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Abstract

This paper discusses the impact of foreign aid on the recipient country's preparedness against natural disasters. The theoretical model shows that foreign aid can have two opposing effects on a country's level of mitigating activities. In order to test the theoretical propositions we analyse the effect of foreign aid dependence on ex-ante risk-management activity proxied by the death toll from major storms, floods and earthquakes occurring worldwide between 1980 and 2002. We find evidence that the crowding-out effect of foreign aid outweighs the preventive effect in the case of storms, while there is mixed evidence in the case of floods and earthquakes.

Keywords: Foreign Aid, Samaritan's Dilemma, Natural Hazards

JEL classification: O17, O19, Q54

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1 Introduction

The debate among economic scholars whether foreign aid is a boon or a bane for developing countries has been going on for decades. This paper further augments the existing discussion by analyzing the effects of foreign aid on the recipient country's capacity to deal with natural hazards such as floods, earthquakes and windstorms. Interestingly, less developed nations do not necessarily experience more natural disaster events, but the death toll from disasters is on average higher in poorer nations (Kahn 2005). Economic scholars explain these differences in vulnerability through the level of development (Kahn 2005, Eisensee & Stroemberg 2007), institutional quality (Kahn 2005), the level of democracy (e.g. Tavares 2004) or income inequality (Anbarci, Escaleras & Register 2005). The role of foreign aid, however, has only received minor attention so far (e.g. Stroemberg 2007, Cohen & Werker 2008).

In general, foreign aid can have two opposing effects on the recipient nation's disaster preparedness: First, aid flows can have a *preventive effect* by directly or indirectly improving a nation's preparedness against natural hazards. In recent years, a number of international initiatives emerged that try to implement disaster preparedness (e.g. awareness-building, installation of monitoring systems, structural measures) in overall aid policies (OCHA 2008). Additionally, general aid flows in infrastructure or social sector projects can create positive externalities for the recipient country's disaster preparedness. An improved telecommunication and transport system for example, facilitates early-warning and evacuation. Better housing structures make communities more resilient against the forces of nature.

Second, while the natural hazard itself is an exogenous shock, the human reaction to such an event is driven by incentives as a result of millions of dollars yearly spent on disaster relief. Foreign aid received in the past might increase the predictability of ex-post relief and induce decision-makers to shirk responsibilities by reducing ex-ante protection activities. Such a reaction could result in higher financial losses and higher death tolls. For this reason, the disincentives induced by the large amount of relief are likely to further exacerbate the sustainable development of regions that are especially vulnerable to large scale disasters. The research focus in our paper is on this so called *crowding-out effect* of foreign aid.

Ex-ante risk management strategies against large-scale catastrophes are generally not implemented by individuals voluntarily, since individuals' incentives for protection against catastrophes are distorted by a lack of interest and information as well as an underestimation of risk occurrence (Kunreuther & Pauly 2006). This public-good problem explains that the vast majority of protective measures (e.g. structural measures, building codes, zoning, early warning) are in the realm of governments and bureaucratic agencies. The ability to provide these public goods is influenced by the level of GDP (Kahn 2005), income inequality (e.g. Anbarci et al. 2005) or the level of heterogeneity among groups in society (e.g. Alesina & Drazen 1991).

These factors can help to explain the large number of fatalities following natural catastrophes, especially in developing countries. To limit the destabilization following a disaster, ad-hoc catastrophe relief from international organizations, national governments, non-governmental organizations as well as private donors is usually paid to the affected countries. Anecdotal evidence also suggests an increase in official development assistance (ODA) in order to ensure long term recovery from the disaster. In 1998 Hurricane "Mitch" devastated large parts of Central America. In Honduras alone the death toll reached 5,600 and the estimated financial losses were $ 3.8 billion. The international community responded to this catastrophe by increasing the official development assistance from $ 361 million (1997) to $ 1.7 billion (1999) and the annual ODA-inflows still remain at a relatively higher level than prior to 1998 ($ 640 million) (Bermeo 2007).

There is no doubt that international assistance after such a devastating event was strongly needed. However, these ex-post payments could set ex-ante incentives that crowd out the willingness of (political) agents to put effort in sufficient preventive action. Based on the conclusion from the Samaritan's Dilemma, the anticipation of charity in the case of a large-scale disaster, might induce governments to diminish protection (Buchanan 1975, Coate 1995), since "[...] current decisions of economic agents depend in part upon their expectations of future policy actions." (p. 474, Kydland & Prescott 1977). A prominent example is the failure on the insurance market: Moral hazard and adverse selection present only a partial explanation for imperfections in the market for natural hazard insurance. Kunreuther (2000) defined the situation of distorted demand and insufficient supply on the market for natural hazard insurance as *disaster syndrome*. Individuals tend to underinsure because a) they underestimate the risk of low-probability-high-loss events and b) they expect financial relief by the government or private charity. Private charity and governmental relief is a premium-free insurance against natural hazards. If a catastrophe occurs, individuals without market insurance are better off because they receive financial support from governmental relief programs. The theoretical model by Raschky & Weck-Hannemann (2007) shows that a higher degree of institutionalization of governmental relief or charity further decreases individual demand for insurance and increases the reliance on aid in a disaster situation. The phenomenon of *charity hazard* (Browne & Hoyt 2000) could also apply to international disaster assistance.

This problem has already been identified in the foreign aid literature in another context as a consequence of producing disincentives through the provision of foreign aid (Gibson, Andersson, Ostrom & Shivakumar 2005). Foreign aid is often paid in order to close the financial gap between the required investment which is necessary to achieve a targeted growth rate and the available resources. The results of Easterly (1999) suggest that the provision of foreign aid based on the financial gap induces recipient countries to reduce savings and hence to increase the financial gap even further. In addition, the work by Cashel-Cordo & Craig (1990) and Khan & Hoshino (1992) provide evidence that international aid might have a negative effect on public-sector fiscal behavior in the recipient countries. In the natural hazard context, the theoretical model developed by Cohen & Werker (2008) suggests that the presence of ex-post relief can distort the relation of ex-ante protection to ex-post relief. However, the model we construct goes one step further by showing that the anticipation of foreign aid can result in a higher death toll from natural disasters. Moreover, to our knowledge, the connection between foreign aid and its influence on the effectiveness of preventive capacity has, so far, not been empirically analyzed.

The remainder of the paper is structured as follows: The next section establishes a theoretical model to analyse the interaction between donor and recipient in the context of natural hazard prevention. Section 3 presents our dataset. In section 4, we test the hypothesis on three different types of natural disasters. Sections 5 and 6 present the results and conclude with suggestions on the redeployment of foreign aid in order to minimize the adverse crowding-out effect.

2 The Model

This section aims to construct a theoretical model, which allows the derivation of the hypothesis, necessary for the empirical analysis of a potential effect of foreign aid on the degree of protection. We first give an intuitive description of the theoretical story behind the model and then present the formal model itself.

2.1 Intuitive description

We imagine a world with a rich donor and a poor recipient country. The donor country receives utility from the recipient country's utility, which has resulted in foreign aid flows in the past. The recipient country is in danger of natural hazards. Past foreign aid flows can, in part, have a preventative effect on the vulnerability of the recipient country and increase the probability that wealth and human beings survive a natural hazard, if a) disaster preparedness measures are implemented in the foreign aid initiative of the past or if b) aid flows are used for measures which create positive externalities, hence contribute indirectly to improved disaster preparedness e.g. infrastructure. However, the recipient country itself can install protection as well, by imposing a proportional tax rate. This tax has two opposing effects on the expected utility of a representative person in the recipient country. On the one hand it contributes to a higher probability of surviving a disaster on the other hand it reduces consumption possibilities. Apart from the above described preventative effect, foreign aid flows of the past can have two negative effects on the probability of surviving, both of which are due to a crowding-out effect of the tax rate. First, the fraction of past foreign aid which contributes to a higher survival probability, could directly crowd out the tax rate necessary for protection measures. In order to get a better idea of this direct crowding-out effect, imagine a government that strives to reach a certain level of protection. Since past foreign aid partly provides protection, the aspired level of protection can be obtained with a lower level of the tax rate (direct crowding-out). Second, foreign aid experiences in the past might increase the predictability of ex-post charity and induce the government of the recipient country to shirk responsibilities. Since a higher tax rate increases the survival probability, the need for disaster relief in case of a natural hazard is reduced. Hence, in the bad state the recipient country does not have an incentive to increase the tax rate because a higher level of protection reduces ex-post charity. In other words, the anticipation of foreign aid crowds out the tax rate. Moreover, in the good state, protection measures reduce the utility of a representative person in the recipient country by lessening consumption possibilities. Thus, the anticipation of disaster relief reduces the incentive to implement protection measures (indirect crowding-out). The net outcome of the positive preventative effect and the two negative crowding-out effects of past foreign aid can result in a lower survival probability if the crowding-out effects outweigh the preventative effect.

2.2 Formal model

We assume a potential "donor country", D and a "recipient country" R, each with identical individuals earning an income of Y_D and Y_R respectively ($Y_D > Y_R$).

The recipient country is in danger of a natural hazard, which occurs with probability π, $0 \leq \pi \leq 1$. There are two factors that can reduce the impact of natural hazards on society: First, the recipient country is assumed to have experienced foreign aid in the past. This transfer increases the utility of a representative individual in country R by a) increasing the consumption possibilities and b) contributing - directly or indirectly - to a better risk prevention. In the following, we use the term preventive effect for the latter. Second, the government of country R can choose a level of protection, which is financed by a proportional tax rate t , with $t \in (0, 1|Y_R)$ by maximizing the utility of a representative person. Hence, the probability that wealth (e.g. capital stock) as well as human beings survive a natural hazard is determined by the tax revenue tY_R as well as the fraction, ψ, of foreign aid p.c., T, inducing the preventive effect, with

$$q = tY_R + \psi T \leq 1. \tag{1}$$

The idea to analyze survival probability stems from the model developed by Anbarci et al. (2005) and is, as we will demonstrate in section 4, important for our empirical applications.[1] We assume that the fraction ψ is exogenous.

[1]Note that our model differs in three major points from the application of Anbarci et al. (2005). First, survival probability is not only determined by the tax revenue but also by foreign aid received in the past. Second, we do not account for income inequality within

The government's choice of t is subject to a trade-off: On the one hand a rise in the tax rate reduces the disposable income and therefore the consumption possibilities, on the other hand it increases the probability of surviving a natural hazard. To be more precise, there exists a threshold level, $\tilde{t}$, below which the positive effect of a higher probability of surviving outweighs the utility reduction due to a lower level of consumption, whereas for $t > \tilde{t}$ the negative effect dominates. In the following we will focus on tax levels smaller than $\tilde{t}$. In this relevant spectrum, we can observe a utility function with, $U'_R(t) > 0$ and $U''_R(t) < 0$. Apart from the preventive effect, there is also a possible crowding-out effect on the tax rate that stems directly from the fraction of foreign aid, which contributes to a higher survival probability $\left(\frac{\partial t}{\partial T} < 0\right)$. In the following, we call this the direct crowding-out effect.

Country D receives utility from consumption C and from country R's utility U_R, $U_D = C + \delta U_R$, with $\delta > 0$. A positive value of δ can be the result of altruism as well as self-interest of the donating country due to strategic considerations. The incorporation of the recipient country's utility level in the utility of the donating country could have a second effect on the recipient country's choice of the tax rate t, if we account for ex-post relief in case of a disaster. That is, due to foreign aid experiences in the past, the government of the recipient country might anticipate the possibility of ex-post charity τ and interpret foreign aid experiences of the past as implicit insurance for the future. Hence, past foreign aid experiences do not only have a positive preventive and a negative, direct crowding-out effect on the survival probability, but also an adverse indirect crowding-out effect. In the following, we will first derive the indirect crowding-out of the tax rate t and second determine the net effect on survival probability q.

Our model is mainly based on Coate (1995). However, there are two fundamental differences. First, while the analysis of Coate (1995) mainly focuses on a Samaritan's Dilemma problem between individuals on a national level, the aim of this work is to investigate the existence of the Samaritan's Dilemma on an international level, where the aid-receiving government shirks responsibilities. Second, Coate (1995) uses three groups of actors, namely two rich individuals, a poor individual and the government, with the latter

a country since this is not our main focus. Needless to say that we control for income inequality in the empirical application. Third, as mentioned above, we believe that the majority of protection measures in fact been used, are described by the characteristics of public goods and financed by taxes.

trying to maximize the welfare of the rich by providing an ex-ante payment to the poor person. Hence, he assumes an ex-ante payment which is primary of strategic nature and aims to reduce the ex-post payment, which is the Samaritan's Dilemma problem of the rich. However, we assume that the ex-ante payment does not have any influence on the ex-post decision, because our focus is not to analyze how the ex-ante payment affects ex-post relief, but rather how it affects the level of protection chosen by the recipient country's government through the preventive as well as direct and indirect crowding-out effects.

The intuitive explanations illustrate that both the donor and the recipient country's behavior are relevant to derive the forces which impact the value of the tax rate t necessary for the implementation of protection measures. Using backward induction, we first focus on the behavior of the donor country. Once, the bad state for the recipient country arises and given the level of the tax rate t, the reaction function of the rich country is

$$\max Y_D - T - \tau + \delta U \left[\left(Y_R(1-t) + T(1-\psi) \right) q + \tau \right] \tag{2}$$

with $q = tY_R + \psi T$. The optimal ex-post emergency aid is implicitly defined by the following first-order-condition, which states that the marginal benefit of the donor country, which results from the higher utility of the recipient country, must equal the marginal costs of the donor country due to a lower level of consumption.

$$\delta U' \left(\left(Y_R(1-t) + T(1-\psi) \right) (tY_R + \psi T) + \tau \right) = 1 \tag{3}$$

In order to derive how the donating country's choice of ex-post aid adjusts to changes of the poor country, we have to discuss the following expression:

$$\left. \frac{\partial \tau}{\partial t} \right|_{dY_R = 0} = -\frac{U_{\tau t}}{U_{\tau \tau}} \tag{4}$$

The denominator of the expression is negative if we assume that the impact of the ex-post transfer on the utility is comparable to the impact of income. A given level of transfer induces increases in the utility level, but the effect is smaller for higher levels of initial utility.

The sign of the nominator is now essential for the determination of the adjustment of the donating country's ex-post transfer to variations of the tax rate undertaken by the recipient country's government. A positive nominator would imply that a rise of the tax rate t would increase the marginal utility of the ex-post transfer (prevention and relief are complements), whereas a negative nominator would suggest that an increase in the tax rate would lead to a decrease of the marginal utility of the ex-post transfer (prevention and relief are substitutes). If the increase of the tax rate has no influence on the marginal utility of the ex-post transfer the nominator reaches the value of zero. Cohen & Werker (2008) point out the importance of this distinction: Prevention and ex-post relief being complements would imply that the donating country would increase the level of aid for higher levels of protection. In contrast, a substitutability of prevention and aid, suggests that the donating country reacts on higher levels of protection by cutting the level of ex-post relief. We believe that both the tax rate and the ex-post payment increase the ability to cope with the potential consequences of natural hazards and that these contributions are largely substitutable, since, in the majority of cases, relief is even productive when protection measures are not implemented. Hence, given the substitutability of prevention and aid, the expression above is negative and states that the donor country will reduce the level of ex-post relief for increasing values of t.

The government of the recipient country is assumed to maximize the expected utility of a representative consumer by taking into account the donor country's reaction function (4).

$$\begin{aligned} \max EU_R = \pi U\left((Y_R(1-t) + T(1-\psi))(tY_R + \psi T) + \tau(t)\right) \\ +(1-\pi)U\left(Y_R(1-t) + T(1-\psi)\right) \end{aligned} \tag{5}$$

We first analyze how changes in the tax rate t affect the recipient country's utility in the bad state. For $\tau > 0$, increases in the value of the tax rate which contribute to a higher level of protection have no influence on the recipient country's utility in the bad state, since higher tax rates will, ceteris paribus, increase the survival probability and hence reduce the need for ex-post charity. The anticipation of foreign aid is perfectly crowding-out the tax rate t, necessary for protection measures. In the good state however, protection measures reduce the utility of the recipient country, since the tax rate reduces the disposable income without contributing to a higher probability of surviving. Thus, allowing for the possibility of ex-post charity, provides an incentive for the aid receiving country to reduce protective measures (indirect crowding-out effect).

The survival probability q in the bad state is determined by the positive preventive effect and the negative crowding-out effects.

$$dq = \underbrace{\frac{\partial q}{\partial t} dt}_{\text{Crowding-out effect(-)}} + \underbrace{\frac{\partial q}{\partial T} dT}_{\text{Preventive effect(+)}} \gtreqless 0 \qquad (6)$$

From equation (6) we can see that foreign aid received in the past will result in a lower (higher) survival probability, if the crowding-out (preventive) effects outweigh the preventive (crowding-out) effects.

3 The Data

We test the propositions of our theoretical model on three different types of natural disasters: storms, floodings and earthquakes. Table 1 provides an overview of the countries in each disaster sub-sample. Our sample of nations is very similar to the sample applied in Kahn (2005)[2]. In their empirical analysis of the impact of disasters on long-term growth, Skidmore & Toya (2002) point out the importance to distinguish between different types of disasters. They argue that climatic disasters (e.g. storms, floods) are more easily forecast and therefore evacuation or taking cover is easier. In comparison, geologic disasters (e.g. earthquakes) are harder to predict. The former are more of a threat to property while the latter type of disasters are a threat to both property and life. They find that climatic disasters have a positive impact on long-run growth, while geologic disasters decrease growth in the long-run.

[Table 1 about here]

Apart from the differences in the effect on economic development, different types of natural hazards require different forms of protective measures. Although activities in natural hazard management show common features (e.g. public good character of enforcing zoning and building codes) they might differ in terms of affordability and duration. For example, the construction of earthquake resistant buildings is very cost-intensive and cannot

[2]We excluded Israel and Egypt from our sample due to these countries' special position in U.S. foreign aid policy (see Alesina & Dollar 2000).

be afforded by the majority of individuals living in developing countries. Forecasts for storms, cyclones or other climatological events are often provided by international agencies and communicated to national governments. If these governments forward a warning to the people at risk, lifes can be saved at relatively low costs. Therefore, we build three subsamples for each type of natural hazard instead of simply pooling observations from all natural hazards.

We compiled our dataset from a number of sources[3]: The data on disaster victims, major disaster, magnitude and the number of people effected is taken from the most comprehensive data set on disasters, the EM-DAT by the Center for Research on the Epidemiology of Disasters (CRED) in Brussels. EM-DAT has collected around 12,000 reports of different disasters, such as floods, storms, earthquakes, volcanic eruptions, landslides as well as man-made disasters. A natural disaster has to fulfill at least one of the following criteria in order to be included in the database: 10 or more people reported killed, 100 people reported affected, declaration of a state of emergency, call for international assistance. Therefore, disasters that occurred in thinly populated areas are not included in the database and in the analysis. Information on the magnitude of storms (wind speed in kph) and earthquakes (Richter scale) also stems from this database. Data on the magnitude of major flood events (i.e. flooded area in km^2) is only available for a small number of flood disasters in the dataset. We therefore obtained historical data on precipitation from the Global Historical Climatology Network by the National Oceanic and Atmospheric Administration (NOAA). The data is collected from thousands of land stations. The earliest entry of a country's monthly mean precipitation ranges back to 1697 (United Kingdom). We used the number of months in year t and country j when precipitation was larger than one standard deviation above the long-term mean of precipitation in a given month as an additional explanatory variable in our estimations.

Data for our main variable of interest, foreign aid p. c., stems from the World Development Indicators (WDI). Although EM-DAT provides figures on international disaster assistance for some major earthquake events, there is no comprehensive collection on financial disaster aid that compiled such data in a concise manner. The study by Stroemberg (2007) used data on U.S. disaster assistance and its determinants. In contrast, we assume that

[3]See Table 18 for a description of the data and the sources´.

expectations about international disaster relief are formed by general aid dependency. Therefore we use figures on overall development aid. National data on real GDP per capita and openness for trade are taken from the Penn World Table Version 6.2. Regarding data on income inequality, one could consider the largest collection of data on Gini coefficients is the World Income Inequality Database (WIID, 2000). This data has been already used in the empirical analysis on disaster victims by Stroemberg (2007). The problem with measuring income inequality over time and between countries is that the concepts and units of income change thus raising questions on the consistency and quality of the data used (Atkinson & Brandolini 2001). To circumvent potential problems and biases, Grün & Klasen (2003) perform a regression-based adjustment to make the Gini-coefficients more comparable. We use the data from that study for our analysis.

Our measure for institutional quality was compiled by Kaufmann, Kraay & Mastruzzi (2008) for the Worldbank. Institutional quality is defined via six dimensions of governance: Control of Corruption, i.e. the extent to which political power is misused for private benefits. Governmental effectiveness, i. e. the quality and credibility of public and civil service and the independence from political pressure. Political stability, i.e. the probability that the current government will be overthrown by a coup d'état. Regulatory quality, i.e. the government's ability to design and enforce sound regulations and promote private sector development. Rule of law, i.e. the protection of property rights and the quality of contract enforcement, the police and the courts. Voice and accountability, i.e. freedom of expression and association as well as the possibility to actively participate in the selection of the government. Our second proxy measure for institutional quality is a country's democracy level. We use the Polity 2 variable, which ranges between -10 (autocratic) and 10 (democratic). Information on a nation's colonial background is provided by Correlates of War 2 Project (2008).

As additional controls, we introduce the general mortality risk from each natural disaster. A recent study by Columbia University and the World Bank (Dilley, Chen, Deichmann, Lerner-Lam, Arnold, Agwe, Buys, Kjekstad, Lyon & Yetman 2005) uses spatial data on historical disaster occurrence and population density and constructs a measure of the geographical distribution of mortality risk from natural disasters worldwide. In the appendix Figures 1, 3 and 5 show the regions with storm, flood and earthquake mortality risk in the world, respectively and Figures 2, 4 and 5 are maps focused on each risk in Asia in order to get a better idea of the resolution of the data. The darker the grid cells, the larger the mortality risk on a 10-point scale. We use this GIS-data and combine it with a shape file of national boundaries to calculate a country's mean exposure to disaster mortality. Data for additional geographical controls (latitude and elevation) stem from the dataset provided by (Kahn 2005). Table 2 reports the mean, standard deviation, minimum and maximum of the variables in the estimated cross-section models for each sub-sample.

[Table 2 about here]

4 Empirical Strategy

Based on the propositions put forward by our theoretical model and the specification applied by Kahn (2005) we derive the following reduced-form specification for our baseline estimates:

$$\begin{aligned} DEATH_{ijt} =& \beta_0 + \beta_1 \text{Ln}(AID_{j,t-1}) + \beta_2 \text{Ln}(GDP_{j,t-1}) + \beta_3 \text{Ln}(POP_{jt}) \\ &+ \beta_4 \text{Ln}(POPDENS_{jt}) + \beta_5 OPEN_{jt} \\ &+ \beta_6 MAGNITUDE_{ijt} + \beta_7 NATHAZ\ RISK_j \\ &+ \beta_8 LATITUDE_j + \beta_9 ELEVATION_j \\ &+ \eta_{ijt} + \upsilon_c + \epsilon_{ijct} \end{aligned} \tag{7}$$

Our dependent variable is the number of deaths, $DEATH_{ijt}$, at event i in country j at year t. Our main variable of interest is foreign aid in period $t-1$ per capita, $\text{Ln}(AID_{j,t-1})$. This variable a) accounts for the direct crowding-out effect of past foreign aid and b) serves as our empirical proxy for the indirect crowding-out effect i.e. the amount of anticipated ex-post aid that migh crowd out national collective hazard management activity. To account for a country's level of development and its general ability to install protective measures we include GDP per capita. In order to reduce potential reversed causality between disaster fatalities and income we use the first lag of GDP p.c., $\text{Ln}(GDP_{j,t-1})$. We expect that richer countries suffer c. p. less deaths from natural catastrophes. In contrast to general belief, the correlation between GDP p. c. and AID p. c. in each of our three sub-samples is moderate (between -0.104 and -0.152). This is in line with the results of empirical studies (e.g. Frey & Schneider 1986, Alesina & Dollar 2000) that identify political and strategic considerations as the driving forces behind foreign aid.

To account for a nation's size and density of population we introduce the natural log of population, Ln(POP_{jt}), and the natural log of population density, Ln($POPDENS_{jt}$), respectively. Gassebner, Keck & Teh (2009) show a negative relationship between the occurrence of disasters and a nation's trade volume. Alesina & Dollar (2000) find that bilateral aid flows are positively related to a nation's openness for trade. To control for potential spurious correlation that might stem from this interrelationship, we include a nation's openness for trade, $OPEN_{jt}$, in our specification.

Apart from these socio-economic variables, the main explanatory factors for disaster fatalities are a disaster's magnitude, and additional climatic, geographical and topographical factors. All else equal, more powerful disasters should kill more people. We include wind speed measured in kilometers per hour as a magnitude variable for our storm sub-sample, the number of months per year t in the country j, with a monthly precipitation that is one standard deviation above the long time precipitation mean in country j for our flood sub-sample and the Richter scale for the earthquake sub-sample.

Nations that are more exposed to natural disasters could also be the subject of more international aid contributions. Thus, we control for a nation's exposure to each disaster type via a proxy variable. Using GIS-data on the mortality risk and a shape file of a country's national boundaries we are able to construct the mean mortality risk from each disaster type for each nation, $NATHAZ\ RISK_j$. The expectations on the country's exposure to disasters are ambiguous. On the one hand, a higher ex-ante risk could be an indicator for more knowledge and better precaution. On the other hand, these proxies could indicate a higher magnitude of events and thus increase the number of fatalities. As a second indicator we use latitude, which accounts for possibility that the occurrence and intensity of climatic disasters might be correlated with their distance to the equator. As a third geographical indicator we use the mean elevation of a country. We also include continent-specific fixed effects, υ_c, and a time trend, η, (both in accordance to the specification by Kahn (2005)). ϵ_{ijct} is the error term.

The dependent variable, $DEATH_{ijt}$, is a discrete, strictly positive count variable. Using simple ordinary least squares (OLS) with the underlying distributional assumption of a normally distributed continuous variable could result in biased estimates. Kahn (2005) log-transformed the dependent variable to overcome this problem. An alternative way is to assume that the data is Poisson distributed and use Poisson regression models. However, if the conditional mean and the variance function of the dependent are not equal, these estimators can overestimate the significance. A more flexible approach is the negative binomial model, which will be applied in this paper.

The empirical estimation is complicated by the fact that the relationship between disaster fatalities and past foreign aid are influenced simultaneously by omitted factors. We try to circumvent this problem by applying an instrumental variable (IV) estimator. Our instruments for past foreign aid are motivated by two seminal contributions in the field of development economics: The first instrument is a country's colonial background. The panel-econometric analysis by Alesina & Dollar (2000) suggests that colonial past is a major determinant of foreign aid. We construct a dummy variable that switches to 1 if a country was either a former British, French or Spanish colony. The choice of our second set of instruments refers to recent work by Isopi & Mattesini (2008). They find that the majority of OECD donors take into account efficiency considerations for their aid-allocation decision. We include the level of corruption control as well as the second and third lag of military expenditure in country j as additional instruments.

In addition, we perform a number of robustness tests: First we control for the influence of institutional quality. Kahn (2005) already suggests that better institutional quality serves as an insurance against mortality risk from natural disasters. We therefore expect the sign to be negative. The second set of estimates looks at the effect of aid from different donor nations. After that, we examine the additional influence of factors that might increase the anticipation of aid. As already mentioned, Alesina & Dollar (2000) showed that former colonies are c. p. more likely to receive foreign aid. We therefore estimate alternative specifications where we control for these factors and the interaction with lagged aid.

The studies by Anbarci et al. (2005) and Kahn (2005) suggest that a country's income inequality $GINI_{jt}$ is an impediment for collective actions and might increase the death toll. In contrast, Eisensee & Stroemberg (2007) who use the UN-WIDER GINI data, do not find any significant relationship between inequality and disaster fatalities. Therefore, the effect of the $GINI$-variable is in principle ambiguous. We run additional specifications that include income inequality of country j in year t as additional robustness checks.

In line with the empirical strategy by Kahn (2005), our second set of estimates analyses the determinants of the annual national death toll from each of the three different natural hazards. The EM-DAT disaster dataset only includes major catastrophes that have exceeded a certain threshold in magnitude (e.g. number of fatalities, state of emergency). A nation could experience a natural disaster but a sufficient amount of protective measures can limit the overall losses and fatalities and thus prohibit the event being included in the dataset. Constructing a panel dataset allows us to analyze this first-stage process as well and use this information as an additional control in a second stage regression of the disaster fatalities.

Using the negative binomial model would assume that the observations with zero death-counts are generated by the same underlying process. This might not apply to our analysis. A zero outcome in the death count can arise from two regimes: Either no disaster took place (regime 1) or a large scale disaster took place and protective measures prevented any fatalities (regime 2). We therefore apply a zero-inflated negative binomial model (ZINB) which allows for overdispersion in the dependent variable and treats the zero outcomes of the dependent variable different from the positive counts. The model combines a binary variable c_i with a standard count variable y_i^* such that the observed variable is given by

$$y_i = \begin{cases} 0 & if \quad c_i = 1 \\ y_i^* & if \quad c_i = 0 \end{cases}$$

The probability that c=1 is denoted by ω_i. We apply the following probit model to estimate the influence of covariates z_i on ω_i.

$$\omega_i = \Phi\left(z_i \gamma\right) \tag{8}$$

The corresponding log-likelihood function is given by

$$
\begin{aligned}
\ell = & \sum_{y_i=0} \ln\left(\Phi\left(z_i\gamma\right)\right) + \alpha(\ln\alpha - \ln(\exp(x_i'\beta) + \alpha)) \\
& + \sum_{y_i>0} \ln(\Gamma(\alpha + y_i)/\Gamma(\alpha)) + \alpha\ln(\alpha - \ln(\exp(x_i'\beta))) \\
& + y_i(x_i'\beta - \ln(\exp(x_i'\beta) + \alpha)) - \sum_{i=1}^{n} \ln(1 + \exp(z_i'\gamma))
\end{aligned}
\tag{9}
$$

The 1^{st} stage probit model captures the process governing that a potential deadly disaster takes place in country j at time t. The 2^{nd} stage estimates the death count once a disaster has taken place by applying a negative binomial estimator.

5 Results

The first set of results for fatalities from storms, floods and earthquakes is presented in Table 3. Our hypothesis, that lagged foreign aid, $\text{Ln}(AID_{j,t-1})$, has an increasing effect on the number of disaster fatalities is only confirmed in the storm sub-sample. The results are robust if the mean of annual aid of the preceding 3 years, $\text{Ln}(3yr.\ AID_{j,t-1,})$, is taken instead of the first lag of aid (column 3.2). The results for floods and earthquakes neither confirm nor reject our hypothesis. The coefficients of the lagged aid as well as the 3-year-mean aid variable do have a positive sign for flood fatalities and a negative sign for earthquake fatalities, but they are not significantly different from zero. These results indicate that the crowding-out effect of aid might be relevant for wind-storm disasters and to a certain extent for floods, but not for earthquakes. The differences between the disaster sub-samples seems to be connected to the choice of our empirical proxy. As already mentioned, foreign aid can have both a preventive as well as a crowding-out effect. The results from the storm and flood sub-sample suggest that the crowding-out effect outweighs the prevention effect while we find some indication that the relationship is vice versa in the case of earthquakes.

Table 4 summarizes the results of the IV estimates, where we instrumented aid with the colonial background, the level of corruption control and past levels of military expenditure. The coefficient for lagged aid is again positive and significant for the storm subsample. While the sign of the coefficient changes in the flood sample and stays negative in the earthquake sample. Again, the estimates with the floods and earthquakes subsamples do not yield significant results for the lagged aid variable. The first stage R^2's for the storms and earthquakes estimates are relatively high (0.500 and 0.269, respectively) and all three estimates pass the Hansen's J-test.

Kahn (2005) showed that nations with better institutions suffer less disaster fatalities and there is a wide discussion in the aid-literature on the effect of institutions on development aid. We control for this interrelationship in Tables 5, 6 and 7 for each disaster-type separately. The results for the storm sample in Table 6 show that the lagged aid variable is still robust after including various measures of institutional quality. Apart from the measures for democracy, $DEMOCRACY_{jt}$, none of the institutional variables appear to have an significant effect on the number of storm fatalities. The coefficients of lagged aid in the flood sample, change sign, while the coefficients in the earthquakes sub-sample do not change. Again the coefficients of lagged aid in the floods and earthquakes sub-samples are not significantly different from zero. Interestingly, the majority of institutional variables appear to have a large and significant mitigative effect against floods and earthquakes.

In Table 8 we analyse the effects of aid from different, major donor countries (France, Germany, Japan, United Kingdom and USA). We only report the coefficients for aid. The sign of the coefficients of lagged aid do not change, however, in the storm sub-sample the effect of the aid-variable from individual donor countries is not significant, while the effect for floods and earthqukes becomes significant.

These results once again point out the importance of distinguishing between different types of disasters and indicate that future research should have a closer look at the variations in forms of development by different donor nations. The remaining coefficients of lagged aid in the subsamples are not significantly different from zero. Table 9 adds a dummy for the colonial background and an interaction term with foreign aid to the baseline specification. Lagged foreign aid is no longer significant for the storm sub-sample, neither is the colony dummy nor the interaction term. In contrast to our expectations, we find some evidence that aid-flows in former colonies (interaction term between lagged aid and U.K. colony for the storm subsample and interaction term between French colony and lagged aid for the flood sub-sample) actually reduces the number of flood victims. These results could indicate that increased aid-flows due to colonial history had direct or indirect effects on disaster preparedness that outweigh the (even higher) crowding-out effect of aid-flows to former colonies.

Table 10 introduces an interaction term between the lagged aid and the institutional quality variable. As before, there is mixed evidence of the effect of aid on disaster preparedness. However, there is a general trend observable that the interaction term of lagged aid and institutional quality has a decreasing effect on disaster fatalities. These results contribute to the discussion on the relationship between institutional quality and aid effectiveness (e.g. Burnside & Dollar 2000, Easterly, Levine & Roodman 2004). In accordance with the discussion in this literature, our results appear to be rather fragile and only have explorative character. Our results are robust to the inclusion of the GINI-variable. The GINI-coefficient itself does not appear to have a significant effect on the number of disaster fatalities.

In the next step we reproduce our results using ZINB (Tables 11-17 in the appendix). Again the results differ between the sub-samples. Lagged aid seems to have an increasing effect on disaster fatalities (at least at the 10 % significance level) in the case of storms. Regarding the estimates for the flood sub-sample we find an interesting pattern: in the first stage probit, lagged aid appears to increase the probability that the number of deaths from floods is positive. However, the second stage suggests that aid has a mitigating effect on the total number of flood deaths. The estimates using the earthquake sub-sample show a similar pattern but the coefficient of aid in the second stage is not significant. We interpret these results as follows: Foreign aid flows reduce the overall extent of flood and earthquake disasters. Nevertheless, aid can also crowd-out the incentives of governments to install preventive measures or enact zoning or building codes that increase the probability of survival or, in other words, reduce the probability that a deadly disaster occurs.

This general pattern persists throughout the ZINB estimates. Reproducing the estimates with institutional quality, lagged aid and the interaction between aid and institutions shows that the overall effect of aid in either sub-sample is reduced. While in the flood subsample the lagged aid coefficient is positive the interaction term between institutional quality and aid is negative. For floods and earthquakes the relationship is mainly vice versa.

The results need to be interpreted with caution as some of the estimates did not converge.

6 Concluding Remarks

Based on the results of the existing literature on the socio-economic determinants of a country's vulnerability against catastrophic events (e.g. Anbarci et al. 2005, Kahn 2005), we analyzed the effect of foreign aid dependence on the recipient country's protection against large-scale catastrophes. Our theoretical model suggests that foreign aid can have both crowding-out and preventive effects. If the crowding-out effects outweigh the preventive effect, foreign aid in previous periods will decrease incentives to provide protective measures and ultimately lead to a higher death toll from natural disaster. The empirical section of our study provides some evidence for charity hazard on international level. Estimates using data on major storm events show that increases in the level of past foreign aid imply higher death tolls resulting from natural catastrophes. For flood disasters and major earthquakes we find some evidence that past foreign aid can increase the probability that the death toll from disasters is non-zero, however, it also reduces the total number of deaths from disasters. As we are using lagged foreign aid as an empirical proxy for anticipated catastrophe aid, it is not possible to disentangle the crowding-out effects and the positive (side-)effects of foreign aid on infrastructure and catastrophe management. The major implication for future research is that an analysis of the effects of aid on natural hazard management largely differs across types of disasters and that a better empirical proxy for the anticipation of international catastrophe aid is needed.

The major policy implication of our results is not a call for a reduction of foreign aid but rather a call for rethinking strategies for international assistance and redesigning existing aid programs. The design of transfers, foreign aid in particular, has been drawing attention in economics for a long time (e.g. Nichols 1982, Besley & Coate 1991, Coate 1995, Gahvari & Mattos 2007). The major findings of these articles are that unrestricted transfers induce people to diminish ex-ante protection activities (charity hazard) and to shirk responsibilities. In order to avoid these problems "the tying of aid" (Jepma 1991) through in-kind transfers and restricted transfers, is of interest. Although in-kind and restricted transfers reduce the above mentioned weaknesses of unrestricted aid, they are criticized for causing dead-weight-losses due to a lack of information about recipients' preferences.

However, the case of natural hazards is somehow different, since mitigation activities do not only require financial capital but also expertise. Since developing countries in particular lack this expertise, unrestricted aid will not necessarily lead to efficient targeting. Although alternative adaptation strategies require future research, the impression at first glance is that ex-ante in-kind transfers could be a possible solution in case of natural hazards, since mitigation activities are likely to reduce the extent of catastrophes and the need for ex-post relief. A lower vulnerability to catastrophic events could reduce (at least to a certain extent) developing countries' dependency on foreign aid and contribute to a more independent development of these countries. As economic research on the efficiency of in-kind transfers is far from satisfying, it requires a better understanding of the incentives created by in-kind transfers before developing alternative instruments of foreign assistance.

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Table 1: List of countries and number of natural disasters

Country	Storms	Floods	Earthquakes	Country	Storms	Floods	Earthquakes
Argentina	3	28	1	Mozambique	2	8	0
Australia	18	27	3	Nepal	0	19	3
Austria	0	7	0	New Zealand	3	23	1
Bangladesh	33	35	3	Nicaragua	3	4	3
Bolivia	0	15	2	Nigeria	0	14	0
Brazil	0	50	1	Pakistan	3	24	14
Canada	4	11	0	Panama	1	0	2
Chile	0	14	4	Papua New Guinea	2	4	6
China	21	103	57	Peru	0	25	16
Colombia	1	27	9	Philippines	47	44	10
Costa Rica	2	8	8	Portugal	1	5	0
Denmark	1	0	0	South Africa	2	16	3
Ecuador	0	8	8	Spain	4	11	1
El Salvador	2	2	4	Sri Lanka	1	28	0
France	5	28	0	Switzerland	2	5	0
Greece	0	6	15	Tanzania	0	14	1
Guatemala	1	4	7	Thailand	1	34	0
Honduras	3	11	2	Turkey	1	17	19
India	15	95	13	United Kingdom	10	13	1
Indonesia	0	62	37	United States	34	90	18
Iran	2	45	37	Venezuela	1	15	6
Ireland	1	2	0	Vietnam	8	7	0
Italy	0	0	10	**TOTAL**	289	1109	365
Japan	14	14	20				
Kenya	0	5	1				
Korea, South	6	17	0				
Madagascar	11	2	0				
Malawi	0	11	1				
Malaysia	1	13	0				
Mexico	19	26	17				

Table 2: Descriptive statistics

Obs.	Variable	Mean	Std. Dev.	Min.	Max.
Storms					
FATALITIES	289	226.723	1232.926	0.000	14600.000
AID p.c.	289	0.792	3.770	−1.022	45.062
GDP p.c.	289	10082.490	10136.190	648.365	34364.500
GINI	289	43.056	9.049	25.216	64.796
POP (in tsd.)	289	217809.900	344382.700	2745.429	1271085.000
POPDENS	289	230.988	279.104	1.976	1024.392
OPEN	289	49.772	30.740	12.672	218.796
MAGNITUDE	289	155.886	57.410	45.000	300.000
NATHAZ − RISK	289	3.566	3.187	0.000	7.855
LATITUDE	289	28.085	13.582	2.165	61.063
ELEVATION	289	601.594	449.689	34.259	1839.950
Floods					
FATALITIES	1109	125.649	956.011	0.000	30000.000
AID p.c.	1109	0.758	3.079	−1.023	33.328
GDP p.c.	1109	7496.065	8185.186	389.963	35107.520
GINI	1109	44.203	8.990	25.216	64.796
POP (in tsd.)	1109	249678.700	372010.200	2299.124	1271085.000
POPDENS	1109	131.481	162.153	1.943	972.416
OPEN	1109	45.678	29.358	9.275	228.874
MAGNITUDE	1109	1.654	1.691	0.000	8.000
NATHAZ − RISK	1109	4.282	2.528	0.026	9.854
LATITUDE	1109	25.347	14.976	0.422	61.063
ELEVATION	1109	778.552	552.312	85.476	2565.382
Earthquakes					
FATALITIES	365	381.715	2637.994	0.000	40000.000
AID p.c.	365	1.552	5.562	−0.005	40.578
GDP p.c.	365	5907.357	5978.683	482.528	35107.520
GINI	365	44.055	8.756	25.216	64.196
OPEN	365	45.020	25.089	10.418	214.423
POP (in tsd.)	365	280543.200	420309.300	2434.262	1271085.000
POPDENS	365	109.141	114.505	1.976	989.455
MAGNITUDE	365	6.159	0.881	4.000	8.000
NATHAZ − RISK	365	2.279	2.001	0.000	7.369
LATITUDE	365	25.274	14.519	0.422	53.887
ELEVATION	365	980.628	545.394	85.476	2565.382

Table 3: The determinants of disaster fatalities

	Storms		Floods		Earthquakes	
	3.1	3.2	3.3	3.4	3.5	3.6
Ln(AID_{jt-1})	0.794**		0.098		−0.960	
	(0.347)		(0.250)		(0.753)	
Ln($3yr.\ AID_{j,t-1}$)		0.761**		0.051		−0.991
		(0.308)		(0.164)		(0.744)
Ln($GDP_{j,t-1}$)	−0.552***	−0.548***	−0.135	−0.192	−0.951**	−0.969**
	(0.137)	(0.136)	(0.152)	(0.120)	(0.479)	(0.460)
Ln(POP_{jt})	0.010	0.032	0.307***	0.317***	−0.997	−0.998
	(0.307)	(0.313)	(0.116)	(0.116)	(1.120)	(1.052)
Ln($POPDENS_{jt}$)	−0.002	−0.006	−0.009	0.088	0.007	−0.006
	(0.285)	(0.282)	(0.232)	(0.192)	(0.985)	(0.920)
$OPEN_{jt}$	0.003	0.003	−0.012***	−0.013***	−0.032***	−0.035***
	(0.007)	(0.006)	(0.002)	(0.002)	(0.012)	(0.011)
$MAGNITUDE_{ijt}$	0.012***	0.012***	0.420***	0.430***	2.283***	2.266***
	(0.003)	(0.003)	(0.126)	(0.126)	(0.281)	(0.282)
$NATHAZ-RISK_j$	−0.179**	−0.179**	0.168	0.129	0.060	0.092
	(0.075)	(0.074)	(0.168)	(0.091)	(0.327)	(0.292)
$LATITUDE_j$	−0.014	−0.014	−0.034***	−0.028**	0.019	0.017
	(0.017)	(0.017)	(0.012)	(0.009)	(0.091)	(0.080)
$ELEVATION_j$	−0.001***	−0.001***	0.001***	0.001***	−0.001**	−0.001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
Obs.	292	292	1125	1125	367	367
Log pseudolikelihood	-1388.273	-1388.273	-5013.813	-5077.955	-1445.147	-1444.850
Prob>χ^2	0.000	0.000	0.000	0.000	0.000	0.000

Notes: Negative binomial estimates. Dependent variable is $DEATH_{ijt}$. Standard errors (in parentheses) are adjusted for clustering on country-level. Continent dummies, time trend and constant term included in all specifications. ***, **, * indicate significance at the 1, 5 and 10%-level, respectively.

Table 4: The determinants of disaster fatalities - IV-estimates

	Storms	Floods	Earthquakes
$\text{Ln}(AID_{j,t-1})$	0.885***	0.402	−0.627
	(0.343)	(0.985)	(1.230)
$\text{Ln}(GDP_{j,t-1})$	−0.164*	−0.190	−1.018**
	(0.090)	(0.248)	(0.403)
$GINI_{jt}$	−0.020	−0.019	−0.030
	(0.021)	(0.015)	(0.043)
$\text{Ln}(POP_{jt})$	0.218	0.492	−0.322
	(0.252)	(0.334)	(0.811)
$\text{Ln}(POPDENS_{jt})$	−0.013	0.015	−0.458
	(0.151)	(0.226)	(0.481)
$OPEN_{jt}$	0.004	−0.005	−0.015
	(0.006)	(0.004)	(0.012)
$MAGNITUDE_{ijt}$	0.006***	0.080*	1.215***
	(0.002)	(0.041)	(0.214)
$NATHAZ - RISK_j$	−0.003	0.126	0.330
	(0.063)	(0.097)	(0.271)
$LATITUDE_j$	−0.026*	−0.015	0.032
	(0.015)	(0.011)	(0.037)
$ELEVATION_j$	−0.044*	0.106***	−0.151***
	(0.026)	(0.018)	(0.053)
Obs.	235	647	187
Centered R^2	0.366	0.383	0.316
Prob>F	0.000	0.000	0.000
Hansen's J-stat	0.499	0.238	0.823
F-Stat 1^{st} stage	54.10***	10.87***	15.52***
Shea's R^2	0.500	0.080	0.269

Notes: IV-estimates. Dependent variable is $\text{Ln}(1 + DEATH_{ijt})$. Dummy whether the country has ever been a colony, $COLONY_j$, corruption control, $CORR\ CONT_{jt}$, and the 2^{nd} and 3^{rd} lag of military expenditure, $MILITARY\ EXP_{jt}$, are used as additional instruments. Standard errors (in parentheses) are adjusted for clustering on country-level. Continent dummies, time trend and constant term included in all specifications. ***, **, * indicate significance at the 1, 5 and 10%-level, respectively.

Table 5: Storm fatalities and institutional quality

	5.1	5.2	5.3	5.4	5.5	5.6	5.7
Ln($AID_{j,t-1}$)	0.784**	0.817**	0.726**	0.833*	0.767**	0.772**	1.075***
	(0.342)	(0.353)	(0.307)	(0.442)	(0.332)	(0.329)	(0.345)
Ln($GDP_{j,t-1}$)	−0.673***	−0.667***	−0.627***	−0.577***	−0.658***	−0.372**	−0.208*
	(0.169)	(0.152)	(0.138)	(0.129)	(0.175)	(0.160)	(0.115)
$CORR\ CONT_{jt}$	0.474						
	(0.485)						
$GOV\ EFF_{jt}$		0.389					
		(0.304)					
$POL\ STAB_{jt}$			0.532*				
			(0.202)				
$REG\ QAL_{jt}$				0.123			
				(0.572)			
$RULE\ LAW_{jt}$					0.269		
					(0.419)		
$VOICE\ ACC_{jt}$						−0.454	
						(0.373)	
$DEMOCRACY_{jt}$							−0.116***
							(0.025)
Ln(POP_{jt})	0.048	0.054	0.016	−0.001	−0.003	−0.081	−0.032
	(0.315)	(0.307)	(0.322)	(0.296)	(0.308)	(0.295)	(0.209)
Ln($POPDENS_{jt}$)	0.102	0.047	0.227	0.015	0.048	0.032	0.279
	(0.236)	(0.250)	(0.262)	(0.282)	(0.260)	(0.246)	(0.170)
$OPEN_{jt}$	0.001	0.000	0.001	0.002	0.002	0.001	0.005
	(0.006)	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)	(0.005)
$MAGNITUDE_{ijt}$	0.012***	0.012***	0.013***	0.012***	0.012***	0.013***	0.012***
	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)	(0.002)	(0.002)
$NATHAZ\ RISK_j$	−0.200**	−0.178**	−0.208**	−0.189**	−0.168**	−0.188***	−0.225***
	(0.081)	(0.074)	(0.066)	(0.075)	(0.079)	(0.071)	(0.079)
$LATITUDE_j$	−0.031	−0.027	−0.034**	−0.015	−0.020	−0.018	−0.037***
	(0.028)	(0.020)	(0.016)	(0.020)	(0.020)	(0.014)	(0.011)
$ELEVATION_j$	−0.001***	−0.001***	−0.001***	−0.001***	−0.001***	−0.002***	−0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Obs.	292	292	292	292	292	292	292
Log pseudolikelihood	-1387.450	-1387.637	-1386.003	-1388.219	-1388.010	-1387.101	-1377.600
Prob>χ^2	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes: Negative binomial estimates. Dependent variable is $DEATH_{ijt}$. Standard errors (in parentheses) are adjusted for clustering on country-level. Continent dummies, time trend and constant term included in all specifications. ***, **, * indicate significance at the 1, 5 and 10%-level, respectively.

Table 6: Flood fatalities and institutional quality

	6.1	6.2	6.3	6.4	6.5	6.6	6.7
Ln($AID_{j,t-1}$)	−0.438	−0.334	−0.454	−0.371	−0.262	−0.334	−0.417
	(0.287)	(0.273)	(0.366)	(0.266)	(0.279)	(0.307)	(0.352)
Ln($GDP_{j,t-1}$)	−0.032	−0.004	−0.332*	−0.144	−0.141	−0.131	−0.267*
	(0.130)	(0.154)	(0.175)	(0.147)	(0.134)	(0.146)	(0.154)
$CORR\ CONT_{jt}$	−1.183***						
	(0.321)						
$GOV\ EFF_{jt}$		−1.014***					
		(0.295)					
$POL\ STAB_{jt}$			0.216				
			(0.235)				
$REG\ QAL_{jt}$				−0.946**			
				(0.445)			
$RULE\ LAW_{jt}$					−0.770***		
					(0.153)		
$VOICE\ ACC_{jt}$						−0.481*	
						(0.157)	
$DEMOCRACY_{jt}$							−0.010
							(0.024)
Ln(POP_{jt})	0.268	0.378**	0.151	0.341*	0.367**	0.218	0.193
	(0.163)	(0.189)	(0.209)	(0.174)	(0.170)	(0.171)	(0.197)
Ln($POPDENS_{jt}$)	0.306	0.201	0.112	0.251	0.077	0.078	0.086
	(0.304)	(0.261)	(0.299)	(0.290)	(0.277)	(0.273)	(0.292)
$OPEN_{jt}$	−0.007	0.006	−0.014***	−0.006	−0.010**	−0.013***	−0.012***
	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)
$MAGNITUDE_{ijt}$	0.090**	0.107**	0.120**	0.091*	0.119**	0.135**	0.125**
	(0.043)	(0.049)	(0.054)	(0.046)	(0.051)	(0.056)	(0.056)
$NATHAZ\ RISK_j$	0.077	0.109	0.169	0.151	0.192	0.229*	0.184
	(0.110)	(0.101)	(0.143)	(0.109)	(0.120)	(0.132)	(0.0141)
$LATITUDE_j$	−0.001	−0.014	−0.048***	−0.033**	−0.023	−0.035**	−0.043***
	(0.017)	(0.015)	(0.018)	(0.013)	(0.015)	(0.015)	(0.016)
$ELEVATION_j$	0.001***	0.001***	0.001***	0.001***	0.001***	0.001**	0.001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Obs.	1125	1125	1125	1125	1125	1125	1125
Log pseudolikelihood	-5093.929	-5103.844	-5123.730	-5101.884	-5108.906	-5119.118	-5124.959
Prob>χ^2	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes: Negative binomial estimates. Dependent variable is $DEATH_{ijt}$. Standard errors (in parentheses) are adjusted for clustering on country-level. Continent dummies, time trend and constant term included in all specifications. ***, **, * indicate significance at the 1, 5 and 10%-level, respectively.

Table 7: Earthquake fatalities and institutional quality

	7.1	7.2	7.3	7.4	7.5	7.6	7.7
$\text{Ln}(AID_{j,t-1})$	−0.220	−0.524	−0.686	−0.275	−0.635	−1.028	−1.204**
	(0.531)	(0.418)	(0.979)	(0.453)	(0.823)	(0.991)	(0.501)
$\text{Ln}(GDP_{j,t-1})$	−0.372	−0.093	−0.413	−0.564*	−0.739	−0.970*	−0.981***
	(0.394)	(0.286)	(0.442)	(0.317)	(0.608)	(0.516)	(0.259)
$CORR\ CONT_{jt}$	−1.371*						
	(0.738)						
$GOV\ EFF_{jt}$		−1.999***					
		(0.503)					
$POL\ STAB_{jt}$			−1.226				
			(0.309)				
$REG\ QAL_{jt}$				−1.376***			
				(0.411)			
$RULE\ LAW_{jt}$					−0.550		
					(0.727)		
$VOICE\ ACC_{jt}$						0.099	
						(0.490)	
$DEMOCRACY_{jt}$							0.128***
							(0.027)
$\text{Ln}(POP_{jt})$	−0.258	0.112	−0.849	0.462	−0.718	−0.998	−0.947*
	(0.686)	(0.462)	(0.656)	(0.703)	(1.260)	(1.084)	(0.550)
$\text{Ln}(POPDENS_{jt})$	−0.210	−0.041	0.286	−0.222	−0.021	0.004	−0.003
	(0.565)	(0.426)	(0.681)	(0.577)	(1.031)	(0.941)	(0.489)
$OPEN_{jt}$	−0.036***	−0.029***	−0.028***	−0.023**	−0.034***	−0.031**	−0.020*
	(0.011)	(0.009)	(0.010)	(0.009)	(0.011)	(0.014)	(0.011)
$MAGNITUDE_{ijt}$	2.174***	2.164***	2.210***	2.269***	2.272***	2.282***	2.332***
	(0.302)	(0.307)	(0.295)	(0.300)	(0.291)	(0.281)	(0.247)
$NATHAZ\ RISK_j$	0.198	0.159	−0.065	0.633**	0.095	0.064	−0.042
	(0.223)	(0.169)	(0.330)	(0.248)	(0.340)	(0.314)	(0.226)
$LATITUDE_j$	0.026	0.021	0.046	−0.020	0.023	0.018	0.014
	(0.064)	(0.040)	(0.058)	(0.052)	(0.094)	(0.086)	(0.040)
$ELEVATION_j$	−0.002**	−0.002***	−0.001**	−0.001*	−0.002**	−0.001	−0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Obs.	367	367	367	367	367	367	367
Log pseudolikelihood	-1441.739	-1435.797	-1440.266	-1436.581	-1444.365	-1445.120	-1439.325
Prob>χ^2	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes: Negative binomial estimates. Dependent variable is $DEATH_{ijt}$. Standard errors (in parentheses) are adjusted for clustering on country-level. Continent dummies, time trend and constant term included in all specifications. ***, **, * indicate significance at the 1, 5 and 10%-level, respectively.

Table 8: Disaster fatalities and aid from different donor countries

	Storms	Floods	Earthquakes
Ln($FRENCH\ AID_{j,t-1}$)	0.789	0.136	−2.723***
	(0.616)	(0.496)	(0.923)
Ln($GERMAN\ AID_{j,t-1}$)	0.513	−0.566***	−1.038*
	(0.437)	(0.215)	(0.562)
Ln($JAPANESE\ AID_{j,t-1}$)	0.102	−0.429**	−1.236***
	(0.148)	(0.170)	(0.231)
Ln($UK\ AID_{j,t-1}$)	−0.538	−0.662**	0.375
	(0.418)	(0.302)	(1.568)
Ln($USA\ AID_{j,t-1}$)	−0.053	−0.690**	−0.957**
	(0.272)	(0.271)	(0.441)

Notes: Negative binomial estimates. Dependent variable is $DEATH_{ijt}$. Standard errors (in parentheses) are adjusted for clustering on country-level. Covariates from the baseline specification (equation (5)), continent dummies, time trend and constant term included in all specifications. ***, **, * indicate significance at the 1, 5 and 10%-level, respectively.

Table 9: Disaster fatalities, aid and colonial background

	Storms	Floods	Earthquakes
Ln($AID_{j,t-1}$)	0.644	−0.262	0.029
	(0.412)	(0.605)	(0.634)
($COLONY_j$)	0.275	−0.115	2.897**
	(0.641)	(0.509)	(1.246)
($COLONY_j * AID_{j,t-1}$)	0.380	−0.299	−1.027
	(0.501)	(0.487)	(0.657)
Ln($FRENCH\ AID_{jt-1}$)	−1.379	0.152	−2.650
	(0.501)	(0.312)	(0.866)
($FRENCH\ COLONY_{j,t-1}$)	1.207***	−0.421	*n.a.*
	(0.291)	(0.243)	
($FRENCH\ COLONY_j * AID_{j,t-1}$)	−1.303	−4.400***	*n.a.*
	(0.927)	(0.390)	
Ln($UK\ AID_{j,t-1}$)	0.266	−0.712*	−1.019
	(0.469)	(0.387)	(2.019)
($UK\ COLONY_{j,t-1}$)	0.005	−0.633*	−0.148
	(0.445)	(0.373)	(1.490)
($UK\ COLONY_j * AID_{jt-1}$)	−2.430***	0.077	4.078
	(0.800)	(0.402)	(3.303)

Notes: Negative binomial estimates. Dependent variable is $DEATH_{ijt}$. Standard errors (in parentheses) are adjusted for clustering on country-level. Covariates from the baseline specification (equation (5)), continent dummies, time trend and constant term included in all specifications. ***, **, * indicate significance at the 1, 5 and 10%-level, respectively.

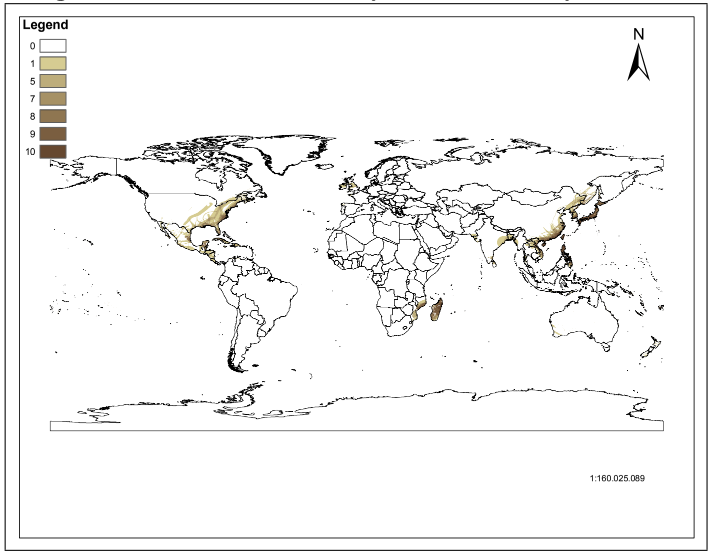
Table 10: Disaster fatalities, aid and institutional quality

	Storms	Floods	Earthquakes
$\text{Ln}(AID_{j,t-1})$	0.687	−0.144	−0.567
	(0.546)	(0.122)	(0.716)
$CORR\ CONT_{jt}$	0.517	−1.163***	−1.683*
	(0.524)	(0.382)	(0.867)
$(CORR\ CONT_{jt} * AID_{j,t-1})$	−0.186	−0.054	0.915
	(0.573)	(0.274)	(0.753)
$\text{Ln}(AID_{j,t-1})$	0.288	−0.297	−0.296
	(0.500)	(0.329)	(0.353)
$GOV\ EFF_{jt}$	0.537	−1.033***	−2.199***
	(0.430)	(0.320)	(0.510)
$(GOV\ EFF_{jt} * AID_{j,t-1})$	−1.015	0.072	−0.403
	(1.103)	(0.335)	(0.304)
$\text{Ln}(AID_{j,t-1})$	1.133**	−0.523	0.263
	(0.440)	(0.522)	(0.493)
$POL\ STAB_{jt}$	0.354	0.264	−2.939***
	(0.322)	(0.363)	(0.790)
$(POL\ STAB_{jt} * AID_{j,t-1})$	0.496	−0.097	1.968***
	(0.320)	(0.443)	(0.599)
$\text{Ln}(AID_{jt-1})$	0.842*	−0.362	−0.608
	(0.481)	(0.279)	(0.586)
$REG\ QAL_{jt}$	0.120	−1.084*	−1.713***
	(0.618)	(0..568)	(0.436)
$REG\ QAL_{jt} * AID_{j,t-1})$	0.011	0.340	1.299*
	(0.732)	(0.400)	(0.786)
$\text{Ln}(AID_{j,t-1})$	−0.092	−0.613**	−0.805
	(0..687)	(0.247)	(0.927)
$RULE\ LAW_{jt}$	0.552	−0.608**	−0.903
	(0.433)	(0.257)	(0.957)
$(RULE\ LAW_{jt} * AID_{j,t-1})$	−1.143	−0.681**	1.060
	(0.791)	(0.293)	(0.952)
$\text{Ln}(AID_{j,t-1})$	0.831***	−0.359	−1.958
	(0.304)	(0.328)	(1.341)
$VOICE\ ACC_{jt}$	−0.301	−0.501*	0.051
	(0.408)	(0.300)	(0.642)
$(VOICE\ ACC_{jt} * AID_{j,t-1})$	−0.532	−0.196	0.943
	(0.572)	(0.765)	(0.817)
$\text{Ln}(AID_{jt-1})$	0.814*	−0.483	−2.959***
	(0.465)	(0.447)	(0.478)
$DEMOCRACY_{jt}$	−0.125***	−0.012	0.099***
	(0.054)	(0.026)	(0.030)
$(DEMOCRACY_{jt} * AID_{j,t-1})$	0.039	0.010	0.181
	(0.054)	(0.033)	(0.053)

Notes: Negative binomial estimates. Dependent variable is $DEATH_{ijt}$. Standard errors (in parentheses) are adjusted for clustering on country-level. Covariates from the baseline specification (equation (5)), continent dummies, time trend and constant term included in all specifications. ***, **, * indicate significance at the 1, 5 and 10%-level, respectively.

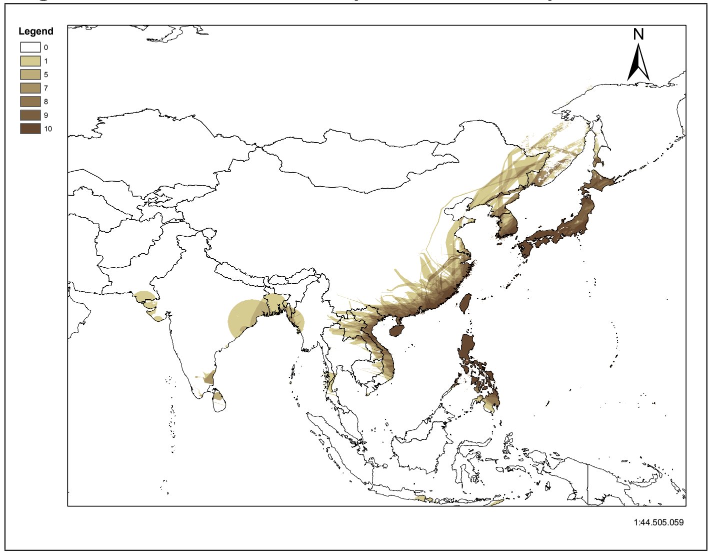
A Appendix

Figure 1: Distribution of Cyclone Mortality - World



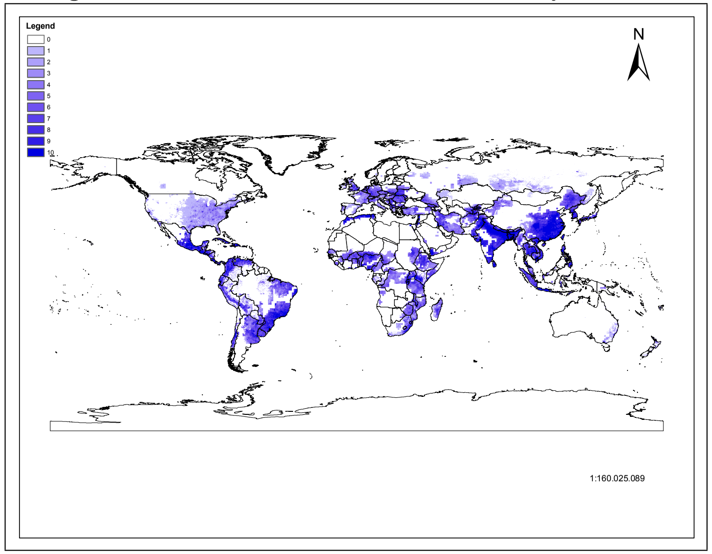
Data source: Dilley et al. (2005)

Figure 2: Distribution of Cyclone Mortality risk - Asia



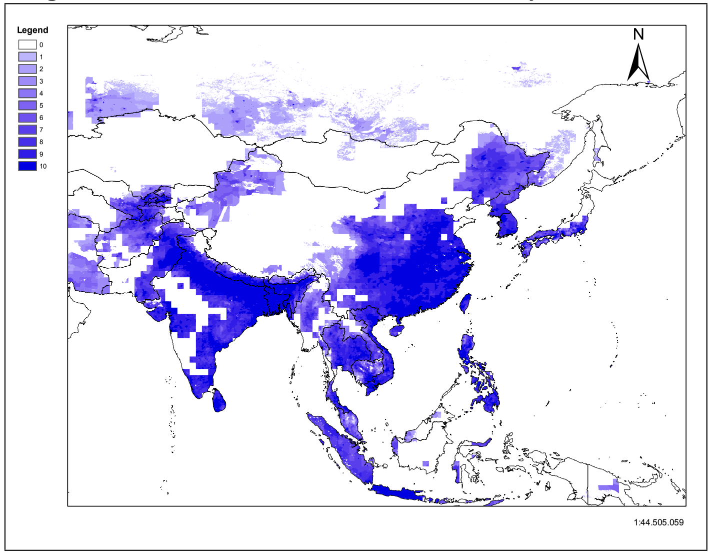
Data source: Dilley et al. (2005)

Figure 3: Distribution of Flood Mortality - World



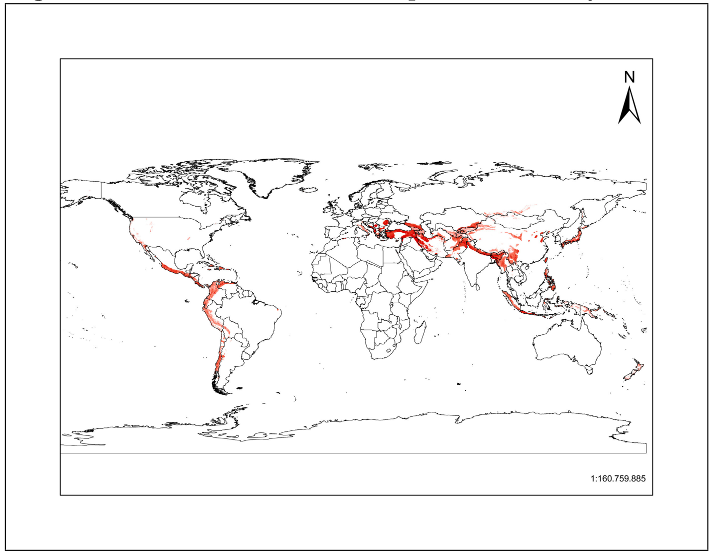
Data source: Dilley et al. (2005)

Figure 4: Distribution of Flood Mortality Risk - Asia



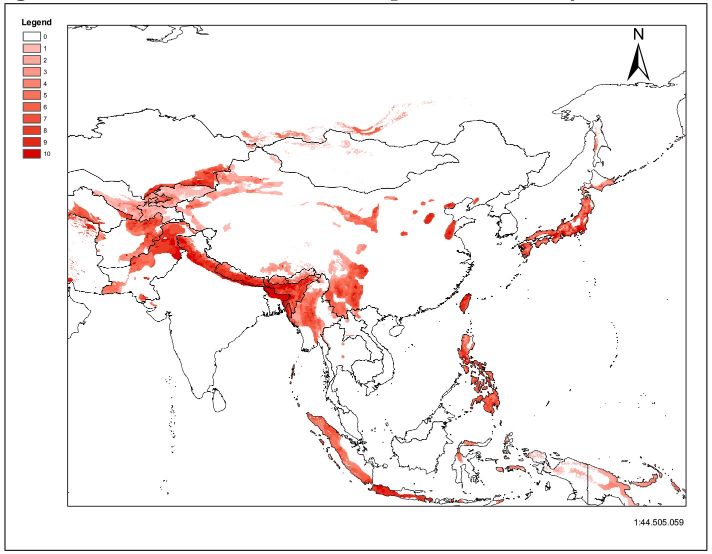
Data source: Dilley et al. (2005)

Figure 5: Distribution of Earthquake Mortality - World



Data source: Dilley et al. (2005)

Figure 6: Distribution of Earthquake Mortality risk - Asia



Data source: Dilley et al. (2005)

Table 11: The determinants of disaster fatalities - ZINB

	Storms		Floods		Earthquakes	
	11.1	11.2	11.3	11.4	11.5	11.6
Ln($AID_{j,t-1}$)	0.252*		−0.263**		−0.344	
	(0.133)		(0.116)		(0.263)	
Ln(3yr. $AID_{j,t-1}$)		0.229*		−0.319**		−0.338
		(0.125)		(0.136)		(0.312)
Ln($GDP_{j,t-1}$)	−0.690***	−0.729***	−0.542***	−0.605***	−0.406	−0.528
	(0.260)	(0.887)	(0.215)	(0.203)	(0.745)	(0.863)
$GINI_{jt}$	−0.010	−0.015	−0.033*	−0.032*	−0.002	−0.001
	(0.022)	(0.023)	(0.017)	(0.018)	(0.033)	(0.036)
Ln(POP_{jt})	0.703***	0.746***	0.196	0.215	0.341	0.420
	(0.134)	(0.138)	(0.138)	(0.145)	(0.333)	(0.335)
Ln($POPDENS_{jt}$)	−0.049	−0.075	−0.076	−0.104	−0.855**	−0.883**
	(0.146)	(0.147)	(0.131)	(0.149)	(0.373)	(0.374)
$OPEN_{jt}$	0.004	0.006	−0.003	−0.002	−0.002	−0.001
	(0.005)	(0.005)	(0.004)	(0.004)	(0.012)	(0.014)
$DISASTERS_{jt}$	0.097**	0.090**	0.384***	0.336***	0.028	0.023
	(0.0437)	(0.0407)	(0.128)	(0.127)	(0.219)	(0.239)
$NATHAZ-RISK_j$	0.934***	0.982***	0.352*	0.345*	2.093**	2.126**
	(0.207)	(0.215)	(0.186)	(0.202)	(0.875)	(0.943)
1^{st} stage Probit model						
Ln($AID_{j,t-1}$)	−0.165		−0.376**		−0.483**	
	(0.133)		(0.174)		(0.219)	
Ln(3yr. $AID_{j,t-1}$)		−0.070		−0.293		−0.925**
		(0.165)		(0.184)		(0.417)
Ln($GDP_{j,t-1}$)	−0.107	−0.066	−0.473**	−0.308	0.249	−0.528
	(0.321)	(0.887)	(0.215)	(0.233)	(0.353)	(1.051)
Ln(POP_{jt})	−0.446***	−0.385*	−0.598***	−0.557***	−0.063	−0.872**
	(0.138)	(0.232)	(0.178)	(0.210)	(0.337)	(0.425)
$DISASTERS_{jt}$	−8.916***	−10.150	−8.363***	−8.163***	−12.330***	−17.410***
	(1.115)	(8.761)	(0.702)	(0.661)	(2.826)	(5.295)
$NATHAZ-RISK_j$	0.0530	0.288	−0.163	−0.159	1.470	1.446**
	(0.207)	(0.215)	(0.186)	(0.202)	(0.875)	(0.943)
Obs.	2186	1978	2174	1966	2186	1978
Nonzero obs.	430	403	605	560	197	177
Log Pseudolikelihood	-2468.351	-2282.336	-3614.626	-3307.053	-1200.485	-1080.443
Prob>chi^2	0.000	0.000	0.000	0.000	0.000	0.000
Vuong Test (z-value)[a]	14.21***	14.05***	16.55***	16.36***	7.22***	6.97***

Notes: ZINB-estimates. Dependent variable is $DEATH_{ijt}$. Standard errors (in parentheses) are adjusted for clustering on country-level. The 1^{st} stage probit regression estimates the probability that nobody in nation j and year t died from the specific natural disaster. The 2^{nd} stage negative-binomial estimates the number of disaster deaths. Continent dummies, time trend and constant term included in all 2^{nd} stage negative-binomial specifications. ***, **, * indicate significance at the 1, 5 and 10%-level, respectively. [a]The test compares the ZINB with a negative binomial model and selects the one that is closest to the true conditional distribution (Vuong 1989).

Table 12: The determinants of Storm fatalities and Institutions - ZINB

	12.1	12.2	12.3	12.4	12.5	12.6	12.7^b
$\text{Ln}(AID_{j,t-1})$	0.239*	0.230*	0.205	0.249*	0.243*	0.258*	0.162
	(0.143)	(0.135)	(0.147)	(0.135)	(0.140)	(0.137)	(0.132)
$\text{Ln}(GDP_{j,t-1})$	−0.656**	−0.576**	−0.572**	−0.668**	−0.650**	−0.717***	−0.203
	(0.260)	(0.281)	(0.236)	(0.271)	(0.260)	(0.261)	(0.687)
$CORR\ CONT_{jt}$	−0.087						
	(0.210)						
$GOV\ EFF_{jt}$		−0.215					
		(0.224)					
$POL\ STAB_{jt}$			−0.425				
			(0.263)				
$REG\ QAL_{jt}$				−0.062			
				(0.259)			
$RULE\ LAW_{jt}$					−0.073		
					(0.200)		
$VOICE\ ACC_{jt}$						0.059	
						(0.193)	
$DEMOCRACY_{jt}$							−0.003
							(0.021)
$GINI_{jt}$	−0.011	−0.013	−0.014	−0.010	−0.011	−0.010	−0.037
	(0.022)	(0.022)	(0.021)	(0.022)	(0.022)	(0.022)	(0.028)
$\text{Ln}(POP_{jt})$	0.706***	0.712***	0.671***	0.704***	0.702***	0.707***	0.094
	(0.134)	(0.137)	(0.134)	(0.133)	(0.134)	(0.135)	(0.214)
$DISASTERS_{jt}$	0.101**	0.107**	0.125**	0.0981**	0.100**	0.0957**	0.162***
	(0.046)	(0.043)	(0.052)	(0.044)	(0.043)	(0.044)	(0.052)
$NATHAZ-RISK_j$	0.947***	0.919***	0.997***	0.934***	0.930***	0.923***	0.764
	(0.208)	(0.201)	(0.236)	(0.204)	(0.205)	(0.207)	(0.469)
1^{st} stage Probit model							
$\text{Ln}(AID_{j,t-1})$	−0.161	−0.156	−0.164	−0.165	−0.164	−0.167	−0.135
	(0.132)	(0.129)	(0.132)	(0.132)	(0.132)	(0.133)	(0.438)
$\text{Ln}(GDP_{j,t-1})$	−0.111	−0.104	−0.132	−0.108	−0.110	−0.104	0.205
	(0.316)	(0.311)	(0.319)	(0.316)	(0.315)	(0.319)	(6.521)
$\text{Ln}(POP_{jt})$	−0.446***	−0.449***	−0.413***	−0.445***	−0.446***	−0.445***	−0.570
	(0.140)	(0.138)	(0.153)	(0.137)	(0.139)	(0.135)	(1.446)
$DISASTERS_{jt}$	−8.764***	−9.271***	−8.951***	−8.985***	−9.018***	−8.820***	−11.920
	(1.149)	(1.174)	(1.097)	(1.106)	(1.127)	(1.076)	
$NATHAZ-RISK_j$	0.061	0.060	0.037	0.051	0.054	0.047	0.036
	(0.304)	(0.295)	(0.286)	(0.291)	(0.294)	(0.288)	(2.202)
Obs.	2186	2186	2186	2186	2186	2186	2118
Nonzero obs.	430	430	430	430	430	430	425
Log Pseudolikelihood	-2468.210	-2467.615	-2465.740	-2468.301	-2468.258	-2468.28	-2466.052
Prob>chi^2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Vuong Test (z-value)^a	14.28***	14.21***	14.56***	14.24***	14.23***	14.20***	13.99***

Notes: ZINB-estimates. Dependent variable is $DEATH_{ijt}$. Standard errors (in parentheses) are adjusted for clustering on country-level. The 1^{st} stage probit regression estimates the probability that nobody in nation j and year t died from the specific natural disaster. The 2^{nd} stage negative-binomial estimates the number of disaster deaths. Continent dummies, time trend and constant term included in all 2^{nd} stage negative-binomial specifications. ***, **, * indicate significance at the 1, 5 and 10%-level, respectively. ^{a}The test compares the ZINB with a negative binomial model and selects the one that is closest to the true conditional distribution (Vuong 1989). ^{b}indicates that ZINB model did not converge.

Table 13: The determinants of Flood fatalities and Institutions - ZINB

	13.1	13.2	13.3	13.4	13.5	13.6	13.7
Ln($AID_{j,t-1}$)	−0.344***	−0.321***	−0.292**	−0.187*	−0.298**	−0.260**	−0.216*
	(0.119)	(0.110)	(0.121)	(0.102)	(0.117)	(0.115)	(0.130)
Ln($GDP_{j,t-1}$)	−0.273	−0.192	−0.499***	−0.296*	−0.262	−0.381**	−0.452***
	(0.166)	(0.179)	(0.164)	(0.154)	(0.166)	(0.164)	(0.159)
$CORR\ CONT_{jt}$	−0.807***						
	(0.219)						
$GOV\ EFF_{jt}$		−0.846***					
		(0.213)					
$POL\ STAB_{jt}$			−0.318*				
			(0.174)				
$REG\ QAL_{jt}$				−0.696***			
				(0.221)			
$RULE\ LAW_{jt}$					−0.631***		
					(0.194)		
$VOICE\ ACC_{jt}$						−0.376**	
						(0.191)	
$DEMOCRACY_{jt}$							−0.021
							(0.0204)
$GINI_{jt}$	−0.024	−0.025	−0.036**	−0.031*	−0.027*	−0.028	−0.031*
	(0.016)	(0.017)	(0.017)	(0.017)	(0.016)	(0.017)	(0.017)
Ln(POP_{jt})	0.164	0.264*	0.150	0.288**	0.191	0.172	0.207
	(0.149)	(0.150)	(0.150)	(0.142)	(0.147)	(0.142)	(0.138)
$DISASTERS_{jt}$	0.314***	0.314***	0.403***	0.339***	0.343***	0.358***	0.372***
	(0.109)	(0.114)	(0.124)	(0.111)	(0.114)	(0.124)	(0.128)
$NATHAZ-RISK_j$	0.239	0.321**	0.372**	0.340**	0.344**	0.451**	0.391**
	(0.166)	(0.157)	(0.169)	(0.168)	(0.171)	(0.183)	(0.177)
1^{st} stage Probit model							
Ln($AID_{j,t-1}$)	−0.306*	−0.306*	−0.371**	−0.327*	−0.332*	−0.370**	−0.417**
	(0.171)	(0.175)	(0.182)	(0.170)	(0.173)	(0.171)	(0.200)
Ln($GDP_{j,t-1}$)	−0.402*	−0.398*	−0.457**	−0.454**	−0.436**	−0.470**	−0.488**
	(0.223)	(0.227)	(0.222)	(0.219)	(0.217)	(0.212)	(0.218)
Ln(POP_{jt})	−0.513***	−0.515***	−0.590***	−0.546***	−0.554***	−0.591***	−0.613***
	(0.194)	(0.196)	(0.186)	(0.180)	(0.188)	(0.178)	(0.199)
$DISASTERS_{jt}$	−8.038***	−8.006***	−8.330***	−8.153***	−8.182***	−8.305***	−8.472***
	(0.660)	(0.703)	(0.739)	(0.684)	(0.700)	(0.700)	(0.837)
$NATHAZ-RISK_j$	−0.175	−0.151	−0.149	−0.167	−0.161	−0.148	−0.124
	(0.156)	(0.158)	(0.169)	(0.164)	(0.161)	(0.166)	(0.185)
Obs.	2174	2174	2174	2174	2174	2174	2106
Nonzero obs.	605	605	605	605	605	605	601
Log Pseudolikelihood	-3595.895	-3596.888	-3609.905	-3601.927	-3602.016	-3609.569	-3588.584
Prob>chi^2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Vuong Test (z-value)[a]	16.34***	16.27***	16.68***	16.43***	16.38***	16.37***	16.57***

Notes: ZINB-estimates. Dependent variable is $DEATH_{ijt}$. Standard errors (in parentheses) are adjusted for clustering on country-level. The 1^{st} stage probit regression estimates the probability that nobody in nation j and year t died from the specific natural disaster. The 2^{nd} stage negative-binomial estimates the number of disaster deaths. Continent dummies, time trend and constant term included in all 2^{nd} stage negative-binomial specifications. ***, **, * indicate significance at the 1, 5 and 10%-level, respectively. [a]The test compares the ZINB with a negative binomial model and selects the one that is closest to the true conditional distribution (Vuong 1989).

Table 14: The determinants of Earthquake fatalities and Institutions - ZINB

	14.1	14.2	14.3	14.4	14.5	15.6	14.7
$\text{Ln}(AID_{j,t-1})$	−0.448***	−0.425***	−0.545**	−0.158	−0.449***	−0.294	−0.288
	(0.174)	(0.157)	(0.269)	(0.246)	(0.173)	(0.275)	(0.308)
$\text{Ln}(GDP_{j,t-1})$	0.479	0.795***	0.100	0.003	0.344	−0.125	−0.273
	(0.321)	(0.230)	(0.485)	(0.675)	(0.367)	(0.832)	(0.852)
$CORR\ CONT_{jt}$	−1.423***						
	(0.369)						
$GOV\ EFF_{jt}$		−1.996***					
		(0.297)					
$POL\ STAB_{jt}$			−1.062				
			(0.665)				
$REG\ QAL_{jt}$				−1.044***			
				(0.293)			
$RULE\ LAW_{jt}$					−1.305***		
					(0.310)		
$VOICE\ ACC_{jt}$						−0.284	
						(0.540)	
$DEMOCRACY_{jt}$							−0.014
							(0.064)
$GINI_{jt}$	0.012	−0.003	0.001	−0.012	−0.019	−0.010	−0.010
	(0.026)	(0.020)	(0.028)	(0.043)	(0.027)	(0.034)	(0.037)
$\text{Ln}(POP_{jt})$	0.101	0.384*	−0.193	0.609*	0.230	0.390	0.432
	(0.297)	(0.207)	(0.513)	(0.348)	(0.271)	(0.341)	(0.345)
$DISASTERS_{jt}$	0.127	0.110	0.0966	0.218	0.105	−0.0118	0.0210
	(0.232)	(0.200)	(0.212)	(0.303)	(0.256)	(0.232)	(0.223)
$NATHAZ-RISK_j$	0.999	1.075**	0.925	1.921*	1.324**	2.090**	2.263**
	(0.722)	(0.496)	(1.138)	(0.984)	(0.668)	(0.929)	(0.919)
1^{st} stage Probit model							
$\text{Ln}(AID_{j,t-1})$	−0.447	−0.443**	−0.554	−0.459	−0.461**	−0.490	−0.425
	(0.979)	(0.214)	(0.398)	(0.451)	(0.206)	(0.510)	(0.576)
$\text{Ln}(GDP_{j,t-1})$	0.584	0.423	0.925	0.766	0.314	0.851	0.746
	(1.811)	(0.397)	(0)	(0)(0.365)	(0)	(0)	
$\text{Ln}(POP_{jt})$	−0.150	−0.115	−0.316	−0.199	−0.0789	−0.247	−0.195
	(1.413)	(0.226)	(0.302)	(0.353)	(0.276)	(0.387)	(0.440)
$DISASTERS_{jt}$	−10.94	−10.36***	−12.26***	−11.01***	−10.83***	−12.00***	−12.07***
	(0)	(0.823)	(1.832)	(1.541)	(1.561)	(1.953)	(1.708)
$NATHAZ-RISK_j$	1.143	1.146***	1.104**	1.116***	1.319*	1.096***	1.165***
	(0.955)	(0.407)	(0.437)	(0.398)	(0.674)	(0.364)	(0.392)
Obs.	2186	2186	2186	2186	2186	2186	2118
Nonzero obs.	197	197	197	197	197	197	197
Log Pseudolikelihood	-1194.289	-1186.551	-1198.308	-1195.723	-1194.314	-1200.931	-1201.144
Prob>chi^2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Vuong Test (z-value)^a	7.30***	7.33***	7.09***	7.52***	7.28***	7.13***	7.13***

Notes: ZINB-estimates. Dependent variable is $DEATH_{ijt}$. Standard errors (in parentheses) are adjusted for clustering on country-level. The 1^{st} stage probit regression estimates the probability that nobody in nation j and year t died from the specific natural disaster. The 2^{nd} stage negative-binomial estimates the number of disaster deaths. Continent dummies, time trend and constant term included in all 2^{nd} stage negative-binomial specifications. ***, **, * indicate significance at the 1, 5 and 10%-level, respectively. ^{a}The test compares the ZINB with a negative binomial model and selects the one that is closest to the true conditional distribution (Vuong 1989).

Table 15: Disaster fatalities and aid from different donor countries - ZINB

	Storms		Floods		Earthquakes	
	Coeff.	ZI Probit	Coeff.	ZI Probit	Coeff.	ZI Probit
Ln($FRENCH\ AID_{j,t-1}$)	−0.100	−0.153	0.008	−0.123	1.011[a]	−0.090
	(0.423)	(0.535)	(0.248)	(0.219)	(0.814)	(1.787)
Ln($GERMAN\ AID_{j,t-1}$)	0.371	−0.342	−0.337***	−0.428***	−1.475***	−1.117
	(0.229)	(0.787)	(0.117)	(0.164)	(0.354)	(1.140)
Ln($JAPANESE\ AID_{j,t-1}$)	0.158[a]	−0.450	−0.284***	−0.150	−0.804***	−0.294
	(0.185)	(0.403)	(0.080)	(0.108)	(0.245)	(0.438)
Ln($UK\ AID_{j,t-1}$)	−0.725	−0.188	−0.682***	−0.593	−0.437	−3.064*
	(0.441)	(0.692)	(0.252)	(0.925)	(0.571)	(1.700)
Ln($USA\ AID_{j,t-1}$)	0.500**[a]	0.071	−0.440***	−0.195	−0.042[a]	−1.278
	(0.228)	(0.433)	(0.107)	(0.158)	(0.294)	(0.698)

Notes: ZINB-estimates. Dependent variable is $DEATH_{ijt}$. Standard errors (in parentheses) are adjusted for clustering on country-level. The 1^{st} stage probit regression estimates the probability that nobody in nation j and year t died from the specific natural disaster. The 2^{nd} stage negative-binomial estimates the number of disaster deaths. Covariates from the ZINB baseline specification (Table 13), continent dummies, time trend and constant term included in all 2^{nd} stage negative-binomial specifications. ***, **, * indicate significance at the 1, 5 and 10%-level, respectively. [a]indicates that ZINB model did not converge.

Table 16: Disaster fatalities, aid and institutional quality

	Storms		Floods		Earthquakes	
	Coeff.	ZI Probit	Coeff.	ZI Probit	Coeff.	ZI Probit
Ln($AID_{j,t-1}$)	0.377***	−0.150	−0.394***	−0.200	−0.603***[a]	−0.942
	(0.129)	(0.131)	(0.139)	(0.229)	(0.193)	(1.726)
$CORR\ CONT_{jt}$	0.623**	0.478	−1.199***	−0.562	−1.923***	−7.954*
	(0.253)	(0.355)	(0.232)	(0.820)	(0.430)	(4.195)
($CORR\ CONT_{jt} * AID_{j,t-1}$)	−0.317***	−0.264	0.323***	0.172	0.219	3.462
	(0.117)	(0.218)	(0.101)	(0.216)	(0.321)	(2.481)
Ln($AID_{j,t-1}$)	0.379***	−0.493	−0.269**	−0.377**	−0.462**	−0.352
	(0.145)	(0.476)	(0.124)	(0.177)	(0.230)	(0.255)
$GOV\ EFF_{jt}$	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*
	n.a.	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*
($GOV\ EFF_{jt} * AID_{j,t-1}$)	−0.442***	−0.720*	0.030	0.005	−0.870***	−0.625**
	(0.106)	(0.391)	(0.086)	(0.096)	(0.208)	(0.303)
Ln($AID_{j,t-1}$)	0.149[a]	−0.329	−0.277***	−0.345***	−0.163	65.008***
	(0.162)	(0.642)	(0.075)	(0.131)	(0.446)	(0.518)
$POL\ STAB_{jt}$	0.153	0.644	−1.076***	0.183	−2.256***	−93.576
	(0.305)	*n.a.*	(0.181)	(0.242)	(0.773)	(0.835)
($POL\ STAB_{jt} * AID_{j,t-1}$)	−0.413***	−0.431***	0.360***	−0.087	0.633	−17.019***
	(0.103)	(0.155)	(0.070)	(0.089)	(0.464)	(0.835)
Ln($AID_{j,t-1}$)	0.373**	−0.176	−0.427***	−0.308*	−0.243	−0.184
	(0.162)	(0.123)	(0.146)	(0.180)	(0.187)	(0.736)
$REG\ QAL_{jt}$	0.243	−0.180	−1.536***	−0.058	−1.802***	−0.194
	(0.329)	(0.565)	(0.467)	(0.343)	(0.669)	(1.464)
$REG\ QAL_{jt} * AID_{j,t-1}$)	−0.313*	−0.093	0.461***	0.006	0.532	−0.690
	(0.182)	(0.187)	(0.139)	(0.104)	(0.474)	(0.772)
Ln($AID_{j,t-1}$)	0.370**	−0.086	−0.366***	−0.357***	−0.449**[a]	0.467
	(0.161)	(0.141)	(0.128)	(0.179)	(0.179)	(13.840)
$RULE\ LAW_{jt}$	0.293	0.435	−1.048***	0.053	−1.371***	−16.037***
	(0.263)	(0.607)	(0.228)	(0.317)	(0.479)	(3.634)
($RULE\ LAW_{jt} * AID_{j,t-1}$)	−0.312**	−0.188	0.330***	−0.102	0.016	5.938***
	(0.149)	(0.148)	(0.101)	(0.116)	(0.327)	(5.626)
Ln(AID_{jt-1})	0.429**	0.023	−0.363***	−0.352**	−0.265	696.449***
	(0.184)	(0.245)	(0.138)	(0.173)	(0.224)	(17.202)
$VOICE\ ACC_{jt}$	0.644*	1.214	−0.868***	−0.009	0.546	613.177***
	(0.337)	(1.522)	(0.282)	(0.383)	(0.437)	(14.891)
($VOICE\ ACC_{jt} * AID_{j,t-1}$)	−0.393*	−0.448	0.287**	0.045	0.546	−674.046***
	(0.215)	(0.851)	(0.129)	(0.120)	(0.437)	(16.594)
Ln($AID_{j,t-1}$)	.207	11.926***	−0.272*	−0.501**	−0.492	10.489
	(0.139)	(0.308)	(0.159)	(0.208)	(0.397)	(30.378)
$DEMOCRACY_{jt}$	0.013	14.300***	0.052	−0.082*	−0.103[a]	1.224
	(0.033)	(0.270)	(0.039)	(0.043)	(0.119)	(17.077)
($DEMOCRACY_{jt} * AID_{j,t-1}$)	0.001	−5.037***	0.012	0.021	0.049	−0.909
	(0.017)	(0.123)	(0.014)	(0.013)	(0.054)	(4.648)

Notes: ZINB-estimates. Dependent variable is $DEATH_{ijt}$. Standard errors (in parentheses) are adjusted for clustering on country-level. The 1^{st} stage probit regression estimates the probability that nobody in nation j and year t died from the specific natural disaster. The 2^{nd} stage negative-binomial estimates the number of disaster deaths. Covariates from the ZINB baseline specification (Table (13)), continent dummies, time trend and constant term included in all 2^{nd} stage negative-binomial specifications. ***, **, * indicate significance at the 1, 5 and 10%-level, respectively. [a]indicates that ZINB model did not converge.

Table 17. Variable Definition and Source

Variable	Description	Source
KILLED	Total number killed by a natural disaster	EM-DAT, CRED (2008)
AID	Aid per capita (current US Dollars) Total real ODA commitments in recepient country per capita	World Bank, World Development Indicators
GDP	Real GDP per capita (US Dollars in 2000 prices)	Penn World Table Version 6.2
GINI	Measure for income inequality	Grün & Klasen (2003)
POP	Total Population expressed in thousands	World Bank, World Development Indicators
POPDENS	People per square kilometer	World Bank, World Development Indicators
OPEN	Exports plus Imports of goods and services divided by GDP	Penn World Table Version 6.2 Penn World Table Version 6.2
MAGNITUDE	Disaster magnitude expressed in: *Storms:* Wind speed measured in Kilometers per hour *Floods:* Number of months per year in the country, with a precipitation sum that is 1 standard deviation above the long time precipitation mean in the country *Earthquakes:* Richter scale	 EM-DAT, CRED (2008) NOAA (2008) EM-DAT, CRED (2008)
$NATHAZ - RISK$	GIS-DATA on spatial mortality risk Country mean (0-10)	Dilley et al. (2006)
LATITUDE	Absolute Latitude in degrees	Kahn (2005)
ELEVATION	Elevation in meters	Kahn (2005)
CORR CONT	Perception of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as influence of elites.	Kaufmann et al. (2008)
GOV EFF	Perception of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.	Kaufmann et al. (2008)
POL STAB	Perception of the likelihood that the government will be destabilized or overthrown by un-	Kaufmann et al. (2008)

Table 17. Variable Definition and Source *cont.*

Variable	Description	Source
	constitutional or violent means, including politically-motivated violence and terrorism.	
REG QAL	Perception of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.	Kaufmann et al. (2008)
RULE LAW	perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.	Kaufmann et al. (2008)
VOICE ACC	Perception of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media.	Kaufmann et al. (2008)
DEMOCRACY	Proxy for the political system in a country. Include information on competitiveness and openness of executive recruitment, constraints on chief executive, regulation and competitiveness of participation.	Marshall & Jaggers (2005)
COLONY	Colonial Background Dummy variable that switches to one if the country has ever been a colony	Correlates of War 2 Project (2008)
MILITARY EXP	Military Expenditure per GDP	World Bank, World Development Indicators

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Paul A. Raschky and Manijeh Schwindt

Aid, Catastrophes and the Samaritan's Dilemma

Abstract

This paper discusses the impact of foreign aid on the recipient country's preparedness against natural disasters. The theoretical model shows that foreign aid can have two opposing effects on a country's level of mitigating activities. In order to test the theoretical propositions we analyse the effect of foreign aid dependence on ex-ante riskmanagement activity proxied by the death toll from major storms, floods and earthquakes occurring worldwide between 1980 and 2002. We find evidence that the crowding-out effect of foreign aid outweighs the preventive effect in the case of storms, while there is mixed evidence in the case of floods and earthquakes.

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