Journal of Conflict Resolution
Volume 51 Number 5
October 2007 715-743

DOI: 10.1177/0022002707305234
http://jcr.sagepub.com
hosted at
http://online.sagepub.com

Political Aftershocks:
The Impact of Earthquakes on Intrastate Conflict

Dawn Brancati
Institute for Quantitative Social Science
Harvard University, Cambridge, Massachusetts

Although many scholars, policy makers, and relief organizations suggest that natural disasters bring groups together and dampen conflicts, earthquakes can actually stimulate intrastate conflict by producing scarcities in basic resources, particularly in developing countries where the competition for scarce resources is most intense. Capitalizing on a natural experiment design, this study examines the impact of earthquakes on intrastate conflict through a statistical analysis of 185 countries over the period from 1975 to 2002. The analysis indicates that earthquakes not only increase the likelihood of conflict, but that their effects are greater for higher magnitude earthquakes striking more densely populated areas of countries with lower gross domestic products as well as preexisting conflicts. These results suggest that disaster recovery efforts must pay greater attention to the conflict-producing potential of earthquakes and undertake certain measures, including strengthening security procedures, to prevent this outcome from occurring.

Keywords: *earthquakes; natural disasters; conflict; civil war; natural experiment*

After an earthquake killing 30,000 struck Kashmir in 2005, hopes were high that the disaster would unite people across boundaries and bring an end to conflicts simmering in the region. "This is a common tragedy," declared Lalit Mansingh, India's Ambassador to Washington, DC.[1] "It can bring people together" and "help in furthering the peace process."[2] Policy makers such as Mansingh and many scholars suggest that natural disasters can reduce conflict by uniting people in a common fate and a shared goal of reconstruction. In Kashmir, however, hopes for peace were quickly dashed as talks between India and Pakistan over the disputed land continued

Author's Note: For comments, I thank Markus Alexander, Larry Bartels, Ruth Ben-Artzi, Bear Braumoeller, Dolores Ciccone, William Cotte (Colombian Red Cross), Federico Ferrara, Shareen Hertel, Shigeo Hirano, Gary King, Rudolf Muller (United Nations, Central Emergency Response Fund), Eric Werker, and especially Olivia Lau, whose knowledge of earthquakes speaks of a true Californian. For GIS support, I thank Patrick Florance and Whitley Frost at Harvard University. I also thank the many experts who shared their time and knowledge in helping me correct the selection bias in the Minorities at Risk (MAR) dataset, as well as James Fearon and David Laitin for sharing their data. Replication data for this study are available at http://jcr.sagepub.com/cgi/content/full/51/5/715/DC1/.

to stumble after the quake, while violence in the region was unabated.[3] Elsewhere, including Colombia in 1999 and El Salvador in 1986, earthquakes have not only failed to foster peace but have seemed to spur intrastate violence as well. What effect do earthquakes have on conflict, if any, and why?

Earthquakes, I argue, promote intrastate conflict by increasing competition among groups for scarce resources (e.g., food, water, housing, medicine, and relief aid). Scarcities, in turn, provoke frustrations, which lead to anger and violence. Their effects are greater in economically developing countries than in developed ones since earthquakes have more severe consequences in the former than in the latter. Earthquakes also have larger effects in countries already experiencing conflict since rebels can capitalize on earthquakes to attract popular support, recruit soldiers, and finance campaigns.

Why earthquakes? Earthquakes may provoke conflict more than any other type of natural disaster because they have rapid onsets. In occurring quickly and without warning, earthquakes are more likely to stoke feelings of frustration arising from relative deprivation than disasters with slow onsets, such as droughts. Earthquakes, moreover, unlike some other disasters such as famine, are exogenous to conflict. Conflict, that is, does not affect whether earthquakes occur or the magnitude with which they strike, although conflict may increase the amount of damage that earthquakes inflict. Earthquakes do not occur, furthermore, in regions of the world particularly prone to conflict, as do droughts, which dominate Africa. Additionally, while earthquakes occur primarily along fault lines, earthquakes are not predictable.

Despite the political importance of natural disasters, such as earthquakes, only a few studies have explored their effect on conflict (Kelman and Koukis 2000; Quarantelli and Dynes 1976; Evin 2004; Ember and Ember 1992; Miguel, Satyanath, and Sergenti 2004). These studies are sharply divided over whether they believe disasters mitigate conflict by fostering cooperation among groups (Kelman and Koukis 2000; Quarantelli and Dynes 1976; Evin 2004), exacerbate it by reducing economic development (Miguel, Satyanath, and Sergenti 2004), or whether simply the threat of disasters fosters conflict by triggering preemptive strikes against other groups for resources expected to be scarce in the future (Ember and Ember 1992).

In this study, I hope to advance this debate by suggesting why conflict may not emerge as theorized and how actual scarcities that arise in the wake of earthquakes can incite conflict, as well as the conditions under which they are more likely to do so. I also hope to provide a more rigorous test of these effects by using data on a single type of disaster that is exogenous to conflict and by expanding the number of cases in which the effects of disasters are studied. In this analysis, I also measure disasters very precisely, using data compiled based on seismographic instruments and taking into consideration not only the frequency of earthquakes but also the magnitude with which earthquakes strike as well as the population density of the areas in which they occur.

The statistical analysis presented here is based on 185 different countries around the world from 1975 to 2002. The analysis draws on data from the Centennial Earthquake Catalog (Engdahl and Villasenor 2002) and several different datasets to measure intrastate conflict, including the Integrated Data for Events Analysis (IDEA) dataset (Bond et al. 2003) the Minorities at Risk (MAR; Center for International Development and Conflict Management [CIDCM] 2005) dataset, and the Fearon and Laitin (2003) civil war dataset. The results of this analysis suggest that earthquakes increase intrastate conflict and have larger effects in less developed countries as well as countries already experiencing some form of conflict, but earthquakes in bordering countries have little, if any, impact on intrastate conflict.

The remainder of this article is organized as follows. In the first section, I describe earthquakes—how often they occur, where they occur, and how severe are their effects in countries. In the second section, I present my argument for why earthquakes increase intrastate conflict by intensifying competition for basic resources. I discuss the data I use and the measurements I employ in the statistical analysis in the third section, and in the fourth, I describe the results of the statistical analysis. In the fifth section, I conclude with a discussion of the applicability of these findings to other natural disasters and their implications for postdisaster reconstruction.

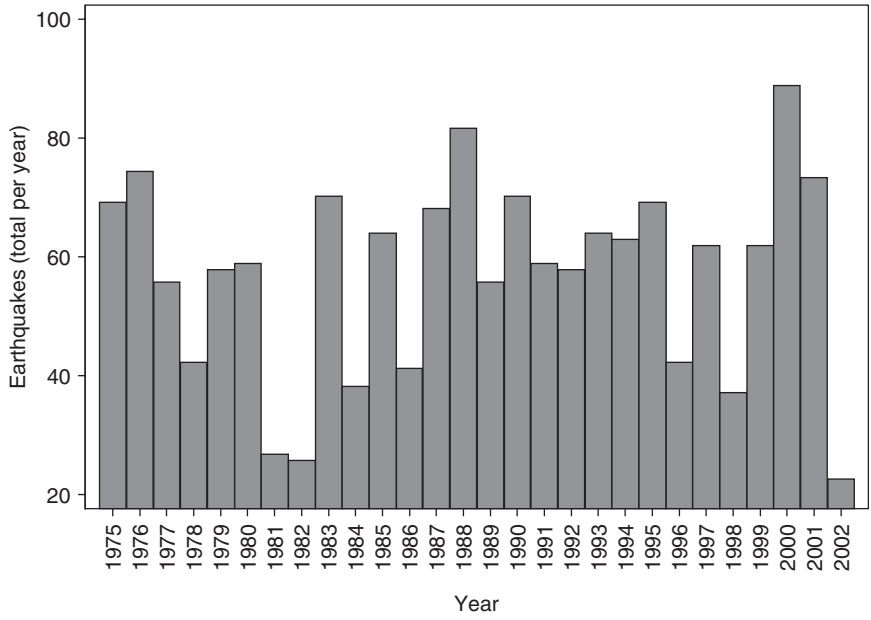
Earthquake Demographics

Earthquakes are caused by the release of energy within the earth's crust, triggering sudden, sometimes violent movements of the earth's surface. They occur primarily along plate boundaries or fault lines and although earthquakes can arise in the interior of plate boundaries, interplate earthquakes are generally much larger than intraplate ones.[4] Earthquakes can also occur beneath the ocean floor where they can trigger tsunamis, such as the one that struck Asia in 2004 following a M9.0 earthquake in the Indian Ocean.

Earthquakes occur almost daily, although earthquakes that can actually be felt on the earth's surface (i.e., earthquakes approximately M5.5 or higher on the Richter scale) occur less often. According to the U.S. Geological Survey, more than 1,500 earthquakes of this magnitude have occurred in countries between 1975 and 2002 and as many as 89 earthquakes have occurred in a single year. Although the rate with which earthquakes arise is fairly constant over time, some scientists project that the melting of the polar ice caps may cause earthquakes to become more common in the future (Ekström, Nettles, and Tsai 2006).

Since earthquakes occur primarily along plate boundaries, they affect some regions of the world more than others. Earthquakes occur most often in Asia, the western seaboards of North America and Latin America, and along the Mediterranean Sea. The countries in which earthquakes have occurred most often between 1975 and 2002 are Papua New Guinea (173), followed by Indonesia (159) and

Figure 1
Number of Earthquakes M5.5 or greater (1975-2002)

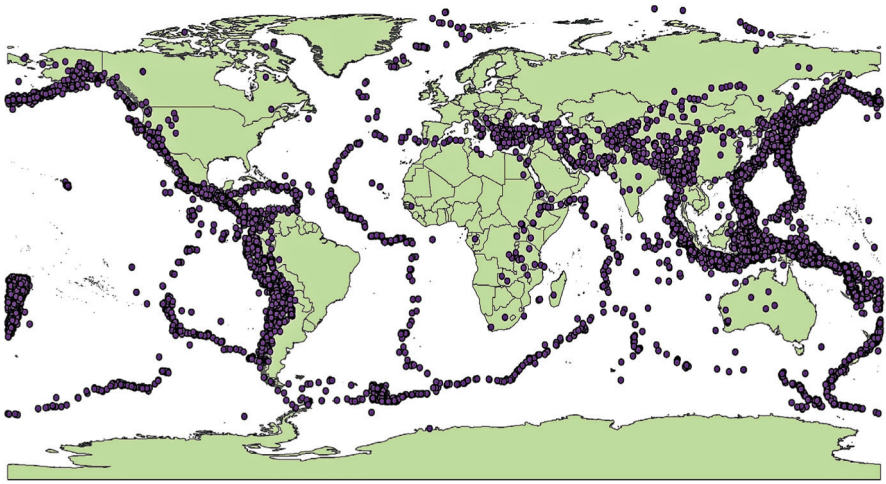


Source: Data based on E. R. Engdahl and A. Villasenor (2002), Centennial Earthquake Catalog. The data in this graph include only earthquakes occurring in the countries contained in the statistical analysis.

Chile (102). No country in this period has experienced more earthquakes in a single year than China, which was subjected to 16 earthquakes in 1976. However, topping M8.2 on the Richter scale, the most intense earthquake that occurred in this period took place in Bolivia in 1994.

While earthquakes occur more often in some regions of the world than in others, those in which earthquakes arise most often are not necessarily more conflict prone than others. Low- and medium-intensity conflicts strike countries throughout the world, including developed ones, while civil wars occur primarily in sub-Saharan Africa. Earthquakes, furthermore, do not occur more often in underdeveloped countries and rarely occur in sub-Saharan Africa. In fact, the average number of earthquakes that strike countries belonging to the Organisation for Economic Co-operation and Development (OECD) is no different than that which affects non-OECD countries.[5] For this reason and others, earthquakes are an ideal measure with which to evaluate the effect of natural disasters on conflict.

Figure 2
Geographic Location of Earthquakes M5.5 or Greater (1975-2002)



Source: Data based on E. R. Engdahl and A. Villasenor (2002), Centennial Earthquake Catalog.

Natural Disasters in Perspective

Disasters are the subject of intense study in the fields of psychology, health, and economics, where their effects on infectious disease (Bissell 1983), depression and physical abuse (Curtis, Miller, and Berry 2000), and unemployment and debt (Benson and Clay 2004; Freeman, Keen, and Mani 2003; Albala-Bertrand 1993) are keenly examined. Disasters are not as well studied, however, in the field of political science, although a few works have examined government responses to disasters (Cohen and Werker 2006; Brass 1986; Klinenberg 2004), as well as the effects of disasters on voting (Achen and Bartels 2004). Several studies across different fields have also examined the impact of disasters on conflict, but these works are sharply divided over disasters' perceived effects.

Several such studies argue that natural disasters dampen conflict (Kelman and Koukis 2000; Quarantelli and Dynes 1976; Evin 2004). Using case studies and illustrative examples primarily of international conflict, these works contend that disasters dampen conflict not only by uniting people in a common fate but also by making previous sources of conflict seem unimportant relative to the disaster and bringing people together to work on a common goal, namely a country's relief, recovery, and reconstruction. In the words of Ilan Kelman and Theo Koukis

(2000), "the cooperative spirit generated from common efforts to deal with disasters through either perceived necessity or choice from the humanitarian imperative possibly overrides pre-existing prejudices, breaking down barriers which then may never be rebuilt" (p. 214).

Many relief organizations share this view. According to the Geography Unit of the Peace Corps, natural disasters "bring people together, reinforce interconnections, and reveal surprising traits of heroism. Working together to respond to a natural disaster can unite us with others in a common bond of humanity."[6] Many policy makers cleave to this belief as well. After the tsunami struck Asia, the president of Sri Lanka, Chandrika Kumaratunga, broadly proclaimed that the tsunami would create a new dimension in the peace process between the government and the Liberation Tigers of Tamil Ealam (LTTE). According to Kumaratunga, "[t]he extent of devastation caused by the Tsunami was unprecedented in the history of our country. However as the saying goes 'every dark cloud has a silver lining.' . . . in the recent history of 20 years of this country we have never had such a fine, practical and advantageous opportunity for peace."[7]

A number of factors, however, may prevent cooperation from emerging after natural disasters. Often the individual, one-on-one interaction, which psychologists argue is needed among equals to overcome preexisting prejudices, does not occur in reconstruction and recovery efforts (Allport 1954). Much of relief and reconstruction efforts are carried out by national governments, armed forces, and foreign countries as well as large international organizations, such as the United Nations and Red Cross. Although local organizations can participate in these efforts, providing a greater chance for the appropriate interaction to emerge, in societies already experiencing conflict, many of these organizations are drawn along conflict lines.

Many of the cases suggesting that disasters foster cooperation are based on international not intrastate conflict, where one country is affected by a disaster and another offers assistance, so that there is no competition for scarce resources between countries or an opportunity for countries to blame each other for the scarcities. Also, in some cases, there was a move toward cooperation prior to the disaster, as in the case of Greece and Turkey in 1999 (Ker-Lindsy 2000). Furthermore, in postdisaster situations, instead of preexisting tensions seeming unimportant in comparison to existing disasters, often preexisting tensions taint the recovery process, leading some groups to be or perceive to be disadvantaged in recovery efforts.

Potentially, natural disasters may also reduce conflict by diminishing the capacity of groups to initiate or sustain conflicts, decimating national infrastructures, destroying ammunition and weapon supplies, and reducing the availability of human capital needed to carry out conflicts. Natural disasters can also kill important political leaders without which warring factions may lack the necessary leadership to conduct conflicts.[8] Disasters, however, can reduce the capacity of states to suppress rebellion and concurrently increase the capacity of groups to fight, providing them with new

sources of funding and new opportunities to attract support and recruit members, as will be discussed further in the subsequent section.

A few statistical studies argue, in contrast, that natural disasters intensify conflict. Miguel, Satyanath, and Sergenti (2004), for example, suggest that droughts increase civil wars in Africa. The goal of this study is to address the endogeneity problem present in previous studies of civil war by using yearly rainfall as a proxy for development. My goal is different, however. It is to focus specifically on the effects of disasters on conflict, and while disasters may affect GDP, GDP may not fully capture the impact of disasters on conflict. Disasters can cause short-term shortages in basic resources, which may not have much impact on yearly measures of national GDP. Disasters can also spark large-scale population movements, attract lootable international aid, and give rise to orphans who are prime targets for rebel recruitment.

Given my different theoretical goal, my methodological approach also differs from Miguel, Satyanath, and Sergenti (2004). Whereas they use rainfall to proxy for development in an instrumental variable regression analysis, I study disasters separately from development but still interact the two to understand the conditional effect of development on disasters.[9] I further look at the effect of disasters on low- as well as high-intensity conflicts, such as civil wars, and focus on a different type of disaster, earthquakes, which, like rainfall, however, are exogenous to conflict. My analysis also includes all regions of the world, which is valuable since Africa is prone to both droughts and civil wars.

An anthropological study by Ember and Ember (1992) also argues that natural disasters exacerbate conflict. Their argument is similar to the one presented here. However, Ember and Ember claim that the threat of future natural disasters, not actual disasters, leads to conflict among ethnographic societies, which steal resources from each other to prepare for future disasters. While I share Ember and Ember's conviction that the impact of disasters on conflict is associated with resource scarcity, I contend that actual disasters, not the threat of future disasters, cause scarcities and hence conflict.

Ember and Ember (1992) also use statistical analysis to understand the impact of disasters on conflict. Their analysis differs from mine, however, in a number of respects. Ember and Ember's earlier analysis relies on a single measure of conflict based on expert opinion of a particular point in time. Their measures of disasters (i.e., famine and weather or pest disasters that threaten food supplies) are also loosely defined and similarly based on expert opinion. This analysis, in contrast, utilizes multiple measures of conflict for countries, not ethnographic societies, over a long period of time and focuses on a particular type of disaster, earthquakes, which are measured precisely and are not endogenous to conflict, which famine may be construed as.

Finally, in a related literature on the environment, scholars have suggested that hazards, such as overpopulation, environmental degradation, and resource depletion,

can incite conflict by causing population movements, fostering grievances against states, and reducing the capacity of states to suppress rebellion (Homer-Dixon 1994, 2001; Kahl 1998; Reuveny 2002). I share this literature's position that environmental events can stimulate conflict but focus on a different type of environmental event. Earthquakes are different from environmental issues typically studied by this literature because they have rapid onsets. Victims of rapid-onset events are more likely to notice changes in their conditions than victims of slow-onset events and are less likely to adapt to them as well (Gleditsch 1998). Earthquakes, moreover, are exogenous to conflict, unlike certain environmental events. Finally, in contrast to these environmental studies, which skillfully use process tracing to tease out the effects of environmental events on conflict in particular cases, I use statistical analysis to generalize about the effect of earthquakes on conflict more broadly.

Earthquakes, Scarcities, and Conflict

Earthquakes, I argue, increase intrastate conflict by creating scarcities in basic, life-sustaining resources (e.g., food, water, and housing). The idea that scarcities can yield violent conflict is not new. The link, however, between scarcities, disasters, and conflict has heretofore been underexplored. Scarcities following earthquakes can arise from a number of different processes. Earthquakes can cause water shortages by contaminating drinking wells or reservoirs and destroying water supply lines. Earthquakes can create food shortages by destroying crops, killing animal life, and wrecking fishing fleets, and they can also create housing shortages by decimating homes, hotels, dormitories, and so forth. Finally, scarcities in energy supplies can arise from earthquakes knocking down power lines, contaminating oil supplies, and destroying infrastructure needed to deliver energy supplies to homes and businesses.

Scarcities, in turn, can lead to conflict because of feelings of frustration and desperation arising from relative deprivation. According to relative deprivation theories, groups become frustrated when they are denied material benefits that they once had in the past or that other groups have over them and respond to these situations through anger and violence (Grofman and Muller 1973; Miller, Bolce, and Halligan 1977; Horowitz 1985; Hechter 1975). Relative deprivation theories are especially applicable to crises following earthquakes since these theories stress rapid changes in people's conditions such as those that arise from earthquakes. Gradual changes are less likely to result in violence since people may not be aware of these changes and may adjust to them more easily. Relative deprivation theories are also appropriate for explaining conflict following earthquakes because scarcities do not generally affect all groups equally and individuals commonly blame government leaders for natural disasters regardless of whether they are actually responsible for them (Achen and Bartels 2004).

Competition for scarce resources can also result in violence as desperate groups fight to obtain resources either with other individuals or governments responsible for distributing resources. Conditions that normally induce cooperation, such as long time horizons and repeated play, are not present in cases of severe scarcities since individuals may not survive unless they have certain resources. Resource competition often evolves into violence at the point in which relief aid is distributed to victims who struggle to get provisions. At other times, it occurs as people try to steal resources from others, breaking into stores, gas stations, supply trucks, homes, and so forth, where they encounter resistance from property owners and police forces. Such behavior was widespread in Muzaffarabad following last year's earthquake in Pakistan, in Armenia after an earthquake killed 25,000 in 1988, and in Colombia after the coffee-zone earthquake of 1999. Frequently, competition for scarce resources also results in violent protests or rebellion against governments, with groups seizing government offices and police stations because they blame states for inadequately providing basic resources to victims. Maintaining the rule of law following an earthquake is challenging because police and military forces needed to enforce order may be preoccupied by relief and recovery efforts.

Earthquakes are most likely to intensify intrastate conflict under two conditions. The first is the level of economic development in a country. The propensity for earthquakes to intensify conflict is greater in less developed countries than in more developed ones since scarcities are larger in the former than in the latter (Anbarci, Escaleras, and Register 2005). Since home construction and infrastructure are more advanced in developed countries, these countries typically sustain less damage than developing countries. Well-developed countries also have the financial means with which to alleviate shortages quickly once disasters occur and are generally better able to maintain public order (Fearon and Laitin 2003).

The second condition under which earthquakes are more likely to promote intrastate conflict is the presence of preexisting tensions or lower levels of conflict, which not only increase the incentives for groups to engage in conflict but also the capacity of groups to carry it out. Groups that already harbor ill feelings toward each other are more likely to fight over scarce resources than those that do not, since grievances arising from scarcities may reinforce or magnify existing sentiment, especially if one group faces more scarcities than another. Rebel groups may also capitalize on people's grievances to fuel their movements by blaming scarcities on governments or other social groups. The corrupt practices, for example, of the Somoza regime after the 1972 earthquake that devastated Nicaragua in 1972 and killed an estimated 10,000 engendered enormous support for the Sandinistas. The Somoza regime, which was eventually toppled by the Sandinistas in 1979, allegedly misappropriated millions of dollars in international aid after the earthquake, leaving Nicaraguans with little hope of recovering.[10]

Additionally, preexisting conflicts may increase scarcities because they drain governments financially and prevent them from undertaking measures to reduce

the effects of disasters before they occur (Cohen and Werker 2006). Preexisting conflicts can also make it difficult for governments to deliver aid to conflict zones because they pose significant dangers to relief workers. Earthquakes, meanwhile, can prevent governments from suppressing rebellion because they place enormous demands on police and military soldiers, which are needed in disaster areas to recover bodies, deliver aid, and prevent looting or other forms of violence.

Earthquakes, moreover, can also increase the capacity of groups to carry out conflicts. Earthquakes can attract humanitarian aid, which rebel groups may divert to further their causes (Anderson 1999; Lischer 2003). Not only may groups use relief aid in the form of food and medical provisions to sustain troops, but they may also appropriate motor vehicles and telecommunication devices to transport troops and facilitate communication among them and also divert relief funding to purchase weapons or other supplies. Earthquakes can further increase the capacity of groups to conduct conflicts by orphaning children. Orphans are vulnerable to rebel recruitment because they lack families to protect against rebels kidnapping them and may be lured by enticements of food and housing to voluntarily join rebels as well (Singer 2006).

Illustrative Case Studies

To illustrate the mechanisms through which earthquakes may promote conflict, let us turn our attention briefly to two recent cases of major earthquakes that assumed different forms and intensities and occurred in two distinct regions of the world: the 1999 earthquake in Colombia and the 2004 Indian Ocean earthquake. In January 1999, a M6.0 earthquake struck central Colombia, killing an estimated 1,000 people and injuring thousands more. The earthquake created massive shortages in food, water, and most notably, housing. Adding to the millions already displaced by Colombia's enduring civil war, the earthquake left an estimated 35,000 people homeless. In striking Colombia's coffee zone, the earthquake also severely damaged the country's economy, which shrank by nearly 6 percent in the first quarter of 1999.[11] Although the earthquake did not damage the coffee crop itself, it disrupted coffee production by decimating processing plants and displacing thousands of families who took refuge in the courtyards where coffee beans were previously laid out to dry before processing.

Although the United States extended millions of dollars in aid to Colombia, the national government's initial response to the disaster was poor. In the immediate aftermath of the quake, distribution problems and communication failures prevented the government from adequately delivering aid to the disaster zone, resulting in widespread violence in the region. Not only was there extensive looting by quake victims, who pilfered desperately needed resources from stores, but there were also frequent clashes between angry, frustrated citizens and police or military forces, compelling the government to impose a curfew on the region.

Attacks by rebels, who failed to withdraw as scheduled from the demilitarized zone after the earthquake, intensified during this time as well. The earthquake impeded the government's ability to suppress the rebels, in particular the Revolutionary Armed Forces of Colombia (FARC) and National Liberation Army (ELN), by draining the government's coffers and diverting troops to the disaster area.[12] The earthquake may have also hindered peace negotiations between the government and rebels, which were already stumbling at the time of the quake, by undermining the government's credibility and reducing its bargaining power. Speaking more generally, Walter Cotte, director general of National Relief for the Colombian Red Cross, relates that "earthquakes influence a process of peace positively or negatively depending on the manner with which the actions of emergency support include all the affected."[13] Disaster relief in a conflict-torn country such as Colombia, however, is complex and challenging, Cotte further states, because "politicization is a permanent risk besides the large influence of armed actors in search of other interests in their war strategy."[14]

Similar dynamics were present in Sri Lanka following the tsunami, which killed 300,000 in Asia and was triggered by a M9.0 earthquake in the Indian Ocean. In Sri Lanka, the tsunami caused extreme shortages in food, water, housing, and so forth, which international relief aid did little to reduce. Remarkably, the tsunami left an estimated 1.5 million people homeless and hundreds of thousands facing food shortages in a country where over 4 million people were already undernourished.[15] Shortages were exacerbated by the fact that Sri Lanka, like Colombia, is not very well developed economically and lacked the technology to forewarn the disaster as well as the financial resources with which to reduce the scarcities. With a GDP per capita of US$809 in 2004, nearly half that of Colombia in 1999, Sri Lanka relied heavily on billions of dollars of international aid to recover from the tsunami, a process still in development today.[16]

Despite these shortages immediately after the tsunami struck, intrastate conflict did not erupt, and hopes were high that the tsunami would facilitate increased cooperation between the government and the LTTE, which agreed to work with the government to distribute relief aid to the tsunami's victims. Soon after, however, the LTTE engaged in renewed violence and jeopardized the cease-fire agreement in place at the time. Strapped by relief efforts, the government faced significant difficulties resisting LTTE attacks. In the first ten months of 2005, the LTTE killed 200 people, three times as many people as it killed in the previous year.[17]

The LTTE bolstered its campaign among Tamils by claiming that the government favored the Sinhalese-dominated South in aid distribution, even though the South suffered less damage from the tsunami. The LTTE also advanced its campaign by seizing control of aid distribution in the Northeast and delivering this aid much more efficiently than the Sri Lankan government.[18] The LTTE even took advantage of the number of children orphaned and left homeless by the tsunami to recruit LTTE soldiers. Allegedly, the LTTE also smuggled war supplies into the country under the

guise of relief aid, diverted donations to fuel their war effort, and sent sympathizers abroad as ''economic refugees'' so that they could send money back to the LTTE. While LTTE soldiers at times used different tactics than those in Colombia, rebels in both countries capitalized on the disasters to advance their causes.

Data and Measurements

While these cases are illustrative of the effects earthquakes can have on conflict, to examine their impact more systematically, I conduct a statistical analysis of the effects of earthquakes on intrastate conflict in as many as 185 countries around the world between 1975 and 2002. By examining this question using a statistical analysis that capitalizes on a natural experiment design, I hope to establish general patterns about the effects of earthquakes on intrastate conflict as well as intervening factors, such as economic underdevelopment and preexisting conflict.

Independent Variable

The data on earthquakes are drawn from Centennial Earthquake Catalog (1964-present; Engdahl and Villasenor 2002), which is available from the U.S. Geological Survey. I use this dataset because it is accurate and reliable—based on seismographic instruments located around the world, and applies an objective selection criterion. All earthquakes that occur in the world registering M5.5 or higher on the Richter scale are included in the Centennial Earthquake Catalog. The dataset is not based on newspaper coverage, the amount of damage caused by earthquakes, or the declaration of an earthquake as a disaster, which may be endogenous to conflict. For this reason, I do not use the most well-known and widely used dataset on natural disasters, EM-DAT: The OFDA/CRED International Disaster Database (Centre for Research on the Epidemiology of Disasters 2006; Guha-Sapir and Below 2004).

The *Centennial* data (Engdahl and Villasenor 2002) are very precise, indicating the magnitude of each earthquake that occurs and its epicenter's latitude and longitude.[19] I exploit this data on magnitude to measure the strength of earthquakes and the amount of damage they are likely to inflict on a country.[20] I also identify the population densities of the regions in which earthquakes occur for this reason, with the expectation that earthquakes striking more densely populated regions cause more damage.[21] I identify the countries and regions in which earthquakes occur, as well as the population density of these regions, using ArcMap (Environmental Systems Research Institute, Inc. n.d.).

To determine if the level of intrastate conflict in one country is affected by the occurrence of disasters in neighboring countries, I also measure the total number of earthquakes that occur in bordering countries. I do so using the CIA's *World Factbook* (2007) to identify which countries border each other and the *Centennial*

Earthquake Catalog (Engdahl and Villasenor 2002) to determine the number of earthquakes in these countries. I do so expecting victims of earthquakes to relocate to neighboring countries, where they may stoke conflicts by creating competition for scarce resources (Hopkins 2007). The closer an earthquake occurs to a border, the more likely groups are to relocate across countries. Conflict may also be sparked by earthquakes in bordering countries since their shocks may be felt in other countries as well.

Dependent Variables

My dependent variable, intrastate conflict, is captured using several different variables. The first is the number of intrastate conflict events that occur in a given month, which is derived from the IDEA dataset (Bond et al. 2003). The IDEA dataset includes all international and intrastate events reported by Reuters news services on a daily basis between the 1990 and 2004, which I aggregate to a monthly level for the purposes of this analysis. I only include in this study events that relate to intrastate violence, namely seizures, actions/battles, abductions, hijacking, kidnapping/hostage taking, use of armed forces and physical force, physical assaults, assassinations, coups/mutinies, suicide bombings, mine explosions, bombings, riots, crowd control, and attacks.[22]

Although the IDEA events dataset (Bond et al. 2003) allows me to measure intrastate conflict over short time intervals, the IDEA dataset has a number of shortcomings. Reuters news coverage may be biased toward "newsworthy" countries, which tend to be large, Western, and economically developed.[23] Countries that experience earthquakes may also be deemed more newsworthy than those that do not, although coverage of earthquake events may detract from that of conflict as well. The IDEA dataset, moreover, gives equal weight to different forms of intrastate conflict regardless of intensity. For this reason, I also measure intrastate conflict in two other ways that capture the intensity of intrastate conflict evenly across all countries in the world.

The second variable measures the level of antiregime rebellion in a country based on data from the MAR dataset (CIDCM 2005). Antiregime rebellion includes conflicts between minority groups and states or dominant groups exercising state power.[24] MAR provides data on antiregime rebellion on a yearly basis from 1985 to 2000. Antiregime rebellion is divided into the following eight categories: (0) none evident, (1) political banditry and sporadic acts of terrorism, (2) sustained campaigns of terrorism, (3) local rebellions, (4) small-scale guerilla activity, (5) intermediate forms of guerilla activity, (6) large-scale forms of guerrilla activity, and (7) protracted civil war.

The MAR dataset (CIDCM 2005), however, does not provide information on the level of antiregime rebellion in countries that do not have "at risk" groups, defined as all nonstate communal groups that either collectively suffer or benefit from

systematic discriminatory treatment vis-á-vis other groups and/or groups that collectively mobilize in defense or promotion of their self-defined interests. Since excluding these countries from the analysis could bias the results, I have identified the level of rebellion in these countries by contacting experts on each of the excluded countries and asking them to identify the level of rebellion within each country using MAR's antiregime rebellion scale.[25] I also completed my own research on the level of intrastate conflict in each of these countries using newspaper articles, reports, and scholarly works on intrastate conflict. I then compared and combined the results of both to determine the final coding for antiregime rebellion.[26]

Although this measure is informative, it only captures violence involving minority groups. Disasters may increase violence among other groups besides minorities and may even increase violence within minority groups by creating competition for scarce resources. The method that I use to aggregate the MAR data (CIDCM 2005) to the national level may also obscure the effects of earthquakes. I aggregate the data to the national level according to the maximum level of rebellion experienced by any group in a country in a given year, which can conceal the effect of earthquakes if they raise the intensity of conflict involving one group, but not higher than that of another group in a country.

The third variable measures whether a civil war has occurred in a country in a given year. Earthquakes should have a smaller effect on civil wars than other forms of conflict since civil wars represent the most intense form of intrastate conflict and are not very common. Earthquakes, however, may increase the intensity of preexisting conflicts so that they evolve into civil wars and may prolong ongoing civil wars, but they are unlikely to cause civil wars in countries not already experiencing some form of conflict. The data for this measure are based on the Fearon and Laitin (2003) dataset on civil wars (1945-1999), which categorizes events as civil wars if they meet three requirements: (1) they involve fighting between agents of (or claimants to) a state and organized, nonstate groups who sought either to take control of a government, take power in a region, or change government policies; (2) they kill at least 1,000 people over their course with a yearly average of at least 100 people; and (3) the number of persons killed involves the death of at least 100 people on both sides (including civilians attacked by rebels).[27]

Control Variables

Since earthquakes constitute a natural experiment, it is not necessary to include a laundry list of control variables in the analysis. However, to examine the conditions under which earthquakes are more likely to promote conflict, I include certain controls in the analysis. Specifically, I include a measure of a country's gross domestic product (GDP) per capita (constant 2000 US$) in the analysis, expecting development to reduce the impact of earthquakes. The GDP data are based on the World Bank's World Development Indicators (WDI) Online (World Bank 2007).

The correlation between earthquakes and GDP per capita is less than 0.10.[28] Unfortunately, I do not have data on scarcities to test their effect directly.

I also include a measure for anocracy using the Polity IV Index (Polity IV Project 2006) ranging between −10 (autocracy) and +10 (democracy) to determine if the impact of earthquakes is affected by the rule of law, which tends to be stronger in democracies and autocracies than in anocracies (Hegre et al. 2001). Democracies may further reduce the potential for conflict because they are seemingly associated with fewer discrimination-based grievances than other regimes (Fearon and Laitin 2003). I consider anocracies to be regimes falling between −5 and +5 on the Polity scale. Alternatively, I include in the analysis the Polity IV Index and its squared term to represent the inverse U-shaped relationship expected between regime type and conflict.

Last, I include a control for mountainous terrain, which Fearon and Laitin (2003) argue encourages conflict by providing cover for rebels. Earthquakes often occur in mountainous areas, making it important to control for terrain to distinguish its effect from that of earthquakes. Based on Fearon and Laitin (2003), mountainous terrain is measured as the percentage of a country that is mountainous (logged).

Analysis

Conflict Events

In the first set of analyses presented in Table 1, I test the effect of earthquakes on the number of intrastate conflict events that occur in a month using the IDEA dataset (Bond et al. 2003). The analysis is a negative binomial model with robust standard errors clustered by country.[29] The analysis includes year-fixed effects to control for trends over time and a lag for the number of conflict events in the previous month, which is positive and significant in all models. In alternative models (not shown), I test the effect of earthquakes on conflict events using a conditional negative binomial model with country and year-fixed effects. The coefficients for earthquakes in these models are substantively the same as those in Table 1 and statistically significant at the $p \leq 0.05$ level or better.[30]

In model 1, I test the effect of earthquakes on the number of conflict events that occur in a month controlling for conflict events in the previous month and earthquakes in bordering countries, which have a positive but not significant effect on conflict. The results of model 1 are depicted in Figure 3. As this graph illustrates, the probability of intrastate conflict not resulting declines as the number of earthquakes in a month increases. The predicted probability that a country will experience conflict in a given month is 0.05 higher if an earthquake occurs than if one does not occur, provided that conflict did not occur in the previous month and an earthquake has not occurred in a bordering country. If nine earthquakes occur in a month under the same conditions, it is 0.34 points higher than if none occur. Most

Table 1
Conflict Events (Negative Binomial Model)

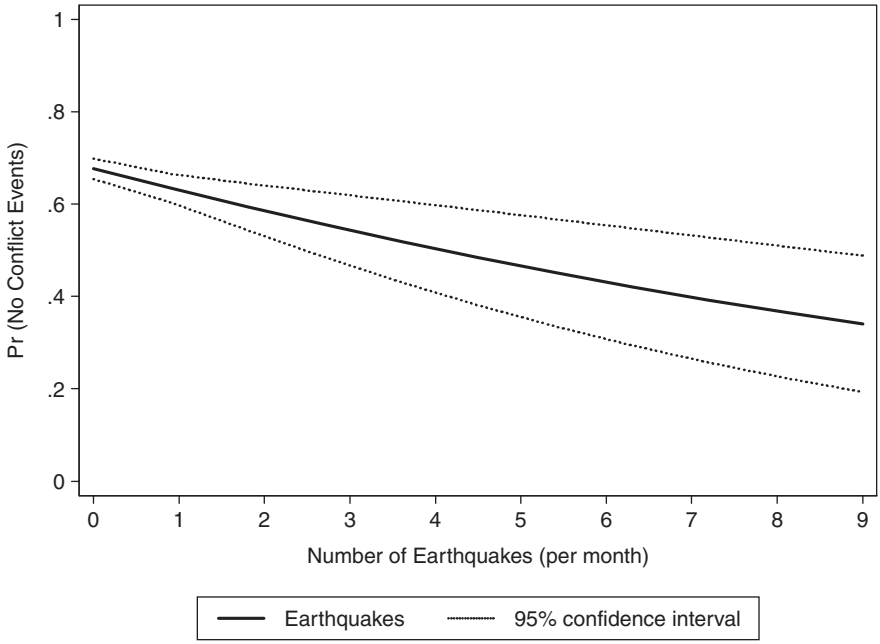
	Model 1	Model 2	Model 3
Conflict events (lag)	0.09***	0.08***	0.08***
	(0.01)	(0.01)	(0.01)
Earthquakes (number)	0.43***	0.48***	0.98***
	(0.14)	(0.14)	(0.23)
Earthquakes in bordering countries (number)	0.10	−0.08	−0.08
	(0.07)	(0.07)	(0.07)
GDP per capita (constant 2000 US$)		2.5e − 05***	2.5e − 05***
		(8.9e − 06)	(9.0e − 06)
Anocracy		0.27*	0.27*
		(0.15)	(0.15)
Mountainous terrain		1.7e − 04***	1.7e − 04***
		(4.1e − 05)	(4.1 − 05)
Earthquakes × GDP per capita			−1.6e − 05**
			(7.0e − 06)
Earthquakes × conflict events (lag)			−0.03***
			(0.01)
Constant	0.40***	−0.34	−0.35
	(0.11)	(0.21)	(0.21)
Log pseudolikelihood	−48348.76	−40755.44	−40750.19
Alpha	5.53	4.61	4.61
Observations	26973	21602	21602

Note: Standard errors are in parentheses; GDP = gross domestic product.
* $p \leq 0.10$ ** $p \leq 0.05$ *** $p \leq 0.01$.

countries experience no more than one to two earthquakes per month, although some countries have experienced more than two earthquakes and as many as nine in a month.[31] Facing multiple earthquakes can intensify conflict even if they do not occur in the same area of a country because they can cripple a state's capacity to conduct relief efforts.

To determine if the impact of earthquakes depends on the population density of the area in which earthquakes strike as well as their magnitude, I conduct two additional analyses (not shown). In the first, I only analyze earthquakes that occur in regions where the population density is fifty persons/km^2, and in the second, I replace earthquakes with an ordinal scale representing the highest magnitude of an earthquake in a given month. According to the first model, a single earthquake increases the probability of conflict occurring by 0.07 points, provided that conflict did not occur in the previous month and an earthquake did not occur in a bordering country.[32] According to the second, the probability of conflict occurring increases by 0.10 if the highest magnitude of any earthquake occurring in a month is between M7.5 and M8.5 rather than M5.5 and M6.5.[33]

Figure 3
Earthquakes and Conflict Events



Note: In this model, the lag of conflict and earthquakes in bordering countries is set to zero.

In model 2, I add controls for GDP, anocracy, and mountainous terrain, while continuing to limit the analysis to earthquakes that occur in regions where the population density is at least 50 persons/km^2.[34] In this model, the coefficient for earthquakes, which is barely affected by the inclusion of the controls, is positive and significant. According to this model, GDP, mountainous terrain, and anocracy also have significant effects on conflict, although anocracy is only significant at the $p \leq 0.10$ level.[35] Replacing anocracy with the Polity IV Index (and its squared term), confirms an inverse U-shaped relationship between democracy and conflict. The two terms, which also improve the model fit, are jointly significant at the $p \leq 0.05$ level.

In model 3, I add interaction terms to the previous model between earthquakes and the level of economic development in countries as well as the lag of conflict. In interpreting interaction effects, it is important to consider the joint significance of the main effects and interaction terms as well as the marginal effects.[36] According to model 3, the likelihood of conflict resulting after an earthquake is only 0.05 points greater if GDP is US$1,000 compared to US$50,000.[37] The main effects for

earthquakes, GDP, and the relevant interaction term are jointly significant at the $p \leq .01$ level. If I include the two interaction effects presented in model 3 in separate models, the results of each individually are substantively and statistically the same as those included jointly in this model.

In contrast to expectations, however, earthquakes have smaller effects in countries already experiencing some form of conflict according to model 3. While this unexpected finding may result from earthquakes displacing news coverage of existing conflicts so that earthquakes appear to have weaker impacts in countries already experiencing conflict, this finding is not robust. By including country fixed effects in this model (not shown), the sign on the interaction term becomes positive, consistent with my expectations, suggesting that this result is a function of unexplained country-specific factor(s).[38] In a separate model (not shown), I add an interaction term to represent the relationship between earthquakes and anocracy, which is also different across the clustered and fixed-effects specifications.

To summarize, the results of the previous analysis show that earthquakes increase the likelihood of conflict occurring in a country while controlling for many different factors. They also indicate that earthquakes are slightly more likely to result in less developed countries. It is not clear, however, whether the impact of earthquakes is greater in anocracies and countries already experiencing conflict since the results for these factors differ depending on the specification. I do not find that earthquakes in bordering countries have any effect on conflict events.

Antiregime Rebellion

In the second set of analyses presented in Table 2, I test the effect of earthquakes on the level of rebellion in countries per year using the MAR dataset (CIDCM 2005). The model is an ordered logit model with robust standard errors clustered by country and fixed effects to control for trends over time.[39,40] The analysis includes a lag for the level of rebellion in the previous year, which is positive and significant in all models.

In model 4, I test the effect of earthquakes on the level of rebellion in countries, controlling for rebellion in the previous year and earthquakes in neighboring countries. In this analysis, earthquakes increase rebellion as do earthquakes in bordering countries. According to this model, if three earthquakes occur in a year, the likelihood that no conflict will occur is only 0.01 points lower than if no earthquake occurs. Most countries experience no more than two to three earthquakes per year, but some countries (i.e., China, Indonesia, and Papua New Guinea) have experienced as many as fifteen to sixteen earthquakes per year.[41]

In alternative models (not shown), I explore whether larger earthquakes occurring in more densely populated areas have greater effects on conflict. According to these models, if the population density of the region in which three earthquakes strike is at least fifty persons/km^2, the likelihood of conflict resulting is marginally

Table 2
Antiregime Rebellion (Ordered Logit Model)

	Model 4	Model 5	Model 6
Antiregime rebellion (lag)	1.67***	1.71***	1.72***
	(0.10)	(0.12)	(0.12)
Earthquakes (number)	0.06**	0.10**	0.29
	(0.03)	(0.04)	(0.19)
Earthquakes in bordering countries (number)	0.05***	0.02	0.02
	(0.02)	(0.02)	(0.02)
GDP per capita (constant 2000 US$)		−1.8e − 05**	−1.7e − 05*
		(9.0e − 06)	(9.3e − 06)
Anocracy		0.09	0.08
		(0.14)	(0.14)
Mountainous terrain		4.0e − 05	3.7e − 05
		(3.3 − 05)	(3.3e − 05)
Earthquakes × GDP per capita			−5.8e − 06
			(5.9e − 06)
Earthquakes × Rebellion (lag)			−0.04
			(0.04)
Log pseudolikelihood	−1764.15	−1585.36	−1584.88
Observations	2586	2321	2321

Note: Standard errors are in parentheses; GDP = gross domestic product.
* $p \leq 0.10$ ** $p \leq 0.05$ *** $p \leq 0.01$.

higher than if the same number of earthquakes strike a region of any population density. Similarly, if the highest magnitude of any earthquake occurring in a year ranges between M7.5 and M8.5, the likelihood of conflict occurring is 0.03 points higher than if the highest magnitude is between M5.5 and M6.5.[42]

In model 5, I introduce controls for GDP, anocracy, and mountainous terrain, while continuing to restrict the analysis to earthquakes occurring in regions with population densities of at least fifty persons/km^2.[43] In this model, the effect of earthquakes on antiregime rebellion is positive, significant, and approximately the same size as in the previous model. According to model 5, increasing GDP also decreases conflict, while earthquakes in bordering countries, anocracy, and mountainous terrain have no effect on rebellion.

Furthermore, interacting the effect of earthquakes with GDP in model 6 shows that earthquakes are less likely to lead to rebellion in countries with higher levels of GDP and that the effect of GDP is greater the more earthquakes occur in a year. According to model 6, the difference in the probability of rebellion occurring in a country where GDP per capita is US$20,000 instead of US$1,000 is 0.02 if no earthquakes occur in a year, 0.08 if three earthquakes occur, and 0.14 if five earthquakes occur.[44] In this model, the interaction term is not significant on its own but is jointly significant with earthquakes and GDP at the $p \leq 0.07$ level.

Rebellion is also more likely to result after earthquakes if countries experience rebellion in the previous year according to model 6. In this model, the interaction term for earthquakes and the lag of rebellion is not significant on its own but is jointly significant with the relevant main effects at the $p \leq 0.01$ level. According to model 6, the difference in the probability of rebellion not resulting if no rebellion occurred in the previous year versus sustained campaigns of terrorism is more than 0.01 points greater for two earthquakes than for none.[45] Beyond three earthquakes, however, this difference is lower than if no earthquakes occur. To explore the robustness of these findings, I include the two interaction effects presented in model 6 in separate models; the results of each individually are substantively and statistically the same as those presented jointly in model 6. In separate models, I interact anocracy with earthquakes and do not find a statistically significant relationship between the two in terms of their effect on conflict.

To summarize, in the previous set of analyses, I find that earthquakes increase the likelihood of rebellion and that earthquakes with higher magnitudes and those occurring in areas with higher population densities, lower levels of development, and preexisting levels of rebellion are even more likely to increase the intensity of antiregime rebellion. I do not find that anocracy and mountainous terrain have any effect on rebellion and only weak support that earthquakes in bordering countries increase rebellion.

Civil War

In the third set of analyses presented in Table 3, I test the effect of earthquakes on the occurrence of civil wars between 1975 and 1999. The estimation procedure is logistic regression with year fixed effects to control for trends in civil wars over time. The standard errors are robust standard errors clustered by country. The analysis includes a lag for the presence of civil wars in the previous year, which is positive and significant in all models. In separate analyses (not shown), I use a conditional logit model to analyze the effect of earthquakes on civil wars with country and year-fixed effects.[46] The effects of earthquakes are not robust to the inclusion of country-fixed effects.

According to model 7, earthquakes increase the probability of civil wars occurring only slightly, which is expected, given the high death toll by which civil wars are defined. In particular, the likelihood of civil war occurring is 0.01 points greater if three earthquakes occur in a year instead of none. In alternative models (not shown), I find that the effect of earthquakes is greater for larger earthquakes occurring in more densely populated areas. According to these models, if three earthquakes occur in regions with populated densities of fifty persons/km^2, the likelihood of civil war occurring is 0.03 points higher than if no earthquakes occur.[47] The probability of civil war occurring also increases by 0.02 points if the highest magnitude of any earthquake occurring in a month is between M7.5 and M8.5 rather than M5.5 and M6.5.[48]

Table 3
Civil War (Logit Model)

	Model 7	Model 8	Model 9
Civil war (lag)	7.05***	6.97***	6.92***
	(0.28)	(0.36)	(0.35)
Earthquakes (number)	0.15**	0.59**	0.63
	(0.07)	(0.24)	(0.47)
Earthquakes in bordering countries (number)	0.01	−0.05	−0.06
	(0.04)	(0.05)	(0.05)
GDP per capita (constant 2000 US$)		−6.0e − 05	−5.4e − 05
		(3.9e − 05)	(4.0e − 05)
Anocracy		0.80**	0.82**
		(0.38)	(0.38)
Mountainous terrain		0.0001**	0.0001**
		(0.0001)	(0.0001)
Earthquakes × GDP per capita			−7.2e − 05
			(6.1e − 05)
Earthquakes × civil war (lag)			0.44
			(0.65)
Constant	−4.31***	−4.95***	−4.96***
	(0.92)	(1.13)	(1.14)
Log pseudolikelihood	−394.64	−310.29	−309.63
Observations	3629	3115	3115

Note: Standard errors are in parentheses; GDP = gross domestic product.
*$p \leq 0.10$ **$p \leq 0.05$***$p \leq 0.01$.

Earthquakes continue to have a strong effect on conflict even when control variables for GDP, anocracy, and mountainous terrain are included in the analysis, as they are in model 8. In this model, I continue to restrict the analysis to earthquakes occurring in population densities of fifty persons/km^2.[49] The size of the coefficient for earthquakes in this model is notably larger than in the previous model of earthquakes striking regions of this population density without controls. In model 8, mountainous terrain and anocracy have a positive and significant effect on the likelihood of conflict, while earthquakes in bordering countries do not. If I replace anocracy with the Polity IV Index and its square, the two terms are jointly significant at the $p \leq 0.05$ level, confirming the anocracy results in model 8.

The likelihood of civil war resulting following earthquakes, however, does not seem to be greater in less developed countries according to model 9.[50] Although the effect of GDP and the interaction term are negative in model 9, the coefficients for GDP and the interaction term for GDP and earthquakes are not significant on their own and are not jointly significant with earthquakes either. Earthquakes do seem, however, to have a greater impact in countries already experiencing conflict. Although the variable for earthquakes and the interaction term in model 9 are not

significant, the main effects for earthquakes and civil war (lag) are jointly significant with the interaction term at the $p \leq 0.01$ level. Based on this model, the difference in the probability of war resulting if a civil war occurred in the previous year and if no civil war occurred in the previous year is 0.03 greater if an earthquake occurs than if no earthquake occurs.[51] I also include interaction effects for GDP and the lag of war in separate models (not shown). In the GDP model, earthquakes are significant at the $p \leq 0.05$ level and are jointly significant with GDP and the interaction term for earthquakes and GDP at the $p \leq 0.10$ level. In the lag of war model, the interaction effect is substantively and statistically the same as the interaction effect for the lag of war in model 9. In a separate model, I also interact anocracies with earthquakes, the results of which do not support the conclusion that the effect of earthquakes is greater in anocracies.

To summarize, the previous analyses show that earthquakes increase the likelihood of civil war slightly and that their effects are greater in countries already experiencing civil war, although the effects are not robust to the inclusion of country-fixed effects. All of the results presented in this section may underestimate the true effects of earthquakes on conflict, however, since their impact depends on other unmeasured factors, such as the depth with which earthquakes occur in the earth's interior as well as the rock structure and soil composition of the area in which they strike. The population estimates, moreover, do not measure the population density of the immediate area in which earthquakes strike but only the region in which they occur and do not directly capture information on the number of deaths or the amount of damage that earthquakes inflict on countries.

Conclusion

In light of recent World Bank estimates that 3.4 billion people are likely to experience at least one major natural disaster where they live, understanding the effects of natural disasters on intrastate conflict takes on new importance.[52] Although some policy makers and scholars argue to the contrary, the analyses in this study reveal that natural disasters, at least in the case of earthquakes, do not reduce conflict and actually seem to intensify it based on three different measures of conflict. While I do not test this hypothesis directly, I argue that the positive relationship between earthquakes and conflict is a result of the scarcities produced by disasters. The analysis also suggests that the impact of earthquakes depends on the population density, economic development, and the level of preexisting conflict present in areas where earthquakes strike as well as the magnitude of the earthquakes themselves. The effect of earthquakes does not seem to depend, however, on whether a country is an anocracy perhaps because this measure does not fully represent the rule of law in countries.

While this study has focused on earthquakes, its findings may be applicable to other types of natural disasters, particularly those with rapid onsets. Disasters, such

as earthquakes, which have rapid onsets, including windstorms and volcanic eruptions, may heighten feelings of frustration more than disasters with slow onsets, such as droughts, and therefore may be more likely to stimulate conflict. All types of natural disasters regardless of whether they have rapid or slow onsets, however, have the potential to intensify conflict by creating scarcities in basic resources and attracting international aid, which may be subverted by combatants to an existing conflict.

Different types of disasters, though, may produce different kinds of scarcities and attract contrasting amounts of international aid. Earthquakes may cause greater damage to infrastructure than other types of disasters, such as droughts and, consequently, spark more severe housing shortages that require a lot of time to overcome. In contrast, food shortages that arise from earthquakes may be easier to rectify than those arising from droughts, which fundamentally deplete food stocks. Earthquakes may also attract more international aid than other types of disasters that are not as large or dramatic as earthquakes, although whether this aid is diverted toward conflict production does not depend on the type of disaster but on the manner in which aid is distributed. Other types of disasters may also create different and more significant obstacles to conflict than earthquakes. Floods and droughts, for example, may physically weaken populations by propagating infectious diseases or producing famines, which debilitate combatants and make conflicts difficult to execute.

Further research is needed into this issue, although a preliminary analysis suggests that the results for earthquakes are applicable to natural disasters more generally (Brancati and Bhavnani 2006). This analysis shows that there is a positive relationship between the number of disasters that occur in countries (i.e., droughts, earthquakes, epidemics, extreme temperatures, famines, floods, insect infestations, landslides, volcanic eruptions, wave or surges, wildfires, and windstorms) and the three different measures of conflict analyzed in this study. Understanding the effect of other types of disasters on conflict is difficult, however, since conflict itself can make some of these disasters more likely to occur by precluding countries from undertaking preventive measures, such as building dams and/or levees.

Geography might not predestine politics, but the findings of this study clearly highlight the central role that geography plays in politics, particularly in intrastate conflict. In addition to calling attention to the importance of geography and disasters to conflict, these findings have far-reaching policy implications. First, they suggest that more attention needs to be dedicated to the political consequences of disasters. Presently, the policy-making community's focus is on how to anticipate and prepare for disasters as well as how to better operate logistically to provide relief in disaster situations. While these issues are important, the discussion surrounding them must also consider their implications for conflict.

Clear international guidelines are also needed about to whom governments and organizations should distribute aid locally, what types of aid to extend, and how to allocate aid more generally to ensure that aid does not aggravate the already fragile

conditions present in some countries. These issues are undoubtedly complex, however. While distributing aid to disaster victims through governments or rebels may potentially fuel conflict, often these groups are those best equipped to deliver aid. What type of aid to distribute is also an important but challenging issue. Aid dispersed in the form of money may be in the greatest danger of being hijacked by combatants. Yet monetary aid may be delivered more quickly than other forms of aid and may allow countries to purchase supplies that best fit their changing needs.

Second, the findings suggest a need for UN peacekeeping troops to assume an expanded role in protecting the delivery of humanitarian assistance in cases of natural disasters. In certain crisis (e.g., Somalia and Yugoslavia), UN peacekeeping troops have accepted this role, although this was not part of their mandate. Troops are needed not only to prevent humanitarian assistance from being pilfered by warring factions, but also to ensure orderly aid distribution, prevent looting, and preserve peace in disaster zones so that government forces are able to devote attention to maintaining peace in the rest of their countries. Training standards are also needed for peacekeeping troops, as well as relief and development workers, to ensure that staff are aware of these issues and able to address disaster-related conflict. Capacity building, finally, must not only entail mere physical relief but also social programming aimed at staving off conflict long after disasters have ended.

Notes

1. "Quake Tragedy to Spur Fragile Indo-Pak Peace," *Daily Star,* October 10, 2005.

2. Ibid.

3. "Kashmir Minister Killed in Attack," *BBC News,* October 18, 2005; "Car Bomb Targets Kashmir Troops," *BBC News,* October 26, 2005.

4. I analyze intraplate earthquakes separately using the *Intraplate Earthquakes (495-2002) Catalog* (Schulte and Mooney 2002), since these quakes have lower magnitudes than those included in the interplate earthquake dataset used in this study. Intraplate earthquakes increase conflict in most models but are not significant, except in the case of civil war, which is likely because of the fact that many intraplate earthquakes and civil wars occur in Africa. Their insignificant effect may also be because of the lower magnitudes with which intraplate earthquakes occur.

5. The mean number of earthquakes between 1975 and 2000 is 0.359 (Organisation for Economic Co-operation and Development [OECD] countries) and 0.360 (non-OECD countries). This difference is not surprisingly not statistically significant. Earthquakes of higher magnitudes do not occur more often in conflict-prone areas. Thirty-one countries of different levels of economic development and propensities for conflict have at some point in this period experienced earthquakes of M7.0 or higher.

6. http://www.peacecorps.gov/wws/guides/insights/geography/intro/enduring.html (accessed in fall 2006).

7. Address by President Chandrika Kumaratunga at the meeting of the Religious Committee of the National Advisory Council for Peace and Reconciliation (NACPR), http://www.presidentsl.org/data/speech/2005/address-religious-committee-nacpr.htm (accessed in fall 2006).

8. The Free Aceh Movement (GAM) in Indonesia suffered a setback as a result of the tsunami in 2004 and the Indonesian army's subsequent military assault, which may have contributed to its decision to sign a peace agreement with the Indonesian government in 2005, although it is difficult to know how

much damage GAM suffered since it may have understated this damage so as not to appear weak to the Indonesian government.

9. I do not use instrumental variable regression to address the endogeneity problem between development and conflict because of the lack of good, available instruments for gross domestic product (GDP).

10. Tracy Wilkinson, "20 Years After Quake, Nicaragua's Capital Still in Ruins," *The Houston Chronicle,* December 28, 2002.

11. Larry Rohter, "Colombia Is Reeling, Hurt by Rebels and Economy," *New York Times,* July 18, 1999.

12. Larry Rohter, "Colombia Quake Sets Back Effort to Negotiate with Rebels," *New York Times,* February 6, 1999.

13. Interview, May 7, 2007.

14. Ibid.

15. Food and Agricultural Organization (FAO), 2004, "The State of Food Security 2004," New York: FAO.

16. Figures are in constant 2000 US$.

17. Somini Sengupta, "Sri Lanka Votes, Torn by War and Tsunami," *New York Times,* November 18, 2005.

18. In neighboring Indonesia, all relief aid was distributed by the Indonesian government, which prevented GAM from using aid to advance its agenda.

19. I exclude all earthquakes from the analysis that do not occur within countries since it is difficult to precisely identify which countries ocean-occurring earthquakes affect, because the distance at which these earthquakes can be felt depends not only on the magnitude and depth of the earthquake but also regional rock type and rock/soil composition—two factors for which I do not have data.

20. It would also be informative to measure the number of deaths that earthquakes cause, but unfortunately the data are not very good. The U.S. Geological Survey Earthquake Hazards Program offers the best data on death tolls, but it only collects these data for earthquakes causing at least 1,000 deaths, which omits many large earthquakes that do not meet this criterion, and it may not be complete. In separate models (not shown), I analyze these data anyway to explore their potential impact on conflict. These results do not show a significant relationship between death tolls and conflict, although this may be due more to data limitations than to anything else. The death toll figures for these models are included in the replication dataset.

21. Unfortunately, it was not possible to test whether earthquakes occurred in a city or how far they occurred from a city of a given population because the ArcMap world files used in this study do not identify every city in the world and do not have a consistent criterion for those that they do.

22. The twenty-eight events' names and codes are: seize (21), seize possessions (211), armed forces (2111), armed force border (2112), abduction (213), hijacking (2131), hostage taking/kidnapping (2132), force use (22), physical assault (222), beatings (2221), bodily punishment (2223), sexual assault (2224), torture (2225), armed actions (223), armed battle (2231), assassination (2232), coups/mutinies (2233), small arms attack (2234), artillery attack (2235), suicide bombing (2236), mine explosion (2237), vehicle bombing (2238), missile attack (2239), riot (224), unconventional (225), chem-bio attack (2251), nuclear attack (2252), and crowd control (226). Duplicate events are filtered out.

23. Gerner and Schrodt (1998) find that the coverage of conflict events by Reuters and the *New York Times* is highly correlated.

24. MAR (CIDCM 2005) also provides information on intercommunal conflict and protest, although I believe rebellion matches my theoretical argument most closely. It is also difficult to correct the selection bias in the intercommunal conflict and protest variables since their coding schemes are not as consistent or transparent as those for rebellion. The protest variable, moreover, does not distinguish between violent and peaceful protests.

25. Nonrisk groups do not have higher levels of conflict than at-risk groups within countries in the MAR dataset. The fact that MAR omits these groups does not bias the results because the data are aggregated to the national level according to the maximum level of violence in a country per year.

26. The most common reason for a discrepancy between the two codings is experts reporting rebellion that does not involve an ethnic group. I have cross-validated the final data with that of James Fearon and David Laitin, who have independently collected data on antiregime rebellion to correct the selection bias in MAR. As a robustness test, I have also excluded from the analysis those countries for which I have data on antiregime rebellion. In these models, the effects of earthquakes are still positive and statistically significant.

27. The dataset was expanded to include information on countries omitted from the study, including Iceland and Luxembourg, which did not experience civil wars in this period.

28. GDP per capita is not logged to facilitate interpretation. Logging GDP produces substantively similar results.

29. A negative binomial model is appropriate for this analysis because the data are overdispersed (i.e., the mean and variance are not equal), and the data do not contain many zeros for which a zero-inflated Poisson model is more appropriate.

30. The conditional negative binomial model for model 1 does not include a lag for conflict events because it would not converge otherwise.

31. Approximately 6 percent of all months in this dataset that have experienced earthquakes have experienced more than two earthquakes in a month. In 1999 Taiwan experienced nine earthquakes in a single month.

32. I played with various cut-points with smaller population densities, generally yielding weaker results and higher population densities, yielding stronger results. According to the U.S. Census (Census Bureau 2000), a population density of fifty persons/km^2 is less than that of California, the most earthquake-prone state of the United States.

33. The coefficient for earthquake magnitude is significant at the $p \leq 0.01$ level in this model, as is the coefficient for earthquakes in the previous model.

34. If I repeat models 2 and 3 of Table 1, including all earthquakes regardless of population density, the coefficients for earthquakes are positive but only significant in model 3 at the $p \leq 0.10$ level.

35. The positive sign on the coefficient for GDP may be indicative of the IDEA dataset's (Bond et al. 2003) bias toward newsworthy and, therefore, most likely wealthy countries as well.

36. Calculating the marginal effects is essential because a variable with an insignificant coefficient may have a significant effect on another variable for certain relevant values of the modifying variable (Brambor, Clark, and Golder 2005; Braumoeller 2004).

37. GDP, as in the previous model, is positive in contrast to expectations. The mean GDP per capita is 5,341. There are seventy-three countries in the dataset in which the mean GDP per capita is US$1,000 or less and seventeen countries in which it is US$20,000 or more. The lag of conflict events is set to zero in this calculation.

38. In this model, the main effects and interaction term are also jointly significant at the $p \leq 0.01$ level.

39. An ordinal logit model is appropriate because the data are ordered but not equally spaced and because countries are able to experience any level of rebellion without having already experienced a less intense form.

40. I do not use country-fixed effects because unit-specific, fixed effects provide inconsistent estimates in (unconditional) nonlinear models. The inconsistency results from the number of unit-specific or incidental parameters increasing without bound as $N \rightarrow \infty$, while the information about each of the parameters remains fixed (Wooldridge 2002, 493-5).

41. As many as ten earthquakes have occurred in a single year in areas where the population density is fifty persons/km^2.

42. The coefficient for earthquake magnitude is significant at the $p \leq 0.05$ level in this model, while the coefficient for earthquakes in the previous model is significant at the $p \leq 0.06$ level.

43. If I do not place restrictions on the population density in which earthquakes occur for models 5 and 6, the coefficients for earthquakes demonstrate slightly smaller effects, which are statistically significant at the $p \leq 0.05$ level.

44. In this model, all remaining variables are set to zero, except mountainous terrain, which is set to its mean. In this study, GDP per capita is less than US$1,000 in sixty-nine countries, and GDP per capita is US$20,000 or higher in ten countries. The mean is 5,288.

45. In this model, all remaining control variables are set to zero, except mountainous terrain, which is set to its mean.

46. A conditional logit model has a negligible amount of bias according to Ethan Katz (2001) when $T \leq 20$, where T = time periods. The unconditional logit model has a negligible amount of bias for $16 \leq T < 20$.

47. In this model, the lag of civil war and the number of earthquakes in bordering countries are set to zero, and the coefficient for earthquakes is significant at the $p \leq 0.01$ level in this model.

48. The coefficient for earthquake magnitude is significant at the $p \leq 0.05$ level.

49. If I repeat models 8 and 9 using all earthquakes, the coefficient for earthquakes is significant in model 9 at the $p \leq 0.10$ level.

50. I also repeat models 7, 8, and 9 using civil war onset as my dependent variable and all earthquakes as my independent variable, while dropping the lag of war, which is always zero, from the models. In all these models (not shown), the number of earthquakes is positive and significant at the $p \leq 0.05$ level or better.

51. In this model, all remaining control variables are set to zero, except mountainous terrain, which is set to its mean.

52. The natural disasters studied in this report are droughts, floods, cyclones, earthquakes, volcanoes, and landslides (World Bank 2005).

References

Achen, Christopher H., and Larry M. Bartels. 2004. Blind retrospection: Electoral responses to drought, flu and shark attacks. Unpublished manuscript, Princeton University, Princeton NJ.

Albala-Bertrand, J. M. 1993. Natural disaster situations and growth: A macroeconomic model for sudden disaster impacts. *World Development* 21 (9):1417-34.

Allport, Gordon W. 1954. *The nature of prejudice.* Cambridge, MA: Addison-Wesley.

Anbarci, Nejat, Monica Escaleras, and Charles A. Register. 2005. Earthquake fatalities: The interaction of nature and political economy, *Journal of Public Economics* 89 (9-10): 1907-33.

Anderson, Mary B. 1999. *Do no harm: How aid can support peace—or war.* Boulder, Colorado: Lynne Rienner.

Benson, Charlotte, and Edward J. Clay. 2004. *Understanding the economic and financial impacts of natural disasters.* Washington, DC: World Bank.

Bissell, Richard A. 1983. Delayed impact infectious disease after a natural disaster. *Journal of Emergency Medicine* 1 (1): 59-66.

Bond, Doug, Joe Bond, Churl Oh, J. Craig Jenkins, and Charles Lewis Taylor. 2003. Integrated data for events analysis (IDEA): An event typology for automated events data development. *Journal of Peace Research* 40 (6): 733-45.

Brambor, Thomas, Williams Roberts Clark, and Matt Golder. 2005. Understanding interaction models: Improving empirical analyses. *Political Analysis* 14 (1): 63-82.

Brancati, Dawn M., and Rakhi Bhavnani. 2006. *Natural disaster conflicts.* Unpublished manuscript, Harvard University, Cambridge, MA.

Brass, Paul. 1986. The political uses of crisis: The Bihar famine of 1966-1967. *The Journal of Asian Studies* 45 (2): 245-67.

Braumoeller, Bear. 2004. Hypothesis testing and multiplicative interaction terms. *International Organization* 58 (4): 807-20.

Center for International Development and Conflict Management (CIDCM). 2005. Minorities at Risk Project. College Park, Maryland: CIDCM.

Center for International Development and Conflict Management (CIDCM). 2006. Polity IV Project. University of Maryland, College Park.

Central Intelligence Agency. 2007. *World Factbook*. Washington, DC: CIA. https://www.cia.gov/library/publications/the-world-factbook/ (accessed on June 25, 2007).

Centre for Research on the Epidemiology of Disasters (CRED). 2006. EM-DAT: The OFDA/CRED International Disaster Database. Université Catholique de Louvain, Brussels, Belgium. http://www.em-dat.net/figures_2006.htm (accessed on June 25, 2007).

Cohen, Charles, and Eric Werker. 2006. The political economy of "natural" disasters. Unpublished manuscript, Harvard University, Cambridge, MA.

Curtis, Thom, Brent C. Miller, and E. Helen Berry. 2000. Changes in reports and incidence of child abuse following natural disasters. *Child Abuse and Neglect* 24 (9):1151-62.

Ember, Carol R., and Melvin Ember. 1992. Resource unpredictability, mistrust and war: A cross-cultural study. *Journal of Conflict Resolution* 36 (2): 242-62.

Engdahl, E. R., and A. Villasenor. 2002. *Centennial earthquake catalog*. Washington, DC: U.S. Geological Survey.

Ekström, Göran, Meredith Nettles, and Victor C. Tsai. 2006. Seasonality and increasing frequency of Greenland glacial earthquakes. *Science* 24, March 311 (5768): 1756-8.

Environmental Systems Research Institute, Inc. n.d. ArcMap, version 9.0. http://www.esri.com/ (accessed June 25, 2007).

Evin, Ahmet O. 2004. Changing Greek perspectives on Turkey: An assessment of the post-earthquake rapproachment. *Turkish Studies* 5 (1): 4-20.

Fearon, James, and David Laitin. 2003. Ethnicity, insurgency and civil war. *American Political Science Review* 97 (1): 75-90.

Freeman, Paul K., Michael Keen, and Muthukumara Mani. 2003. Dealing with increased risks of natural disasters: Challenges and options. Working paper, WP/03/197, International Monetary Fund, Washington, DC.

Gerner, Deborah J., and Philip A. Schrodt. 1998. *Early warning and early response: The effects of media coverage and crisis assessment and early warning in the Middle East.* New York: Columbia University Press-CIA Online. http://www.ciaonet.org/book/schmeidl/ (accessed on June 25, 2007).

Gleditsch, Nils Petter. 1998. Armed conflict and the environment: A critique of the literature. *Journal of Peace Research* 35 (3): 381-400.

Grofman, Bernard N., and Edward N. Muller. 1973. The strange case of relative gratification and potential for political violence: The V-curve hypothesis. *American Political Science Review* 67 (2): 514-39.

Guha-Sapir, Debarati, and Regina Below. 2004. The quality and accuracy of disaster data: A comparative analyses of three global datasets. Prepared for the ProVention Consortium, Disaster Management Facility, World Bank, Washington, DC.

Hegre, Håvard, Tanja Ellingsen, Scott Gates, and Nils Petter Gleditsch. 2001. Toward a democratic civil peace: Democracy, political change and civil war, 1816-1992. *American Political Science Review* 95 (1): 33-48.

Hechter, Michael. 1975. *Internal colonialism: The Celtic fringe in British nationalist development.* Berkeley/Los Angeles: University of California Press.

Homer-Dixon, Thomas F. 1994. Environmental scarcities and violent conflict: Evidence from cases. *International Security* 19 (1): 5-40.

———. 2001. *Environment, scarcity and violence.* Princeton, NJ: Princeton University Press.

Hopkins, Daniel J. 2007. Flooded communities: The post-Katrina migration's negative impact on attitudes toward the poor and African Americans. Unpublished manuscript, Harvard University, Cambridge, MA.

Horowitz, Donald. 1985. *Ethnic groups in conflict.* Berkeley/Los Angeles: University of California Press.

Kahl, Colin H. 1998. Population growth, environmental degradation, and state-sponsored violence: The case of Kenya, 1991-93. *International Security* 23 (2): 80-119.

Katz, Ethan. 2001. Bias in conditional and unconditional fixed effects logit estimation. *Political Analysis* 9 (4): 379-84.

Kelman, Ilan, and Theo Koukis, eds. 2000. Disaster diplomacy. Special issue, *Cambridge Review of International Affairs* XIV (1): 214-94.

Ker-Lindsy, James. 2000. Greek-Turkish rapprochement. Special issue, *Cambridge Review of International Affairs* XIV (1): 215-32.

Klinenberg, Eric. 2004. Denaturalizing disaster: A social autopsy of the 1995 Chicago heat wave. In *Violence in war and peace: An anthology*, edited by Nancy Scheper-Hughes and Philippe I. Bourgois, 308-17. Malden, MA: Blackwell.

Lischer, Sarah Kenyon. 2003. Collateral damage: Humanitarian assistance as a cause of conflict. *International Security* 28 (1): 79-109.

Miguel, Edward, Shanker Satyanath, and Ernest Sergenti. 2004. Economic shocks and civil conflict: An instrumental variables approach. *Journal of Political Economy* 112 (4): 725-53.

Miller, Abraham H., Louis H. Bolce, and Mark Halligan. 1977. The J-curve theory and black urban riots: An empirical test of progressive relative deprivation theory. *American Political Science Review* 71 (3): 964-82.

Quarantelli, E. L., and R. R. Dynes. 1976. Community conflict: Its absence and its presence in national disasters. *Mass Emergencies* 1:139-52.

Reuveny, Rafael. 2002. Economic growth, environmental scarcity and conflict. *Global Environmental Politics* 2 (1): 83-110.

Schulte, Saskia M., and Walter D. Mooney. 2002. *Intraplate earthquakes (495-2002).* Washington, DC: U.S. Geological Survey.

Singer, P. W. 2006. *Children at war.* Berkeley/Los Angeles: University of California Press.

U.S. Census Bureau. 2000. United States Census 2000. Washington, DC. http://www.census.gov/main/www/ cen2000.html (accessed on June 25, 2007).

Wooldridge, M. J. 2002. *Econometric analysis of cross-section and panel data.* Cambridge: Massachusetts Institute of Technology.

World Bank. 2005. Natural disaster hotspots: A global risk analysis. Washington, DC: World Bank.

———. 2007. *World development indicators (WDI) online*. Washington, DC: World Bank. http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/0,,contentMDK:21298138 ~ pagePK:64133150 ~ piPK:64133175 ~ theSitePK:239419,00.html (accessed on June 25, 2007).