The Political Economy of "Natural" Disasters

Charles Cohen
Eric Werker

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Charles Cohen

Vice President, Sankaty Advisors, Boston MA

Eric Werker

Assistant Professor, Harvard Business School, Boston MA

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ABSTRACT

Natural disasters occur in a political space. Although events beyond our control may trigger a disaster, the level of government preparedness and response greatly determines the extent of suffering incurred by the affected population. We use a political economy model of disaster prevention, supported by case studies and preliminary empirics to explain why some governments prepare well for disasters and others do not. We show how the presence of international aid distorts this choice and increases the chance that governments will under-invest. Policy suggestions that may alleviate this problem are discussed.

## I.	INTRODUCTION

Natural disasters occur in a political space. They are not driven by politics, nor are they immune from politics. Incentives faced by human actors can affect the prevention, mitigation, and damage of natural disasters, even if they cannot affect the likelihood of rainfall in a specific area or seismic activity along a particular fault line. This is hardly controversial. The vast literature on disaster prevention and response has appreciated the political dimension of disasters for decades (Olson, 2000; Platt, 1999; Blaikie et al, 1994; Albala-Bertrand, 1993; Bommer, 1985; Cuny, 1983; Davis and Seitz, 1982; Diggins, Wright, and Rossi, 1979; Abney and Hill, 1966). There is empirical evidence of the relationship: in the United States, political considerations may explain half of all federal disaster relief (Garrett and Sobel, 2003) and electoral factors influence whether a president issues a disaster declaration (Reeves, 2005); around the world, disasters tend to be more severe in poorer countries that are poorly run (Stromberg, 2007; Kahn, 2005).

This paper represents the first attempt to synthesize these observations into a formal model of disaster mitigation that contains empirical predictions on the severity of disasters. In addition, this paper is the first to systematically incorporate the political aspect of disaster in the heart of the model and recognize the feedback between policy interventions and the seriousness of the disasters themselves. By bringing free relief to countries afflicted by so-called natural disasters, international humanitarians can create problems of moral hazard with a time-inconsistency nature. In the event of a government being ill prepared for a disaster, international relief effectively rewards bad behavior on the part of the poor countries' governments.

We adopt a precise, mathematical definition of disaster when the model is introduced in Section II.[1] Our definition is in spirit with Erikson (1976): "[Disasters] involve considerable

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harm to the physical and social environment; they happen suddenly or are socially defined as having reached one or more acute stages; and something can be done to mitigate their effects before or after they happen" (quoted in Kreps, 1998: 33). In other words, disasters involve a stochastic negative shock whose severity can be affected through a process of prevention and relief. It is precisely that process that we model. Henceforth, "shock" refers to the natural act itself—the volcanic eruption, earthquake, drought, etc.—and "disaster" refers to the net impact of the shock on the population.

Natural disasters have killed over 62 million people world-wide since 1900 (OFDA/CRED 2003). This is approximately the same number as all those killed in both World Wars,[2] yet scarce attention has been paid to natural disasters in the economics and political science literature, while dozens of articles on conflict are published each year. Over 85 percent of the deaths occurred between 1900 and 1950, and a little over one million deaths from natural disasters have occurred since 1990.[3] Certainly part of the credit for the relatively small number of disaster deaths in the last decade is due to the efforts of the global humanitarian community, and to its ever-increasing resources and effectiveness. In the month of October 2005 alone, international humanitarians and national Red Cross chapters responded to natural disasters in the Central African Republic, Costa Rica, El Salvador, Guatemala, India, Indonesia, Mexico, Nicaragua, Pakistan, Paraguay, Romania, and the Sudan (Reliefweb 2005).

In this paper, we take as given that the relevant actors work in a political space, and we model that space using a reduced-form framework. National governments care about the social welfare of their citizens, but also want to maximize government income. These governments can spend on both preventative and palliative measures to lessen the impact of a potential natural shock. International humanitarian organizations can step in with ex-post relief to poor countries

that experience natural disasters. This setup produces a number of important results, some of which have been independently noted in different strands of the literature.

The model predicts that rich governments and governments that care about social welfare spend more on disaster prevention and mitigation. Governments can use natural disasters to redistribute power through the *political effect*, favoring disaster spending in regions that are politically aligned with the party in power. Governments are less prone than local populations to "insure" against disasters through preventative measures, because a regional shock has less impact on the national government's income than on that of the local region.

The addition of humanitarian aid to the model produces a *bailout effect*: governments under-invest in disaster prevention when they know that they will be bailed out in the event of disaster. This effect is mitigated for pariah states, which may not have access to international aid. In the extreme, we can witness a *racket effect*, where governments can deliberately neglect a population so as to attract—and steal—humanitarian aid in the event of a disaster. Governments without other sources of external income are more likely to be influenced by the racket effect. In addition, in the case of shocks that decimate local populations, international organizations will tolerate higher levels of theft to deliver urgently needed aid. This can lead to a *desperation effect*: in dire circumstances, rapacious governments have a stronger ability to increase their level of theft.

These results have policy implications for reducing the severity of natural disasters. First, the international humanitarian community must be involved in disaster prevention if it is to offer free relief. Second, whenever possible, disaster relief should be provided locally so as to reduce the significance of the racket and political effects on the central government. Third, political development, in the form of more responsive governments and less intrastate conflict,

will reduce the severity of disasters. Fourth, in particularly problematic areas, governments can be given extra payments for proper disaster preparation, including establishing and enforcing efficient regulations.

This paper is related to two large bodies of research in political science: political economy of war and foreign aid. In essence, disasters can be used as a blunt policy instrument to target or reward populations and to enrich a government, and they can be mitigated with outside effort. Corollary works on the political economy of war include investigations into why the state might target its own population (Valentino, Huth, and Balch-Lindsay, 2004; Harff, 2003; Krain, 1997), and the effectiveness of benevolent outside intervention on internal conflict (Doyle and Sambanis, 2000; Paris, 1997; Diehl, Reifschneider, and Hensel, 1996). By highlighting the potential of foreign assistance to affect domestic outcomes we are adding to a rich literature on the distortionary impact of foreign aid that has hitherto focused on non-disaster aid (Goldsmith, 2001; Bräutigam, 2000; Lancaster, 1999; Uvin, 1998).

The rest of the paper is organized as follows. In Section II, the model is presented and the terms are defined. Section III solves the model in the case of no outside humanitarian relief, while Section IV allows for external disaster aid. Policy implications and conclusions are offered in Section V.

II.   A POLITICAL MODEL OF DISASTERS

Before making any predictions on the severity of disasters we set up the model from which the results will be derived.

A. Disasters, Prevention, and Relief

Assume that a natural shock, such as an earthquake or hurricane, strikes with an exogenous probability q, and causes monetary damage k. We assume that governments cannot control the probability of such a shock, only the shock's impact. We model the impact of the shock as a per capita loss $k - f(b, a)$, where $f(b,a)$ is the total level of relief from preventative spending done before the shock hits (b) and palliative spending done after the shock hits (a). We assume that f is concave. Preventative and palliative spending may either be complements (that is, a dollar spent on prevention increases the benefit of a dollar spent on relief, e.g. a dam) or substitutes (spending on prevention decreases the per-dollar benefit of spending on relief, e.g. famine relief), and this will play a key role in our analysis. In addition, f has a maximum value of k (disaster aid cannot make improvements that bring utility above the non-disaster state).

We define a *disaster* as the net impact of a shock, or $k - f(b,a)$. The *initial disaster* is given by $k - f(b,0)$; the level of damage reported after the shock first hits. In other words, a shock k's immediate impact on a population is governed by the amount of disaster prevention b that a government has undertaken. While the net impact of the shock is further determined by any palliative care a, the disaster that makes the newspaper will not have yet been attenuated by the relief activity. For the most part, the distinction between a "disaster" and an "initial disaster" is helpful only in explaining the observed level of disasters around the world. For the purposes of government decision making, $f(b,a)$ and not $f(b,0)$ is most important.

B. Government Spending

The government may either spend money on disaster prevention or allocate it to other uses. The government derives utility from two sources: social welfare from disaster prevention and income that it uses for other purposes. Formally, the government has a utility function $v(w, I)$, where w is social welfare of the population and I is government income. An individual

citizen's welfare is given by a utility function *u(y)*, where *y* is an exogenous level of individual income. If a shock hits, a citizen's income is reduced by *k - f(b,a)*, and hence her utility drops to *u(y – (k - f(b,a)))*. Following a representative consumer model, we assume

$$v(w, I) = \sum_i \lambda_i u(y_i) + v(I).$$

In words, the government is a Benthamite social planner, assigning different weights λ_i to different regions (the regions are indexed by *i*). This λ_i reflects the government's inherent interest in region *i*. We might expect populous regions, swing regions, or politically organized regions to have high values of λ_i. In racially or ethnically polarized countries, λ may even be negative in some regions. $\sum_i \lambda_i u(y_i)$ is simply the weighted average of citizen utility across the country. The government also cares about income, through a concave function $v(I)$. We are assuming that government utility is separable in income and social welfare. If this is not true, then we need to worry about the complementarity or substitutability of these inputs. We present this simpler version that captures all the essential insights of our model without unnecessary technical complications.

This is not a general equilibrium model; we have decided to ignore issues regarding taxation or supply-side responses to government actions, as these are not central issues in our paper. In particular, we ignore the fact that government income is actually a function of the income of the citizens of the country.

The form of this utility function should not necessarily be interpreted literally as the way that central governments make decisions, but rather as a reduced form for a series of vastly more complicated decisions. We also recognize that central government decisions are not perfectly coordinated;[4] however, we still think that this functional form will capture the most important

dynamics. Even though the government may not have preferences directly over these inputs, it will behave as though it does, and hence this utility function serves as a consistent representation of these preferences.[5] In addition, one can also interpret our formulation as the reduced form of a more explicitly political model.[6] We are not as interested in the subtle dynamics of such a model as with the interaction of national governments with international relief organizations, and hence we will use this reduced form throughout the paper.

We abstract from the much larger spending decisions that the central government must make and consider only that the government has a fixed supply of money I to spend on disaster prevention or to put aside for other spending. In this model, each country is made up of n distinct regions to which funds can be allocated, which we index by i. The government spends b_i on prevention and a_i on relief in region i.

III. GOVERNMENT SPENDING AND DISASTERS IN THE ABSENCE OF AID

In this section, we solve the model without strategic interactions with an outside relief agency, derive first-order conditions, and take several comparative statics.

A. Efficient Disaster Spending

As a reference case we assume that the government is simply trying to maximize the utility of one representative citizen. Assume that the unit cost of preventative measures is p_b and of palliative measures p_a. Hence, the government is solving the problem (recall that q is the probability of a disaster):

$$\max_{b,a} \left(1 - q\right)u\left(y - p_b b\right) + qu\left(y - \left(k - f\left(b,a\right)\right) - p_b b - p_a a\right)$$

However, note that we can write this in terms of two variables of greater interest: the total level of relief $r = f(b,a)$, and the level of prevention b. These two variables implicitly define the level of palliative spending:

$$f(a(r,b),b) = r.$$

In words, $a(r,b)$ is the level of palliative aid that must be done to achieve a total level of relief r, given that an amount b of prevention was provided. This implies:

$$\frac{\partial a}{\partial r} = \frac{1}{f_a}$$

$$\frac{\partial a}{\partial b} = \frac{-f_b}{f_a}$$

In addition, the total cost for this spending is now given by a function $c(r,b)$, defined by:

$$c(r,b) = p_a a(r,b) + p_b b.$$

Taking the derivative of this with respect to r:

$$\cdot \frac{\partial c}{\partial r} = p_a \frac{\partial a}{\partial r} = p_a \frac{1}{f_a} \qquad (1)$$

$$\frac{\partial c}{\partial b} = p_a \frac{\partial a}{\partial b} + p_b = p_b - p_a \frac{f_b}{f_a} \qquad (2)$$

Hence our maximization problem is now:

$$\max_{r,b} (1-q)u(y - p_b b) + qu(y - (k-r) - c(r,b)) \qquad (3)$$

Taking the derivative of (3) with respect to r gives us the first of our two first order conditions:

$$u'(y - (k-r) - c(r,b))\left(1 - \frac{\partial c}{\partial r}\right) = 0$$

Substituting in from equation (2) yields:

$$1 - p_a \frac{1}{f_a} = 0$$

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$$f_a = p_a \qquad (4)$$

Hence, the level of palliative spending is *always ex-post efficient*, with marginal benefit of a unit of relief f_a equal to its marginal cost p_a. This is because there is no uncertainty involved here; once a disaster has occurred, the government must simply choose how much to invest in mitigating the disaster. This is like any other spending decision. However, this is not the case for the level of preventative spending:

$$\frac{\partial v}{\partial b} = 0 \Rightarrow (1-q)u'(y - p_b b)(-p_b) + qu'(y - (k-r) - c(r,b))\left(-\frac{\partial c}{\partial b}\right) = 0$$

For simplicity, we use u^s to denote the level of utility in the shock state and u^{ns} in the no-shock state. Substituting and simplifying, the above equation can be written:

$$f_b = p_b\left(1 + \frac{(1-q)u^{ns\,\prime}}{qu^{s\,\prime}}\right)$$

$$\frac{qu^{s\,\prime}}{qu^{s\,\prime} + (1-q)u^{ns\,\prime}} f_b = p_b. \qquad (5)$$

Spending on prevention only has an *expected* benefit: it only helps if a disaster actually occurs. This makes it inherently less efficient than relief, and after a disaster the level of prevention may seem too low, if one forgets that disasters do not occur with certainty.

The term in front of f_b in equation 5 is precisely the factor that adjusts for this uncertainty. We note that it is increasing in q. This means that if shocks are more likely, more should be spent on prevention relative to relief. In addition, when shocks are more severe, marginal utility is higher in the bad state, which means f_b must fall to maintain the equality, and hence (by the concavity of f) the level of prevention rises. This is related to a standard insurance result: the more that a negative shock hurts an individual, the more she will spend ex ante to

prevent it, because she will be very poor (and hence income will be very valuable) after the shock actually occurs.

B. Disaster Spending with a Political Government

We now introduce the government utility function described in Section II. Recall that the central government is maximizing $\sum_i \lambda_i u(y_i) + v(I)$, or, in expected utility:

$$\max_{r,b} q\left(\sum_i \lambda_i u(y_i - (k-r)) + v(I - c(r,b))\right) + (1-q)\left(\sum_i \lambda_i u(y_i) + v(I - p_b b)\right)$$

The form of the government's utility function implicitly assumes that each argument only depends on the sum of the effects across regions, i.e. that there are no regional cross-effects at work. Under this assumption we can restrict our model to one region.[7] Thus the government solves:

$$\max_{r,b} V(r,b) = q(\lambda u(y - (k-r)) + v(I - c(r,b))) + (1-q)(\lambda u(y) + v(I - p_b b)) \quad (6)$$

Differentiating equation 6 with respect to r yields the first of the first-order conditions:

$$\frac{\partial V}{\partial r} = 0 \Rightarrow \lambda u'(y - (k-r)) = v'(I - c(r,b))\frac{\partial c}{\partial r}$$

Equation (1) tells us that $\dfrac{\partial c}{\partial r} = \dfrac{p_a}{f_a}$, hence we have

$$\lambda f_a u^{s\,\prime} = p_a v^{s\,\prime} \qquad (7)$$

The government still sets palliative spending to an ex post efficient level, only now it has a different definition of efficiency. The left hand side of equation 7 gives the amount that citizen utility will be raised by an extra unit of relief, $f_a u^{s\,\prime}$, multiplied by how much the government cares about that utility, λ. The right hand side tells how much the extra unit of relief costs, p_a,

multiplied by the opportunity cost to the government of not saving that money for other purposes, $v^{s\prime}$.

We can find the ratio of prevention to relief by differentiating equation 6 with respect to b to find the other first order condition:

$$\frac{\partial V}{\partial b} = 0 \Rightarrow qv^{s\prime}\left(-\frac{\partial c}{\partial b}\right) - (1-q)v^{ns\prime}p_b = 0$$

This simplifies to:

$$\frac{f_b}{f_a} = \frac{p_b}{p_a} \cdot \left(1 + \frac{(1-q)v^{ns\prime}}{qv^{s\prime}}\right) \quad (8)$$

By the implicit function theorem, these first order conditions generate implicit functions, $r(\lambda, y, k, I, p_a, p_b, q)$ and $b(\lambda, y, k, I, p_a, p_b, q)$, that define the optimal levels of relief and prevention based on the exogenous parameters of the system. Hence, we can now differentiate equations 7 and 8 in order to derive comparative statics and offer predictions on the level of disaster spending and hence on the severity of the initial, and total disaster.

Proposition 1: Under reasonable assumptions, governments are more biased towards relief over prevention compared to self-financing individual households. Proof: all proofs are contained in the appendix.

This is, in essence, a basic insurance/investment result (Arrow and Lind, 1970). Governments are less risk averse than individuals over gambles the size of disasters: while an individual risks getting wiped out, a government usually only faces damage to some small fraction of its economy. Hence they are more willing to forego prevention or formal insurance and simply spend in the case that a disaster occurs. Thus the ex-post revelation of "under-prevention" may not always indicate a misjudgment on the part of the government, as one must

remember that the level of spending was set ex ante, when the appearance of the shock was uncertain.

Corollary 1.1: Smaller (less populous) countries prepare better for disasters.

This corollary immediately follows from Proposition 1. Since governments are better able to smooth disaster relief from current income than individuals, so too are governments of large countries better able to smooth disaster relief than governments of small countries. This implies that small-country governments will spend more on prevention relative to relief than large-country governments, and that the observed initial disaster (before relief has been distributed) will appear larger in big countries than in small countries.

We would like to test this fact empirically. In this paper we will not provide rigorous statistical analysis, which would require a paper in its own right, but will instead present some suggestive aggregate evidence. We assume that disaster preparation can be proxied by the ratio of persons killed to persons affected by disasters. Hence, a high ratio of deaths from disasters to number of people affected by disasters indicates a low level of disaster preparation.[8]

While the following data may suffer from reporting and measurement bias,[9] we nonetheless compare the average deaths weighted by population from natural disasters in small countries to large countries in order to illustrate the logic behind Corollary 1.1 and hence Proposition 1.

[Table 1 here]

As can be seen in the first column of data in Table 1, smaller countries experience a lower annual fatality rate from natural disasters. This may be simply due to there being fewer natural shocks to small countries than to large countries. The second column examines this possibility. As can be seen, this does not appear to be the case: persons living in small countries have a higher

likelihood of being affected by a natural disaster in a given year. Of course, these results should only be taken as illustrative; as we will argue throughout the paper, there are a host of other issues that complicate the story, which any systematic empirical testing of these propositions will have to take into account.

Proposition 2: As long as citizen welfare is not a substitute to government income, richer governments have smaller disasters. i.e. $\dfrac{\partial r}{\partial I} > 0$.

This result is hardly surprising, and has been implicitly noted in the literature. For instance, Kahn (2005) and Stromberg (2007) find that natural shocks are no more likely in poor countries than rich countries, but that poor countries have higher mortality from disasters. Freeman, Keen, and Mani (2003, 9) report that poor countries experience more damage from natural disasters as a percentage of GDP than do rich countries. Disaster prevention can be thought of as a normal good, whose consumption increases with income. Yet all governments that are involved in disaster mitigation, poor and rich, will still prioritize their spending.

Proposition 3: The more the government derives utility from social welfare, the less severe the disaster: $\dfrac{\partial r}{\partial \lambda} > 0$.

Proposition 3 is essentially the bridge between our paper and the oft-cited Sen (1983) observation that democracies do not have famines. For whatever reason, whether it is benevolence or accountability, governments that govern in the interest of social welfare should have less severe disasters. Indeed, Kahn (2005) finds that natural disasters have a smaller death toll in democracies.[10]

Of course, disasters are not simply a nuisance to governments. Used strategically they can strengthen the government if they are harnessed as instruments to weaken potential rivals.

Corollary 3.1 (*The political effect*): Governments spend less on disaster prevention in politically weak or hostile regions.

Politically weak or hostile regions have low levels of λ, and hence the government will not spend much on these regions. This observation, that disasters will "tend to happen" in opposition-aligned areas, has been noted in Albala-Bertrand (1993: 92, 151) and implicitly noted in the conflict literature on food as a weapon and in the geography literature on vulnerability and marginalization.

The food-as-a-weapon literature documents how famine can and has been used as a tool of warfare against political enemies, most notably in Ethiopia, where according to de Waal (1997b: 115), the "principal cause of the [Tigray and northern Wollo] famine was the counter-insurgency campaign of the Ethiopian army and air force in Tigray and north Wollo during 1980-85." A similar situation existed during the Sudanese civil war (Deng and Minear, 1992: 83-119; Keen, 1994). In addition, the geography literature stresses that disasters disproportionately affect marginalized groups that have less political power (Mustufa, 1998; Hewitt, 1998: 85-86; Susman, O'Keefe, and Wisner, 1983).

We can offer a brief quantification of this corollary by comparing the damage from disasters in ethnically fractionalized countries with the damage in more homogenous countries. The implicit mechanism through which a high degree of ethnic fragmentation can lead to higher damage from disasters is that governments of fragmented populations selectively under-prevent by region, thus raising the overall expected impact of a natural shock. Table 2 illustrates this, dividing countries into two equal groups:

[Table 2 here]

As can be seen in Table 2, highly fragmented countries have approximately three times as many deaths and persons affected as the more homogeneous countries. This is consistent with a lower level of disaster prevention and response in highly fractionalized countries. Clearly these statistics are only suggestive: other factors, such as a difference in likelihood of natural shocks, may explain some of the difference.

The recent disasters provide vivid evidence of the political effect. As discussed in the introduction, opposition areas in Indonesia and possibly Sri Lanka were denied the same amount of relief from the impact of the tsunami. The residents unable to flee New Orleans in time to avoid Hurricane Katrina were largely poor and unconnected, and the US Government's Federal Emergency Management Agency (FEMA) payments have been criticized for favoring wealthy residents (Kestin, O'Matz, and Maines, 2005).

On balance, these effects imply that a sufficiently callous and poor government may choose to invest very low amounts in disaster prevention, especially in politically hostile areas. In the next section we argue that this becomes even more likely when the possibility of outside aid is introduced.

IV. INTRODUCING EXTERNAL HUMANITARIAN AID

The presence of international organizations dedicated to the alleviation of suffering has a dramatic effect on the character, form, and—as we will argue—amount of disaster spending in poor countries. There is a quasi-industry of disaster relief (see Macrae, 2002), whose front lines include well-known private aid organizations such as CARE, the Red Cross, Oxfam, and World Vision, as well as multilateral organizations like the United Nations Children's Fund (UNICEF) and the World Food Programme. These are funded by a combination of private donations and government grants. Government spending on humanitarian emergencies is dominated by the

United States, followed by EU member states' collected contributions through the European Community Humanitarian Office (ECHO). Of course there are other forms of aid relevant to disasters. Remittances from relatives abroad may help individuals and thus nations cope with disasters (Yang 2005).

In our model, international aid (which can be thought as some combination of private, public, and NGO aid, though we often abbreviate it to a single NGO for clarity of exposition) only comes in after a disaster has occurred. This is, of course, a simplification of the real world that includes aid for disaster prevention as well as relief. The results of the model will hold so long as the level of international aid for disaster prevention is too low, which certainly seems to be the case (Benson and Clay, 2004, 38). Aid agencies complain, for example, that it is much harder to get donations for prevention than for visible emergencies.[11] This was clearly demonstrated in the aftermath of the events of September 11, 2001, when the American Red Cross was caught up in a scandal that involved their shifting of earmarked donations from relief to prevention, where they believed the money could be better spent (Curran, 2001). Moreover, advocates of disaster spending consistently ask for more attention devoted to prevention, as evidenced in a report by Christian Aid (2005) that quotes statistics suggesting the marginal value of a dollar of prevention is higher than for relief.

If the international humanitarian community guarantees national governments relief aid, it is in essence insuring them against disasters. Does this insurance generate a moral hazard problem? In other words, do we see a bailout effect, where the low price of palliative aid generates underinvestment in preventative spending? As with any price distortion, there will be two effects: a substitution effect and an income effect. In this case we believe that income effects are small: bilateral disaster relief to low-income countries comprised on average only

0.17 percent of GDP from 1999 through 2003.[12] This would lead one to believe that the substitution effect will dominate, and preventative investment will suffer.

We will assume that, if a shock occurs, foreign powers can act after the local government to provide free palliative (but not preventative) aid. We further assume that aid is distributed optimally; hence international organizations will be equalizing the marginal benefit of spending across crises, giving aid until the marginal benefit of a dollar of spending is equal to some critical value *m*.

This means that the NGO is maximizing the following objective function:

$$\max_r O(r) \equiv u(y - (k - r)) - (1 + t)p_a a(r,b)m \qquad (9)$$

The first term is the benefit to the NGO from increasing the utility of the citizens affected by the disaster by *r*. The second term is the cost of this increase (which is done entirely through palliative relief): $a(r,b)$ is the amount of relief that must be provided to achieve a payoff of *r*. The cost of this much relief is $(1 + t)p_a a(r,b)$, where *t* is the "tax" paid on a dollar of aid by humanitarian organizations. This loss could be due to the fact that foreign organizations are inherently less efficient in unfamiliar territory, that they have higher overhead, or that money is stolen (e.g. through bribes). Note that *t* could even be negative. For now we assume that *t* is exogenous. Finally, *m* is the opportunity cost of spending the money here rather than elsewhere. Differentiating this equation with respect to *r* implicitly defines a function *r(b)* by the first order condition for the relief agency:

$$u'(y - (k - r(b))) = (1 + t)p_a m \frac{\partial a}{\partial r} .$$

$$u'(y - (k - r(b)))f_a(b, a(r(b), b)) = (1 + t)p_a m \qquad (10)$$

We assume that, once a disaster strikes, the government acts before the aid agency in providing

palliative aid. Given our modeling of the NGO spending until the marginal value of a dollar of relief reaches *m*, this implies that the government has no incentive to provide any relief unless it wants to provide it at a higher level than the NGO would provide. In that case, we are back to the problem without aid. If it does decide to rely on outside aid, the government is solving the following maximization problem:

$$\max_{b} q \cdot \lambda u\big(y - (k - r(b))\big) + (1 - q)\lambda u(y) + v(I - p_b b). \qquad (11)$$

Differentiating equation 11 with respect to *b* leads to the following first order condition for the government:

$$q\lambda u'\big(y - (k - r(b))\big)\frac{\partial r}{\partial b} = p_b v'(I - p_b b). \qquad (12)$$

To find $\dfrac{\partial r}{\partial b}$ we use standard comparative statics:

$$\frac{\partial r}{\partial b} = \frac{O_{rb}}{-O_{rr}} = \frac{u'\!\left(f_{ba} + f_{aa}\dfrac{\partial a}{\partial b}\right)}{-\left(u'' f_a + u'\!\left(f_{aa}\dfrac{\partial a}{\partial r}\right)\right)}$$

$$\frac{\partial r}{\partial b} = \frac{u'\!\left(f_{ba} - f_{aa}\dfrac{f_b}{f_a}\right)}{-\left(u'' f_a + u'\cdot\!\left(\dfrac{f_{aa}}{f_a}\right)\right)} \qquad (13)$$

This expression is positive if $f_{ba} f_a - f_{aa} f_b > 0$. The second term is always positive (by concavity), but the first may be negative if *b* and *a* are substitutes; this means that the NGO will cut back on aid rather than increase it when the government increases its spending.

Combining equations 10, 12, and 13 yields the following ratio:

$$\frac{f_b}{f_a} = \frac{p_b}{(1+t)p_a} \frac{1}{q} \frac{v'}{m} \frac{1}{\lambda} \left(\frac{u''}{u'} \frac{f_a}{f_{aa}} + 1 \right) f_a + \frac{f_{ba}}{f_{aa}} \quad (14)$$

Compare this to the ratio in the no-aid case:

$$\frac{f_b}{f_a} = \frac{p_b}{p_a} \cdot \left(1 + \frac{(1-q)v^{ns\,\prime}}{qv^{s\,\prime}} \right) \approx \frac{p_b}{p_a} \cdot \left(\frac{1}{q} \right).$$

When will the presence of outside aid cause a distortion in the ratio of the effectiveness of preventative aid to palliative aid, relative to a world without foreign assistance? In other words, when will the existence of outside relief cause governments to place a higher proportion of disaster care on ex-post mechanisms?

Proposition 4: The proportion of disaster relief supplied ex-post rises with the following comparative statics, among others:

1) Relief becomes cheaper for NGOs, i.e. t falls.

2) Governments become poorer relative to NGOs, and the ratio of their marginal utilities of income v'/m rises.

3) The curvature of the utility function of the local population, u''/u', rises (this happens when populations become poorer and approach a subsistence constraint).

4) Preventative and palliative aid are substitutes rather than complements.

In a world where international agencies provide free relief, governments will allow more of the burden of care to shift to the agencies when any of the above conditions are met.

The first situation is very intuitive. In the first situation, when the "price" of relief aid falls, whether through reduced taxation or higher efficiency, the quantity rises, and the ratio of prevention to relief falls. We can offer a simple exposition of the plausibility of this effect by comparing landlocked countries with non-landlocked countries. In landlocked countries, the

price of relief aid is very high, as it is expensive to bring in aid. As such, *ceteris paribus*, relief agencies will find it more efficient to focus their relief efforts on non-landlocked countries, which will drive up the fraction of disaster spending on prevention in landlocked countries. Hence we should expect the initial disaster, proxied for by deaths per capita, to be less severe in landlocked nations. Table 3 examines this proposition:

[Table 3 here]

The figures are suggestive of this first situation being borne out in the data. While landlocked countries are more likely to have natural disasters affect their populations, as indicated by the second column, they experience an annual death rate from natural disasters less than half that of non-landlocked countries.

The second situation of proposition 4 is also fairly simple. When the government of the disaster-prone country has a higher marginal utility from income than the NGO, its opportunity cost of disaster aid is higher, and thus it allows the NGO to "pick up the tab" for the disaster. This implies that the burden of care shifts from prevention to relief.

In the third situation, when the curvature of the utility function of the local population is high, it means that not only is the marginal utility of income high, but taking away any income will cause utility to drop at an accelerating rate. Hence, even if the government cuts back on prevention, making relief less efficient, the NGO will not cut back very much on relief. Even though relief is now less effective in dollar terms, in utility terms it is still almost as effective as before, due to the fact that the marginal utility of income has significantly with the drop in the income of the local population. So the NGO will almost completely compensate for this pullback. The makes shirking on prevention even more appealing.

The fourth situation, where the substitutability of preventative and palliative aid implies a

lower ratio of prevention to relief, describes the case where preventative spending is not a prerequisite for effective relief. In other words, if people can be made better off by either spending on prevention or relief, then the government will sit back and under-prevent, allowing the burden to be picked up in the form of relief by the aid agencies. If, on the other hand, relief is only productive when preventative expenditures have already been undertaken (relief and prevention are complements), the existence of outside relief may actually cause an increase in preventative spending. Such a case can easily be imagined: relief to a flood zone can be provided only when a levee has been constructed (even poorly), but when it has never been built at all relief aid may be futile (or even impossible).

Corollary 4.1 *(the bailout effect)*: The presence of outside relief can increase the severity of the initial disaster.

Distortions caused by the existence of external aid to the proportion of relief (Proposition 4) imply that the level of preventative spending is reduced when the income effect is dominated by the substitution effect. As we have argued above, international relief is a tiny fraction of the GDP of poor countries; free relief will change the amount of prevention they do primarily through the substitution effect of relief being cheaper. Whatever income effect the government gets from free relief will most certainly be spent on other programs, such as education or the military. Thus, when the substitution effect dominates the income effect, the situations described in proposition 4 are also the situations where free relief will result in under-prevention, and hence more severe initial disasters.

This relatively simple application of moral hazard is similar to other literature, from financial crises (Fischer, 1999) to insurance (Shavell, 1979), and as a general insight is known as the "Samaritan's Dilemma" (Buchanan, 1975; Coate, 1995). Essentially, the bailout effect is the

following: if prevention is costly and relief is free, governments will under-spend on prevention. This is not to say that there will be no spending on floodplain management or on making sure that buildings are built to withstand earthquakes, but rather that at the margin, fewer dollars will be spent on preventative activities than would be the case in the absence of free humanitarian relief.

This distortion has been noted in the disaster literature. As Cuny (1983) points out, the expectation of international aid can delay the government's own spending on disaster mitigation. Freeman, Keen, and Mani (2003) note that private individuals and firms, expecting government bailouts in the event of a disaster, will purchase less insurance.

Ethiopia, a nation that regularly makes headlines for famine threat, is a salient example. Because relief aid is forthcoming for the perennially food-insecure country, it can delay reforms that seek to address the underlying issues of food security. Ethiopia has faced almost perpetual drought and crop failure since 1984, sounding donor alarm bells each year. For each of these years 2000, 2002, and 2003, over 10,000,000 Ethiopians are reported as being affected by the drought yet no deaths were recorded—suggesting almost complete international bailouts. The availability of competently-delivered outside food aid means that the Ethiopian government does not need to stake its political future on solving the food insecurity problem. Certainly, it needs to expend some resources to improve the situation, yet resources that would have been spent on alleviating the structural causes of hunger in the absence of global humanitarians are freed up for other purposes.

However, for the bailout effect to apply, governments must be suitable candidates for the international humanitarian apparatus. The bulk of relief aid originates from western governments and their citizens, but their compassion does not reach all areas of the globe

equally.

Corollary 4.2: Pariah states that are not bailed out by international organizations will invest more in disaster prevention.

In essence, this corollary states that if a country will be left to fend for itself in the event of a shock, its leadership will take the necessary precautions to prevent disaster. Moreover, should disaster strike, politicians will not dally in administering relief. We are not aware of this point having been made previously in the disaster literature.

We illustrate this point by looking at two key pariahs in the latter half of the 20th century:[13] Libya under Muammar Al Qadhafi and South Africa under the Apartheid regime. Since Qadhafi came to power in 1969, Libya has had only one natural disaster recorded in the OFDA/CRED database. A flood occurred in 1995 when troubles with the "great man-made river" water pipeline caused $42 million in damages. The pipeline had been insured and no one was killed. In contrast, Algeria (albeit with a population six times as large) had 58 natural disasters over the same time period, with a total of 6700 deaths and $10.6 billion in damages. Even the wealthy Tunisia (with a population twice as large as Libya's) had 13 natural disasters leading to 840 deaths and $418 million in damages.

In South Africa, the Apartheid regime was an international pariah between 1962, when the United Nations first urged its members to break ties with South Africa, and early 1990, when then-President F.W. de Klerk freed Nelson Mandela from prison and lifted restrictions on opposition groups. During this time period, 808 people were killed from natural disasters in South Africa. From March 1990 through the end of 2002, 920 people were killed. This occurred against a backdrop of 1.2 million deaths in Africa from natural disasters between 1962 and 1989 inclusive, and 95,000 deaths between 1990 and 2002. In other words, while Africa as a whole

reduced the mortality from natural shocks by over 90 percent, South Africa—no longer a pariah state—increased its mortality from disasters by 10 percent.

B. Endogenizing Theft

The literature on humanitarian aid in conflict situations is very sensitive to the possibility of aid getting stolen and misused. Recent works by Anderson (1999), Lautze (1997), Prendergast (1996), and others have explored operational frameworks to minimize the potential of theft and misuse of relief in conflict. Yet the potential for theft also exists in natural disaster relief, which in turn may affect the severity of the disaster.

To understand this possibility we assume that t—the tax on NGO spending—is comprised solely of money stolen by the central government from aid organizations, and that this money flows directly into government coffers. In this case the government's maximization problem changes to:

$$\max_{b} q \cdot \left(\lambda u(y - (k - r(b))) + v(I - p_b b + ta(r(b), b)) \right) + (1 - q)(\lambda u(y) + v(I - p_b b))$$

This leads to the slightly modified first order condition:

$$q \left(\lambda u'(y - (k - r(b))) + tv'(I - p_b b + ta(r(b), b)) \frac{1}{f_a} \right) \frac{\partial r}{\partial b} = p_b \left(qv'(I - p_b b + ta(r(b), b)) + (1 - q)v'(I - p_b b) \right)$$

How will this affect the level of preparedness? The general case is complicated, as there are income effects to consider. However, the substitution effect is clear:

Proposition 5 (*the racket effect*)**:** If preventative aid and palliative aid are substitutes, then the presence of theft will always bias prevention downward. If they are complements, the effect is uncertain.

In other words, if a marginal dollar spent on prevention decreases the level of NGO relief spending, then the government will receive less income. This gives the government even less

incentive to invest: not only does it have to spend more on prevention, but it also gets less relief to steal. On the other hand, if a marginal dollar spent on prevention increases relief spending due to prevention and relief being complements, then the government can earn more money from theft by spending more on prevention. As before, we believe that the income effect (which is still at work here) is small.

In essence, proposition 5 is a very strong version of the bailout effect. Whereas the bailout effect concerns a costless cure that lowers prevention, the racket effect deals with a cure that is not only costless, but may in fact be profitable. This not only reduces prevention, but may lead to deliberate negligence on the part of the government in allowing natural shocks to become disasters. At the extreme, leaders can create disasters in order to attract humanitarian aid to steal, as a quotation from an American aid worker in West Africa attests:

> A Liberian warlord said to me one day, "I can starve a village until the children die, and then you
>
> will come with food and medicine which I will take, and no one can do anything about it."
>
> (Montalbano, 1997)

But more subtle forms of the racket effect are possible as well. During the humanitarian crisis that occurred as a result of the 2001 war in Afghanistan, the Taliban imposed a tax of $32 per metric ton brought in by UN World Food Program convoys (Boston Metro, 2001: 4). Earthquake aid to Nicaragua in 1972 was diverted to the Somoza family (Albala-Bertrand, 1993: 191).

This observation, that the potential siphoning of relief can drive the actions of leaders, has been heavily noted in the literature on humanitarian aid in conflict situations during the last decade (Duffield, 2001; Anderson, 1999; Marren, 1997; African Rights, 1994). However it has not yet been applied to regular governments in their prevention and mitigation of natural disasters. As noted in the humanitarian literature, war makers can steal some of the aid resources

to further their military aims. Thus the provision of aid in a conflict situation when aid gets stolen can be somewhat of a dilemma: aid may reduce suffering but at the same time further the conflict. In contrast, lootable aid cannot further a natural disaster ex post, but—as our model implies—it can provide distortionary incentives against disaster prevention ex ante. Indeed, our racket story may have as much in common with Akerlof, Romer, Hall, and Mankiw's (1993) looting model of bankruptcy for profit. The racket effect will not affect all governments equally, however. Those who more desperately need funding will respond more strongly.

Corollary 5.1: Poorer governments react more strongly to the racket effect.

Simply through diminishing marginal utility of government income, richer countries will be less tempted by the potential for aid racketeering. It is quite a severe policy to allow the suffering of one's own population in order to get income and foreign exchange, and only the most desperate of governments with the highest marginal utilities of income would be willing to go to such lengths. Those governments, quite simply, are the ones with virtually no other source of income.

The classic government that fits this description is not a normal member of the international system that can tax its subjects, levy import duties, and appeal for international loans and aid, but rather a rebel government that—barring the presence of mineral resources or a strong diaspora—must rely on a weak and exhausted local tax base and income from taxing humanitarian relief. This factor should contribute to the observation that famines and drought seem to characterize rebel-held areas in civil wars, especially wars that are not over mineral resources. Additionally, Somalia's barren war of the early 1990s featured the manipulation of humanitarian aid as a prominent feature of the conflict (Peterson, 2000). Recently, the North Korean government has insisted on aid being delivered through capital projects and centralized

government-run food disbursal mechanisms, both of which are much more easily expropriated than direct aid to the poor (Fairclough, 2006).

Finally, we endogenize the government's choice of the level of theft. In general this is a complex problem without clear predictions. However, we would like to emphasize one important idea:

Proposition 6 (*the desperation effect*)**:** Governments will steal more from NGOs the worse the impact of a shock on their citizens (i.e. the lower the value of $y - k$, the citizen's income prior to relief):

$$\frac{\partial t^*}{\partial (y - k)} < 0.$$

The intuition behind this effect is simple: since the local population is in bad shape, the NGO gets a very high marginal benefit from treating it, and therefore is not very sensitive to the price of relief aid. A flagrant example of the desperation effect occurred during the war and drought-induced famine in Somalia during 1992. Over four million Somalis were at risk for starvation (Peterson, 2000, 43). Absent the conflict, Somalia is a fairly efficient place for relief distribution. It has multiple ports and a barren landscape making travel relatively easy. But in this situation, humanitarian organizations were forced to go to extensive lengths to get food to the potential victims of the famine, and they were taxed by the "government" at every step along the way. Warlords charged relief agencies $30 per metric ton to keep their food in the port while waiting for safe escorts into the country (Lorch, 1992). Operating within Somalia was so dangerous that even the Red Cross resorted to hiring armed guards to protect the convoys against theft from bandits and local warlords (Auvinen and Kivimäki, 2000, 220), an additional transfer of wealth to the so-called authorities inside the country. But given how dire the situation was, humanitarians were willing to continue delivering aid even with the high levels of theft and

taxation, and this opportunity was seized on by the Somali power brokers.

V. IMPLICATIONS AND CONCLUSIONS

The results of this paper have important implications for the policies of disaster assistance. Our general policy implications are fourfold: invest in prevention, decentralize relief, encourage political development, and reward non-disasters. First, the need for prevention: this stems from the moral hazard problem that free relief generates. If the international community is willing to give relief to poor countries that have natural disasters, it should also recognize the perverse incentives this relief confers on the governments of poor countries. Thus, if wealthy nations are going to offer free relief, they should also offer free prevention.[14] There is already a massive base of knowledge on disaster prevention and preparedness, with multiple journals dedicated to just that. Related concepts include regulation, insurance, and liability (Zeckhauser, 1996).[15] For instance, grants can be made to poor governments to develop and police regulations that pass the costs of the disaster on to those who assume the risks.

Second, decentralization of relief: this can combat both the political effect and the racket effect, if it is politically feasible. If governments know that the affected area will get direct relief, the political benefits of a disaster are reduced, as the opposition population is less damaged. Moreover, the racket effect will be reduced, since the central government can no longer gain financially from the assistance. Of course, there may be reduced efficiency if the aid agency must deliver the aid directly to the victims rather than route it through the central government. Such a loss in efficiency would have to be weighed against the losses through the political effect and the racket effect from a centralized form of delivery.

Third, political development: as governments become more responsive to their population, and as intrastate conflicts decrease, the severity of disasters will naturally fall. This,

in addition to the improved technology of disaster prevention and mitigation, is probably responsible for the dramatic fall in deaths from disasters over the course of the last century. This is yet one more reason to work towards better and more accountable states.

Fourth, reward non-disasters: with the current institutions of relief, and through the racket effect, governments get financially rewarded when they have disasters. In other words, additional payments come during "bad times" while nothing happens during "good times." In this article, we have argued that governments can affect the probability of bad times that are triggered by natural shocks. Optimally, governments would get rewarded for good prevention actions.

The propositions of the model offer a host of empirical predictions that further research may be able to validate. In particular, careful empirical examination may be able to delve further into the possibility raised with the summary statistics of this paper that smaller, more homogeneous, pariah, and landlocked countries better prepare for disasters. Such an investigation will have to properly deal with issues of reporting bias, measurement error, omitted variable bias (the size of the "true" underlying natural shock), and the question of what types of deaths can be prevented through preventative disaster spending and what deaths can be prevented through palliative spending. Other potential avenues for empirical research include comparing unitary versus federal states, and using US states as a microcosm for the world, where the federal government acts like the outside humanitarian relief agency in our model.

With the onset of global warming, it is likely that the incidence of natural shocks will only increase in the years ahead (UNEP 1999). In addition, rising inequality between rich and poor countries combined with a commitment on the part of developed countries to increase foreign aid disbursements indicates that international relief in natural disasters will grow. This

paper has argued that the relief enters, and affects, a very political situation. The paper has also argued that the political economy of natural disasters is understandable and predictable.

Disaster relief is one of the most basic and important transfers of wealth between developed and developing countries. Given correctly, disaster assistance can smooth shocks to poor countries that might otherwise be debilitating. Like all transfers, however, it can distort incentives or be manipulated by self-interested leaders. The contention of this paper is that policy makers ought to craft natural disaster relief to minimize these distortions and manipulations. The "natural" side of disasters is tragic enough that domestic policies and the actions of international relief should be designed to mitigate, rather than exacerbate, the wrath of nature.

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Appendix: Proofs of Propositions

Proof of Proposition 1: We will show that

$$\left(\frac{f_b}{f_a}\right)_{GOVERNMENT} > \left(\frac{f_b}{f_a}\right)_{CONSUMER}.$$

Since f is concave, this implies that the ratio of prevention to relief is lower for governments.

To correct for the fact that governments and individuals do not value income equally, let us just

look at the ratio of marginal productivity of preventative to palliative spending. In the individual

case, this is given by:

$$\frac{f_b}{f_a} = \frac{p_b}{p_a}\left(1 + \frac{(1-q)u^{ns\,\prime}}{qu^{s\,\prime}}\right)$$

Whereas in the governmental case it is:

$$\frac{f_b}{f_a} = \frac{p_b}{p_a}\cdot\left(1 + \frac{(1-q)v^{\prime ns}}{qv^{\prime s}}\right).$$

Hence the ratio of these two is determined by the relative ratios of magnitudes of $\dfrac{u^{ns\,\prime}}{u^{s\,\prime}}$ and $\dfrac{v^{\prime ns}}{v^{\prime s}}$,

i.e.

$$\left(\frac{f_b}{f_a}\right)_{GOVERNMENT} > \left(\frac{f_b}{f_a}\right)_{CONSUMER} \Leftrightarrow \cdot\frac{v^{\prime ns}}{v^{\prime s}} > \frac{u^{ns\,\prime}}{u^{s\,\prime}}$$

This is true under reasonable assumptions. Assume that governments and consumers have the

same constant relative risk aversion and that $I>y$. Then we only need to show that

$$\left(\frac{I - p_b}{I - p_b - p_a}\right)^{\alpha-1} > \left(\frac{y - p_b}{y - (k - r) - p_b - p_a}\right)^{\alpha-1}.$$

This follows from simple algebraic manipulation. This means that palliative spending is much more costly for individuals than governments, and hence they will tend to "insure" more by spending on preventative measures.

Proof of Proposition 2: This follows immediately from standard comparative statics. In a two-good consumption problem, if the goods are separable, then they are both normal. If they are not separable, then they are both normal if they are complements. If they are substitutes, either one or both will be normal (depending on how severe the substitution effect is). Note that if $\lambda<0$, this does not hold, as the government always chooses the corner solution $a=b=0$.

Proof of Proposition 3: We prove this using standard comparative statics. This is straightforward, because:

$$\frac{\partial V}{\partial b} = \frac{f_b}{f_a} - \frac{p_b}{p_a} \cdot \left(1 + \frac{(1-q)v'^{ns}}{qv'^s}\right),$$

and none of these terms involve λ. Hence we know that $\frac{\partial^2 V}{\partial b \partial \lambda} = 0$. This means that the sign of

$\frac{\partial r}{\partial \lambda}$ is given by the sign of $\frac{\partial^2 V}{\partial r \partial \lambda}$:

$$\frac{\partial V}{\partial r} = \lambda u'\big(y - (k - r)\big) - v'\big(I - c(r,b)\big)\frac{p_a}{f_a\big(a(r,b),b\big)}$$

$$\frac{\partial^2 V}{\partial r \partial \lambda} = u'\big(y - (k - r)\big) > 0$$

Proof of Proposition 4: This is true by inspection of the terms on the right hand side of the first order condition:

$$\frac{f_b}{f_a} = \frac{p_b}{(1+t)p_a}\frac{1}{q}\frac{v'}{m}\frac{1}{\lambda}\left(\frac{u''}{u'}\frac{f_a}{f_{aa}} + 1\right)f_a + \frac{f_{ba}}{f_{aa}}.$$

As the terms mentioned move in the directions described, $\dfrac{f_b}{f_a}$ rises. This means that (under

reasonable assumptions about f) the level of preventative aid relative to palliative aid is falling.

Proof of Proposition 5: In this problem, the only first-order change is that the government now

receives revenue from palliative aid. This means that, in addition to caring about the level of r,

the government also cares about the level of a, and how this changes with b. We have:

$$\frac{\partial a}{\partial b} = \frac{f_{ab}u' + f_a f_b u''}{-\left(f_{aa}u' + f_a{}^2 u''\right)}.$$

If b and a are substitutes, then $\dfrac{\partial a}{\partial b}$ is always negative. Assuming that the government's utility

over income is roughly linear over the area in question, the optimal level of b without theft

cannot be an equilibrium, because there is now an additional benefit of more theft from a cut in

prevention. However, if b and a are strongly complementary, then $\dfrac{\partial a}{\partial b}$ may be positive. If this

is this case, increasing b gains the government additional revenue, and hence b will be higher

than in the equilibrium without theft.

Proof of Proposition 6: This proposition will not always hold, but it will under reasonable

assumptions. For expositional simplicity we demonstrate it in an "extreme" case; in more

moderate cases the effect will be muted but will usually go on in the same direction. The

intuition is the same in these other cases.

For simplicity, assume that the government is trying to maximize revenue from theft. To

further simplify our calculations, we assume that $f(b,a) = a+b$ (so that preventative and palliative

spending are perfect substitutes, and the government always sets $b=0$). This means that the

government is maximizing:

$$\max_{t} ta(t) \Rightarrow t \frac{\partial a}{\partial t} + a(t) = 0$$

Where the level of aid and NGO response function is given by

$$u'(y - k + a) = (1 + t)p_a m$$
$$\frac{\partial a}{\partial t} = \frac{p_a m}{u''}$$

Hence the optimal t is defined implicitly by:

$$t^* = \frac{-a}{\dfrac{\partial a}{\partial t}} = \frac{-au''}{p_a m}$$

We take the comparative static with respect to the level of the citizen's post-shock income,

$y - k$:

$$\frac{\partial t^*}{\partial (y - k)} = \frac{-\dfrac{\partial a}{\partial (y - k)} u'' - a\left(1 + \dfrac{\partial a}{\partial (y - k)}\right)u'''}{p_a m}$$

But we note that:

$$\frac{\partial}{\partial (y - k)}(u'(y - k + a)) = \frac{\partial}{\partial (y - k)}((1 + t)p_a m)$$
$$\left(1 + \frac{\partial a}{\partial (y - k)}\right)u''(y - k + a) = 0$$
$$\frac{\partial a}{\partial (y - k)} = -1$$

This implies:

$$\frac{\partial t^*}{\partial (y - k)} = \frac{u''}{p_a m} < 0$$

Hence, the worse off civilians are after a disaster, the more the government will choose to steal

from NGOs.

Table 1: Annual number killed and affected from natural disasters per year by size, 1975-2000[16]

	Deaths from disasters per 1,000,000 people	Persons affected by natural disasters per 1,000 people
Small countries (<500,000 people in year 2000)	12.4 (3.6)	19.4 (1.2)
Large countries (>500,000)	17.6 (3.6)	17.2 (4.6)

Standard errors in parentheses.

Table 2: Annual number killed and affected from natural disasters per year by ethnic fractionalization, 1975-2000[17]

	Deaths from disasters per 1,000,000 people	Persons affected by natural disasters per 1,000 people
Low ethnic fractionalization (<43)	8.2 (2.2)**	9.1 (1.5)***
High ethnic fractionalization (≥43)	26.7 (9.1)**	23.9 (2.5)***

Standard errors in parentheses. **means significantly different at p=0.05. ***means significantly different at p=0.01.

Table 3: Annual number killed and affected from natural disasters per year by landlocked, 1975-2000[18]

	Deaths from disasters per 1,000,000 people	Persons affected by natural disasters per 1,000 people
Landlocked	8.5 (3.9)	22.1 (1.4)*
Not landlocked	19.0 (1.5)	16.3 (3.1)*

Standard errors in parentheses. *means significantly different at p=0.1.

Endnotes

[1] There is extensive debate on the definition of disaster—at least two edited volumes are dedicated solely to this task (Quarantelli, 1998; Perry and Quarantelli, 2004).

[2] White (2003) surveys the estimates for each war. Estimates for World War I are on the order of 10 million and for World War II are on the order of 50 million.

[3] This decrease is probably underreported due to improvements in data collection.

[4] See Rosenthal and Kouzmin (1997) for a discussion of government coordination around natural disasters.

[5] For example: a corrupt kleptocracy may care only about stealing as much money as possible, whereas a benevolent president may care only about the social welfare of the general population. The kleptocracy will still attempt to guarantee some level of social welfare (to avoid a revolution). The benevolent president also cares about money (e.g. to finance a reelection campaign). But these different forms of government will have extremely different marginal utilities from these inputs.

[6] For example: assume that we are embedded in a more complicated game where voters only reelect candidates that they believe are better than some (stochastically chosen) challenger, and that voting costs and political benefits vary with income. Then we may end up with a government's probability of reelection being a function of average voter utility, $p(u(y))$. If the benefits to reelection are equal to R (again, this could be the reduced form of a more complicated game with multiple election cycles), then the government cares about voter utility to the extent that it cares about $p(u(y)) \cdot R$. If $p(u(y))$ is approximately linear, this is then $pRu(y)$. Hence, λ can be interpreted as the product pR, where p measures how accountable politicians are to voters (i.e. how easily they can be thrown out of office), and R measures the rents the politician accrues when he is reelected.

[7] With multiple regions, we would simply have regional subscripts on λ and y in the following analysis.

[8] In our model we are not considering the fact that governments may care about deaths as separate from economic damage.

[9] For example, countries may overstate the size of a disaster in order to gain extra aid. This tendency may vary systematically with a number of country characteristics.

[10] Stromberg (2007) finds weaker support for this hypothesis.

[11] Private communication, Oxfam America executive, December 2005.

[12] Source: SourceOECD and World Bank WDI databases

[13] Rigorous empirical tests are difficult, as pariah states have strong incentives to underreport deaths and other damage from disasters.

[14] In a more generic statement of this problem, Coate (1995) argues for insurance transfers to poor people facing risks under circumstances with rich altruists in order to avoid the bailout effect.

[15] Pollner (2001) describes potential solutions in finance and insurance.

[16] OFDA/CRED 2003. There are 700 observations for small countries and 4022 observations for large countries. These statistics begin in 1975 due to the lower quality of data before then.

[17] OFDA/CRED 2003. There are 1430 observations for each group of countries. Ethnic fractionalization data from Easterly (2001).

[18] OFDA/CRED 2003. There are 988 observations for landlocked countries and 3734 observations for non-landlocked countries. Landlocked status from Easterly (2001).