.1220
	(0.0294)	(0.0355)	(0.0434)	(0.0409)	(0.0651)
Time Trend	0.0608	0.0444	0.0397	0.0982	0.0963
	(0.0260)	(0.0269)	(0.0273)	(0.0308)	(0.0327)
Constant	3.2537	2.5966	3.4792	2.8389	1.9188
	(0.5618)	(0.8712)	(0.8668)	(0.5524)	(3.5304)
Zero Inflated Logit Model					
Total Count of Disasters	-23.3280	-23.3757	-23.5202	-22.3152	-25.2333
	(1.2313)	(1.1827)	(1.2480)	(0.8512)	(2.0879)
Log of Population	-0.8358	-0.8878	-0.8450	-0.3335	-0.3130
	(0.4320)	(0.4180)	(0.4172)	(0.5069)	(0.3062)
GNP Per-Capita	0.1542	0.1500	0.1475	0.1526	0.0567
	(0.0621)	(0.0568)	(0.0580)	(0.0517)	(0.0286)
Log(Settler Mortality Risk)					-0.9511
					(0.3662)
Constant	22.2732	22.6241	22.6019	20.7578	27.8457
	(1.5094)	(1.5171)	(1.5169)	(1.5416)	(3.5731)
/lnalpha	1.2478	1.1967	1.1714	1.1603	1.1576
	(0.0332)	(0.0333)	(0.0341)	(0.0343)	(0.0349)
alpha	3.4828	3.30912	3.22644	3.1909	3.1822
.	(0.1157)	(0.1102)	(0.1101)	(0.1095)	(0.1109)
observations	936	936	936	540	540

Each column of this table reports a separate estimate of a zero inflated negative binomial (ZINB) model. The ZINB model has two equations. The lower panel of the table reports its logit model. The logit predicts the probability that nobody in a given nation in a given year died from a natural disaster.
The upper panel reports the results from the negative binomial regression predicting the death count for nations that have experienced a positive death count. Standard errors are presented in parentheses. The standard errors are adjusted for within nation correlation.

Table Six: Predicted Annual Death From Natural Disaster in Rich and Poor Nations

GNP Per-Capita	Expected Deaths	Predicted Deaths if Deaths>0	Probability Death equals zero
$2,000	774	1061	0.271
$8,000	427	591	0.277
$14,000	230	325	0.291

The table's predictions are based on the results in Table Five's specification (1). In this table, population is set at 100 million and the year is set to 1990. The predictions are based on the actual count of natural disasters that a nation experiences.