Conflict, Earthquakes, and School Outcomes: Two Studies on Nepal

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This report includes two different studies about conflict, earthquakes, and school outcomes in relation to the recent earthquakes in Nepal. The first report is titled *The Impact of Conflict on Natural Disaster Resilience: Evidence from Nepal* and the second report is titled *The Impact of Natural Disasters on Child Education Outcomes: Evidence from Nepal.*

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Table of Contents

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The Impact of Conflict on Natural Disaster Damage: Evidence from Nepal

1. Introduction

The increased frequency of natural disasters globally has prioritized the need for a broader understanding of disaster resilience. More recently, on April 25 and May 12 of 2015, two major earthquakes devastated many Nepalese communities, inflicting damage on multiple sectors of the society. Given the enormous amount of damage caused by the earthquakes, this natural disaster is the greatest natural disaster tragedy to hit Nepal in over 80 years. Almost ten years before the earthquakes shook Nepal, ten years of destructive armed conflict came to a end. This study will examine the link between these two events, both conceptually and empirically, by addressing the question: *Did conflict experience during the armed conflict in Nepal impact the degree of damage resulting from the 2015 earthquakes?*

Over the course of recent history, the frequency, average death toll, and damage from natural disasters have been increasing (Espinoza, Urzua, & Claro 2015; Alexander, 1993; Guha-Sapir, Below, & Hoyois, 2009). An average of 218 million people are affected by natural disasters every year, worldwide. Vulnerability to disasters is not equally distributed across the globe; of these disasters, a disproportionate number of deaths and damage have occurred in Asia, with trends clearly showing that smaller and lower income countries are disproportionately affected (Centre for Research on the Epidemiology of Disasters, 2015).

Globally, the number of total armed conflicts has decreased since the 1980s, yet there has been a steady increase in civil wars and intrastate conflict since the Cold War (Marshall & Cole, 2008). According to Blattman and Miguel (2010), civil wars have been common and widespread over the past fifty years, affecting as much as a third of the globe. Wood (2003) noted that between World War Two and the late 1990s, the number of new civil wars increased rapidly then leveled off, likely due to a relative increase in the duration of each conflict. The prevalence of civil wars is strongly correlated with low per capita income in a country and its disposition to internal conflict, a point that is acknowledged as “one of the most robust empirical relationships in the literature” (Blattman & Miguel 2010). In addition, low levels of economic development may be a contributing factor towards the propensity for civil war (Wood, 2003; Doyle & Sambanis, 2000) while low per capita income is also related to the length of the conflict (Collier & Hoeffler, 2004).

This paper bridges two different strands of literature: 1) conflict outcomes on factors that impact development and 2) impact of these factors on natural disaster damage. The study contributes to the existing literature by developing a link between experience of conflict and natural disaster resilience. The research fills a gap in the existing natural disaster literature: this is one of the first empirical studies to examine how conflict history in a region impacts natural disaster damage. Since the 2015 earthquakes are so recent, academic studies on the incident are not yet published. This paper provides timely analysis on variations of earthquake damage across the country.

Through analysis of the available literature and empirical study, the findings indicate there is a significant relationship between conflict experiences and how earthquakes

affect natural disaster resiliency. Areas with more intense conflict suffered more damage in the recent earthquakes and increased exposure to the conflict is associated with a lower resilience during and immediately after the earthquakes. Additionally, the impact of conflict history appears higher in districts that experienced more severe earthquakes; in other words, conflict experience is of greater importance as the amount of shaking increases. Conflict experiences may affect disaster resilience through several different factors, including: education, level of economic development, and health. Governance is also an important intermediary factor, though it is difficult to observe directly, and so it is not included in the empirical findings of this study. The evidence from Nepal presented in this study linking the armed conflict to resilience following the 2015 earthquakes provides a theoretical and empirical basis for further studies to be done examining the long-term consequences of conflict and the channels through which conflict can impact natural disaster resilience.

This paper begins by giving a detailed background of the history of the armed conflict in Nepal as well as background information on natural disasters and the 2015 earthquakes in Nepal. Subsequent is a literature review outlining the conceptual framework and linking conflict to natural disaster damage. Next is the data and methodology of the empirical study followed by the results of the empirical analysis and conclusion. Lastly, this paper presents several policy implications.

2. Background

2.1 Nepalese Conflict

Beginning in the 1980s, Nepal underwent vast political changes that left certain groups feeling alienated as the Nepalese monarchy expanded its power in the country. In 1989, Nepalese leftist parties formed a coalition with the Nepali Congress Party to begin protesting the lack of wanted reforms. Through secret negotiations, the panchayat system[1] and the ban on political parties were removed shortly after, and all political prisoners were released. An interim government was formed with a new prime minister. One year later a new constitution was written, creating a parliamentary democracy under constitutional monarchy rule and emphasizing the importance of human rights (Pettigrew & Gellner 2013).

Once Nepal became a democracy in 1990, one of the larger leftist groups with ties to the previous Communist Party of Nepal (the Maoist)(CPN-M)[2], joined with the Nepali

[1] "The panchayat system enshrined the absolute power of the monarchy and kept the king as head of state with sole
authority over all governmental institutions, including the Cabinet and the Parliament" (Pettigrew & Gellner, 2013, p. 11)

[2] The Maoist party originated in the 1960s as a sect of the community party which became popular a decade earlier. There was significant internal strife and various factions split from the original Maoist group. The most well known Maoist affiliated group is the Unified Communist Party of Nepal (Maoist) (CPN-M) (Pettigrew & Gellner, 2013).

Congress Party to form the interim government. The CPN-M took part in this new government by running in the 1991 and 1992 elections. During this time, the Maoists received support from labor unions, public school teachers, and clerical government workers (Lawoti & Pahari, 2010).

The armed conflict began on February 13, 1996 after the CPN-M (from now on referred to simply as "the Maoists") gave a list of forty demands to the Nepalese government (Lecomte-Tilouine, 2013).[3] Four days before their ultimatum to the government expired, the Maoists attacked three police stations and ten years of conflict began (Lecomte-Tilouine, 2013; Lawoti & Pahari 2010). The Maoists maintained Rolpa and Rukum as base areas for their operations throughout the conflict and fought mostly from rural areas (Pettigrew & Gellner 2013).

One of the main initiatives of the Maoists was to garner support from the marginalized people of Nepal. This included groups such as women, rural-dwellers, youth, and Dalits, previously known as untouchables[4] (Pettigrew & Gellner 2013).[5] The Maoists were able to unite the marginalized groups with the promise of brotherhood and hope for a better life. The Maoists were against many Nepalese traditions that maintained the current status quo and promoted societal inequality, including discrimination against individuals based on gender, caste, and ethnicity (Valente, 2013). Some scholars considered "the strategy of the CPN (M)…[was] to drive away the political and economic elite from villages in the middle hill region, put an end to all local arms of the state and finally, to replace state structures by those of their own party, while also instituting elections from the 'people's government'" (Lecomte-Tilouine, 2009, pg. 227). However, the political and social aims of the group(s) remained somewhat undefined, even throughout the conflict (Lecomte-Tilouine, 2009).

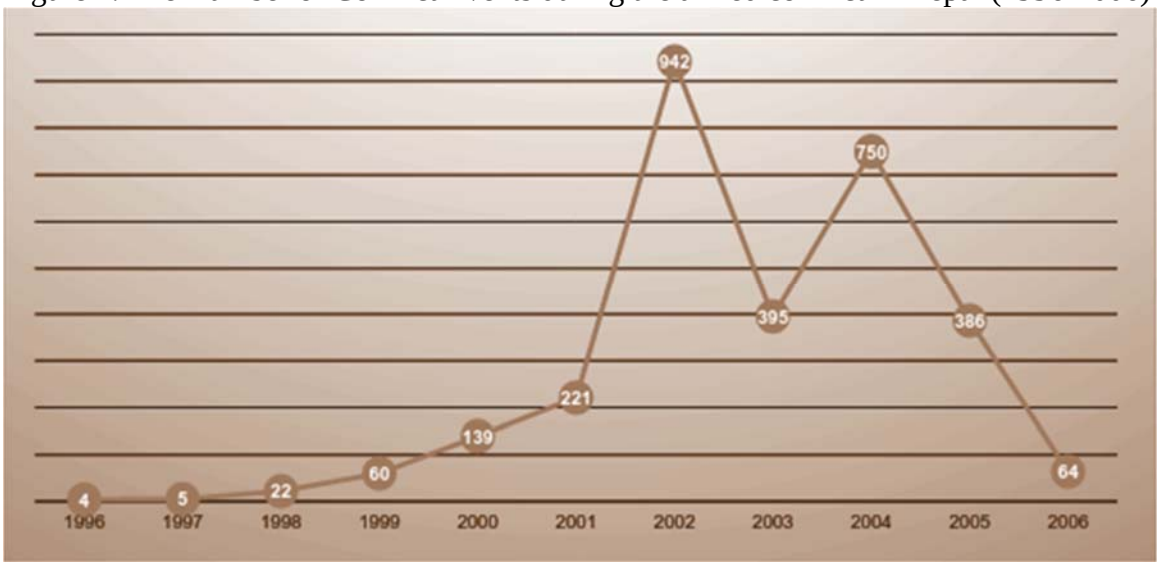
While the fighting was relatively limited at the beginning of the conflict, there was an increase in conflict events between the Maoists and the Nepalese Army after 2001(Figure 1)

[3] Most of the demands on the list called for social and economic reform against injustices. The reforms included an end to the monarchy and the creation of a Constituent Assembly in Nepal. Other demands were more ambitious, such as employment for everyone, free education for everyone, the restriction of non-governmental organizations (NGO) in the country, and strengthening Nepalese nationalism (Lawoti & Pahari 2010; Standing & Parker 2011). Overall, "they have been described by several non-partisan commentators in terms such as 'reasonable and not dissimilar in spirit to the election manifestos of mainstream parties'" (Pettigrew & Gellner, 2013, p.13).

[4] In the Hindu religion, Dalits are the fourth and lowest caste in the caste system. According to tradition, if a Dalit touches another caste, that person has to go through a purification ritual. However, this particular tradition is becoming less popular in the urban areas (Gersony 2003).

[5] The Maoist movement has been describes as an "ideology offered (to) its members, especially those not particularly successful educationally or economically, a new interpretation of their circumstances; in particular, it gives them the opportunity to struggle against their situation and develop a new understanding of their oppression and exploitation" (Lecomte-Tilouine, 2009, p. 228).

Figure 1. The Number of Conflict Events during the armed conflict in Nepal (1996-2006)



Data Source: Armed Conflict Location & Event Data Project (Raleigh, Linke, & Karlsen, 2010)

This increase in conflict events coincides with the Royal Nepalese Massacre in June 2001.[6] The Maoists tried to take advantage of the chaos in Nepal by inciting riots in Kathmandu, but these attempts failed; Maoists hoped the massacre would permanently remove monarchical rule, (Lecomte-Tilouine, 2009). However, the royal massacre did present the Maoists with an opportunity to gain support from those who despised the new king. One of the most recognized slogans from the Maoist campaign after 2001 was "Down with the Feudal-murderer Gyanendra clique" (Lecomte-Tilouine, 2009, p. 230)

On orders from the new king, the army replaced the Nepalese police as the main opponents of the Maoists. November 2001 was the first time the Maoists had physically interacted with the Nepalese army instead of the local police. This clash occurred after a months-long ceasefire broken by the Maoists. By the end of the month, the Maoists were deemed a terrorist organization by the Nepalese government and a state of emergency was instituted. During the latter half of 2001, the government, for the sake of national security, suspended several constitutional rights, including freedom of movement and assembly, freedom of expression, and freedom of the press (Pettigrew & Gellner 2013).

[6] In June 2001, the King and Queen of Nepal, their children, the King's oldest brother, and the several other family members were killed at the Narayanhity Palace in Kathmandu. Publicly, the massacre was blamed on the allegedly disgruntled Crown Prince Dipendra over his parents' disapproval of his future marriage plans (ABC News, 2016; Gregson 2002). The Crown Prince became the King of Nepal until his death two days after the massacre. Other theories about the massacre involve Gyanendra, the King's younger brother, who may have orchestrated the murders in order to take the Crown from his brother. Rumors ran rampant after the massacre because Gyanendra's children and wife were not killed, even though they were in the palace at the time, although his wife was shot (Gregson, 2002). With the line of succession shifting from King Birendra to King Gyanendra, the Maoists openly challenged King Gyanendra by calling him an illegitimate ruler and a murderer (Lecomte-Tilouine, 2009).

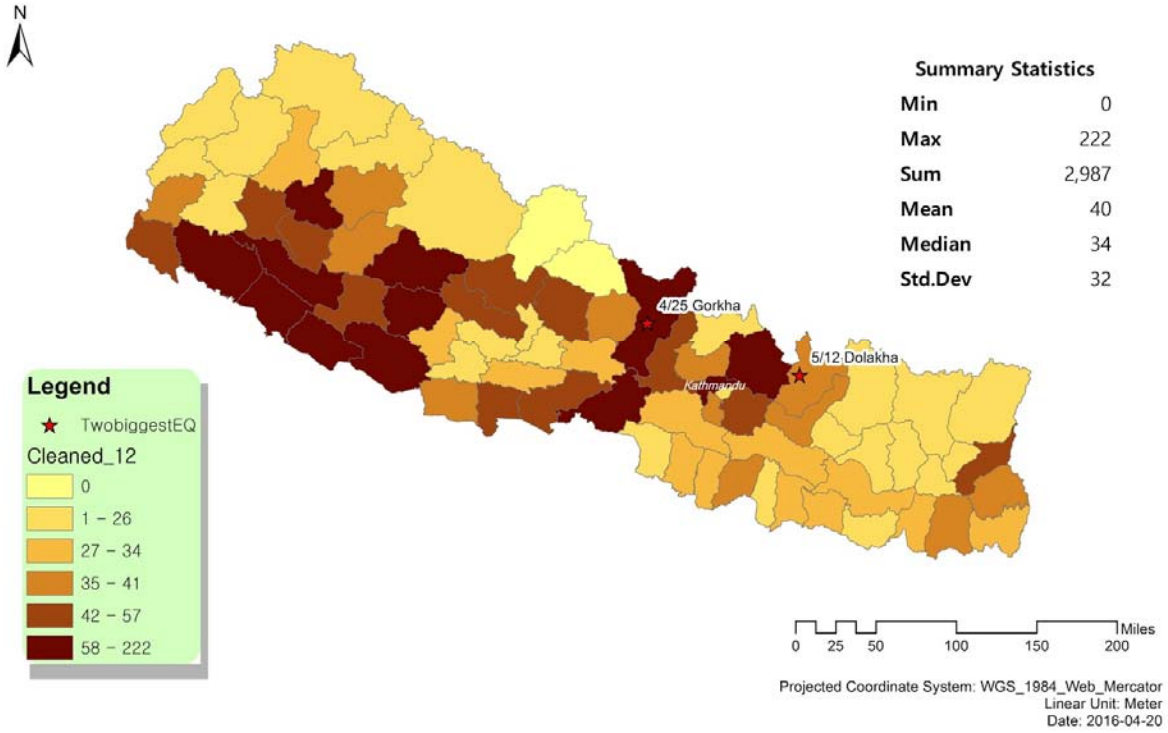
Beginning in 2003, the parties negotiated another ceasefire and began peace talks.[7] The government negotiators would only agree to amend the current constitution, while the Maoists would only agree to create an entirely new constitution. On August 27 the Maoist leader, Prachanda (Pushpa Kamal Dahal) announced the Maoists' withdrawal from the negotiations (Pettigrew & Gellner, 2013). Less than two years later, King Gyanendra gave the monarchy direct power, causing protests by political parties, and by citizens in the streets. This power shift created an alliance formed by seven political parties against the monarchy who named themselves the Seven Party Alliance. King Gyanendra's change from a constitutional monarchy to an absolute monarchy created a three-way power struggle in Nepal. In the end, the Maoists participated in the protests with the Seven Party Alliance but refused to formally join the group (Pettigrew & Gellner, 2013). In late April there was a major clash between the police and protesters during which Nepalese protesters were killed. As a result King Gyanendra renounced some of his power as King in April 2006 to a prime minister to be chosen by the political parties (Pettigrew, 2013). This was followed by a formal ceasefire between the government and the Maoists one month later. By November 2006, both sides had agreed to the Comprehensive Peace Agreement (CPA).[8] This was implemented throughout Nepal the following year.

By the end of the armed conflict there had been 3,030 conflict events and between 13,000 and 16,000 fatalities (BBC, 2009; Pettigrew & Gellner, 2013; United Nations Human Rights Office of the High Commissioner, 2012; Raleigh, Linke, & Karlsen, 2010). The fighting was widespread; in all but two districts, Manang and Mustang, there was a reported conflict killing (United Nations Human Rights Office of the High Commissioner, 2012). Another 200,000 people were internally displaced and between both sides 4,500 children were conscripted. Nepal also had the highest rate of disappearances globally in 2003 and 2004. Although the number of disappearances is unknown, during the conflict 1,619 disappearances were recounted to the National Human Rights Commission. Of the 1,619 disappearances, 1,234 were associated with the government and 331 with the Maoists. The rest of the reported disappearances were unknown (Pettigrew & Gellner, 2013; Human Rights Watch, 2009). Figure 2 shows the distribution of conflict events by district. Conflict events were widespread across the nation, the areas with the most concentrated conflicts extended from the west to the central.

[7] A lack of trust by both sides disrupted the talks. Smaller Maoist insurgency groups continued their attacks across the country during the negotiations and the government questioned the control Maoist leadership had over its followers. The Maoists were also skeptical of the representatives sent by King Gyanendra because they were not independent negotiators. The talks lasted until August and ended in an impasse. Neither side could agree on the Constituent Assembly. However, a lack of trust by both sides disrupted the talks. Smaller Maoist insurgency groups continued their attacks across the country during the negotiations and the government questioned the control Maoist leadership had over its followers. The Maoists were also skeptical of the representatives sent by King Gyanendra because they were not independent negotiators. The talks lasted until August and ended in an impasse. Neither side could agree on the Constituent Assembly.

[8] The CPA "included plans for election to a Constituent Assembly and the monitoring of the weapons and soldiers of the People's Liberation Army (PLA) by the United Nations" (Pettigrew & Gellner, 2013, p. 15).

Figure 2. Map of the Number of Conflict Events during the armed conflict in Nepal by District



Data Source: Armed Conflict Location & Event Data Project (Raleigh, Linke, & Karlsen, 2010)

2.2 Natural Disasters and the 2015 Earthquake in Nepal

In terms of both human life and economic resources, natural disasters take an enormous toll worldwide. Globally, the death toll due to natural disasters rose between 2004 and 2013. The Centre for Research on the Epidemiology of Disasters (2015) found that death rates due to natural disasters have increased over this time period, “reaching an average of more than 99,700 deaths,”(p. 7) and an average of 218 million people affected per year. Earthquakes (including earthquake-related tsunamis) were the number one killer, and were the cause of 55 percent of the deaths caused by natural disasters. The disproportionate amount of people affected in less developed countries is clear; the Center for Research on the Epidemiology of Disasters (2015) found that “on average, more than three times as many people died per disaster in low-income countries” (p.7).

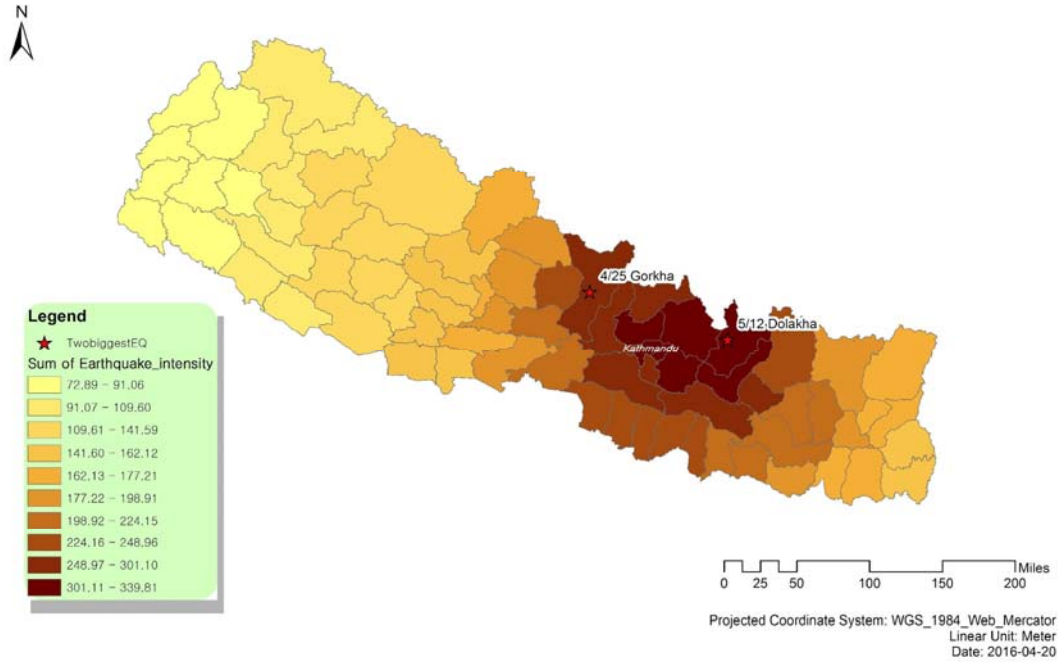
South Asia is one of the hardest hit regions of the world when considering the impact of natural disasters on the economy, with earthquakes being one of the leading culprits. According to the United Nations Economic and Social Commission for Asia and the

Pacific (2015), “a person living in Asia-Pacific was twice as likely to be affected by a natural disaster as a person living in Africa, almost six times as likely than someone in Latin America and the Caribbean, and 30 times more likely to suffer from a disaster than someone living in Europe” (p. 7). While the number of fatalities has been decreasing, the level of economic damage caused by natural disasters in Asia and the Pacific is on the rise.

On Saturday, April 25, 2015, a 7.8 magnitude earthquake struck Gorkha, Nepal. Since then, there have been roughly 400 aftershocks with a magnitude greater than 4.0, including one of 6.8 magnitude the following month on May 12th (United States Geological Survey, 2015). The earthquakes and the following aftershocks have affected about one-third of the Nepalese population. Nearly 9,000 people lost their lives, and over 22,300 people were injured. Close to 500,000 homes were destroyed, and an additional 250,000 houses were damaged. One year after the initial earthquakes many people still live in temporary shelters. An estimated 31.3 billion NPR ($313 million United States Dollars (USD)) of damage and losses were inflicted on the education sector alone, and estimated recovery needs for this sector are 39.7 billion NPR ($397.1 million USD). The estimated total value of damage and losses is $7 billion USD, of which 58 percent occurred in the social sector, which includes mostly housing (Government of Nepal National Planning Commission, 2015).

Figure 3 shows the earthquake intensity distribution by district. This measure takes into account of the distance of each district center to the epicenter of all earthquakes, including the aftershocks between April 25 and June 5.

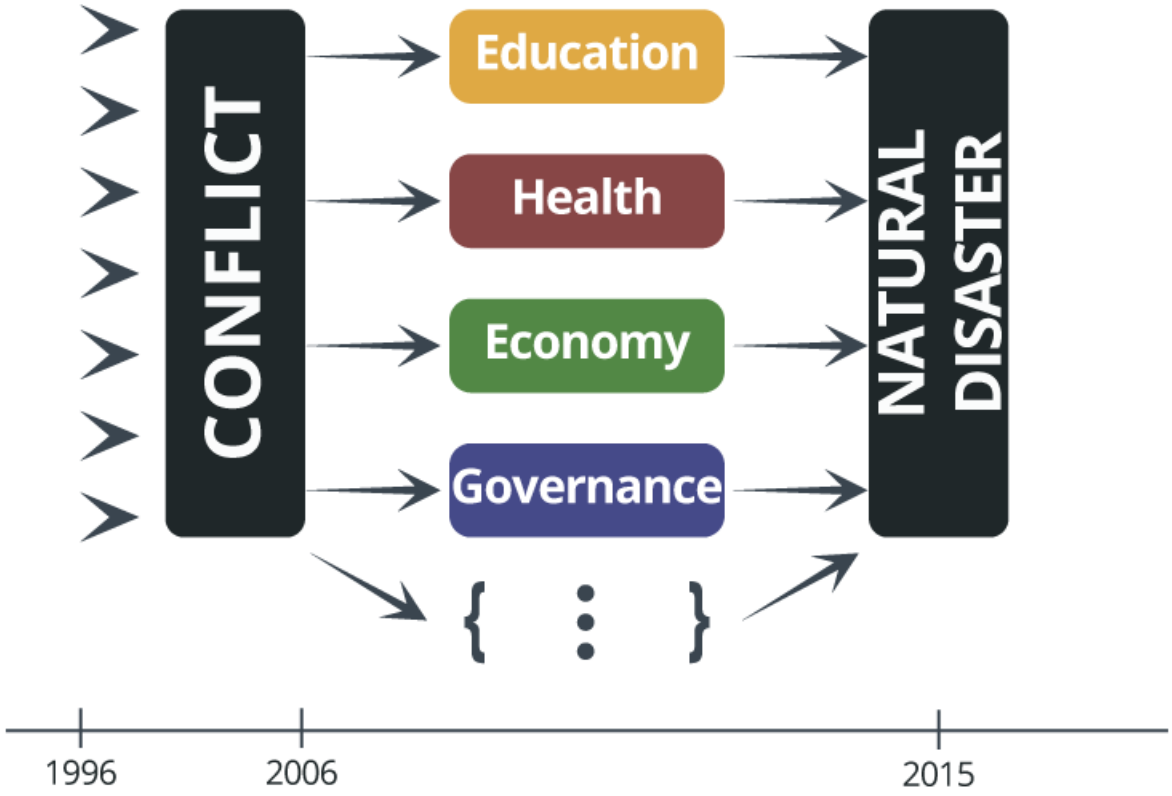
Figure 3. Earthquake Intensity by District



Data Source: Variable calculated using United States Geological Survey data

3. Conceptual Framework

Looking at two separate lines of inquiry in the literature, the relationship between a history of conflict experience and immediate natural disaster outcomes is explored. The conceptual framework is visually represented by the following figure. First, the impact of conflict on four intermediary variables is examined: economic development, education, governance, and health. Then the relationship between each of these four intermediary variables and natural disaster outcomes is outlined.



3.1 Education

3.1.1 Education and Conflict

There are multiple theories about the effect of civil conflict on education regarding educational outcomes. As an intermediate variable, education is affected during and after armed conflict. Generally, conflict has a negative impact on education.

Lai and Thyne (2007) studied the global effect of conflict on education between 1980 and 1997. They find that “civil wars are likely to reduce educational expenditures as well as educational enrollments across all levels” (Lai & Thyne, 2007, p. 289). During a civil

war, the direct and indirect costs of fighting negatively affect education spending. Educational expenditures by the government are reduced by 3.1-3.6% for every year that the civil war continues (Gates et. al, 2012; Lai & Thyne, 2007). Therefore, the longer a conflict continues, the more damage that occurs to the education system in the country. The educational system in a country can be destroyed by civil conflicts due to the redirection of educational funds toward war efforts. Faced with civil conflict, governments redirect funds toward military rather than public goods and resources, like education (Lai & Thyne, 2007).

Lack of educational spending is not the only problem affecting education in a conflict. Valente (2011) explores other factors that hinder school attendance during a conflict. She specifically points out potential enrollment in the military, limited mobility, parental decisions to remove children from school for safety reasons, and the possible destruction of school buildings as reasons for limited attendance during a conflict.

In Nepal, children and teachers were abducted from school buildings by both the government and Maoists during the conflict (Valente, 2013; Standing & Parker, 2011). Both sides were each responsible for killing teachers and students (O'Malley, 2010). This made parents fearful to send their children to school and resulted in decreased attendance (Human Rights Watch, 2004; Valente, 2013). The threat of kidnapping was a large impediment to attracting and retaining teachers in rural Nepal. Furthermore, because schools would sporadically close due to violence, final exams required for students to continue their education were often postponed or canceled. During the armed conflict, school buildings were used for purposes less related to education and more connected to the ongoing armed conflict; classrooms were used as barracks and were not exempt from battles (Standing & Parker 2011; Amnesty International, 2005).

Safety concerns for school-aged children kept many girls at home. In urban areas, boys were often sent to attend school while girls were kept home due to the risk of sexual assault if they travelled without proper supervision (Standing & Parker, 2011). However, living in areas under Maoist control, female school attendance might have increased: Maoists insisted girls attend school in the areas they controlled, issuing fines to parents of girls who were not in school (Standing & Parker, 2011).

3.1.2 Education and Natural Disaster

Toya and Skidmore (2007) found countries with a more educated populace, among other factors, are better able to reduce economic and human loss from natural disasters. This is largely because higher levels of education lead to better and safer decisions when faced with a crisis. Zhou and colleagues (2014) found low education to be a contributing factor to increased deaths during natural disasters. In addition, a study of panel data from fifteen Asian countries (including Nepal) found that several socio-economic factors including level of education and educational attainment reduce fatalities during a natural disaster (Padli & Habibullah, 2010). These same authors (2010) later state that, "it cannot be denied the crucial role played by education in the pre-disaster period, the impact of and possible integration of disaster education into the post-disaster response, and the many

options and new technologies available to educate people about disaster risk management" (p. 435).

A study completed in Japan looked at education received by school children about what to do during an earthquake. It found "to prepare for an earthquake...is only possible through active education in family and community" (Shaw, Shiwaku, Hirohide, Kobayashi, & Kobayashi, 2004, p.45). The study acknowledges earthquake education is not enough to ensure good decision-making skills during an earthquake, but it can be a foundational step. Another survey in New Zealand found that educational information should be provided to help mitigate the most harmful behavior during a natural disaster (Shaw et al., 2004; Ronan, Johnston, & Fairley, 2001).

3.2 Economy

3.2.1 Economic Development and Conflict

There are two divergent views about how conflict affects the economy. One set of scholars believes conflict can lead to economic improvements while other scholars emphasize the negative impact a conflict can have on an economy.

Conflict can reduce gross domestic product (GDP) per capita in the area afflicted. Chen, Loayza, and Querol (2008) found that GDP per capita is substantially lower in post-conflict zones than before the conflict. Additionally, Collier (1999) found that economies of countries in civil war grow, on average, 2.2 percent slower than at peacetime, and Gates et. al (2012) found that GDP per capita growth loss can be as drastic as 20 percent over the first five years of a conflict.

GDP per capita is not the only indicator of economic consequences of civil war. In fact, many of the effects of conflict are indirect (Gates et. al, 2012), which can make it difficult to accurately measure the impacts of conflict. Collier (1999) specified five mechanisms by which conflict destroys economies: destruction of resources, disruption of social order, diversion of public expenditure, dis-saving, and the shifting of assets out of the country. Other indirect economic consequences of armed conflict include the destruction of infrastructure and economic institutions, capital flight, forced migration, and destruction of human capital (Blattman & Miguel, 2010; Gates et. al, 2012). In addition, money and resources are often diverted to military expenditures, leaving fewer resources for other aspects of society.

Imai and Weinstein (2000) focus on the negative impact of civil war on economic growth due to the impact of conflict on domestic investment. They find that because of the lower expected rate of return during internal conflict, there is a dramatic reduction in domestic private and public investment. Lower investment rates lower the amount of capital stock in a country, which is a crucial part of economic growth.

Contrastingly, some evidence has shown in the years directly following conflict, post-conflict zones experience quicker economic growth than non-conflict zones, recovering at a minimum to pre-conflict levels (Chen et. al, 2008; Gates, Hegre, Nygård, & Strand, 2012). Blattman and Miguel (2010) also references this paradox, saying that previous scholars have attributed economic prosperity to previous warfare. The level and speed of economic growth and recovery post-conflict can vary based on many factors that impact the scope of the war, including length of conflict, size of the country, and the economic sector in question (Chen et. al, 2008; Gates et. al, 2012; Imai & Weinstein, 2000). Some contributing factors to growth may be increased output per capita, increased investment, decrease in inflation, international aid, and less military expenditure.

3.2.2 Economy and Natural Disaster

One of the leading indicators of how severely affected a nation will be by a natural disaster, both in terms of death toll and economic damage, is the level of economic development. The Centre for Research on the Epidemiology of Natural Disasters (2015) found that on average, more than three times the number of people die in low income countries as a result of natural disasters compared to developed country counterparts, and that the level of economic development prior to the disaster is one of the greatest contributors to total death toll. Mercer and Reed (2007), along with others (Kahn, 2005; Raschky, 2008; Toya & Skidmore, 2007), consistently find negative correlations between national income and damage caused by natural disasters.

Moreover, using data from natural disasters in 73 countries from 1980 to 2002, Kahn (2005) found that richer nations experience fewer deaths when faced with a natural disaster. For instance, Kahn found that a nation with a GDP per capita of 14,000 USD experiences, on average, only 189 deaths due to natural disaster annually, compared to 893 natural disaster related deaths in a nation with a $2000 USD GDP per capita. Horwich (2000) directly attributes the relative minimal death toll and rapid recovery following the 1995 earthquake in Kobe, Japan to the economic sophistication of the country. Empirical evidence from a study on natural disasters over the years in China shows that as the Chinese economy develops, there are fewer deaths from natural disasters in the country (Zhou et. al 2014).

One reason for the drastic decrease in fatalities related to natural disasters in developed countries is due to the wealth of the population: richer communities can afford to demand the implementation of safety measures and accountability from their government. Poorer nations and communities are more likely to live in structures that are poorly built and unable to withstand physical shock (Horwich, 2000). In more developed nations, emergency response teams, search and rescue professionals, and medical personnel receive the training that they need to properly respond to an emergency situation.

Economic inequality is another key factor of natural disaster damage, as poorer families within a community are often more disproportionately affected by a shock (Kahn, 2005). The Red Cross suggests that those in poverty are the most vulnerable social strata, and Carter, Mogues, and Negatu (2007) found that lower income families feel the effects of

natural disasters more acutely and had a harder time recovering. For example, following Hurricane Mitch in Honduras, poorer families experienced a loss of income that ultimately decreased their consumption; whereas richer families were able to better mitigate their loss with a less dramatic reduction of consumption (Van den Berg, 2008).

3.3 Governance

3.3.1 Governance and Conflict

Governance is also viewed through two diverging strands of the literature. Many scholars argue that good governance decreases after a conflict, while others say it can promote good governance.

Establishment of good governance and political institutions post-civil war is a topic that has been direly neglected in the current economic development literature (Bellows & Miguel, 2009; Blattman & Miguel, 2010). Blattman and Miguel (2010) point out that many prominent economic development textbooks overlook the impact of conflict altogether, and there is a need for further studies in this "emerging field"(p. 5). They claim that impacts of conflict on institutional and governance factors such as property rights and rational functioning bureaucracies are some of the most significant but least understood consequences of civil war.

The generally accepted belief is that civil wars "lead to state deterioration," (p. 191) cause political disintegration, and hinder a state's overall development (Rodríguez-Franco, 2015). Brinkerhoff (2011) finds that it is difficult to establish good, legitimate (democratic) governance in post-conflict zones. Common characteristics that hinder the governance-building process in post-conflict areas include lack of administrative capacity, low resources, low salaries and late wages that discourage and disincentive civil servants. Similarly, Marshall and Cole (2008) claim that, especially in new and transitional governments, societal conflict "stalemates" (p. 5) democratic experiments.

On the other hand, Rodriguez-Franco (2015) challenges the assumption that civil and internal wars hinder state capacity. She found that, under certain circumstances (such as elite and government-renewed solidarity for tax capacity purposes), civil wars can encourage state-building and improved governance. In addition, Bellows and Miguel (2009) and others (Blattman, 2009), found that survivors of conflict are more likely to be involved in politics, participate in political group activities for the benefit of the community, and become local political leaders. These findings indicate that post-civil war zones could experience better governance despite or even as a result of the conflict. Brinkerhoff (2011) argues that following ethnically driven conflicts, increased decentralization may be one of the most effective forms of post-conflict governance. As Blattman and Miguel (2010) succinctly state; "there is no simple, general relationship between civil war and institutions" (p. 43).

3.3.2 Governance and Natural Disaster

It is clear from the literature that both the nature and legitimacy of governance has an enormous impact on the death toll as a result of a natural disaster. Twigg (1998) suggests that the nature of a community's social structures and institutions play a vital role in mitigating vulnerability to natural disaster. In a study on economic development and natural disasters, Toya and Skidmore (2007) found that countries with greater political openness are better able to reduce both economic and human loss from natural disasters. Kahn (2005) tested natural disaster death toll against political and institutional openness, and found that empirically, democracies experience a lower death toll as a result of natural disasters. In effect, greater openness allows for more political accountability and reduced corruption, which forces governments to respond to their people's demands for disaster risk-reducing measures and proactively prepare for unplanned shock so as to minimize their impact. Such measures include, but are not limited to, improved urban planning, strict and enforceable building codes, disaster preparation awareness and transfers of technological knowledge from abroad.

Academic case studies reinforce the theory that non-democratic governance result in higher death tolls from natural disasters. Diagne (2007) found that in Senegal, "the city's vulnerability to floods is a result of human practices" (p. 561). Research on the 2005 earthquake in Kashmir, Pakistan (Halvorson & Hamilton 2010) showed that much of the damage was due to governance-related and preventable problems, including: a lack of building code enforcement, poor information dissemination, lack of national preparedness, and lack of government response. Indeed, one of four primary factors contributing to the magnitude of the disaster was, "lack of seismic risk perception and planning at the national level" (p. 196). Alternatively, the relative lack of damage following the 1995 earthquake in Kobe, Japan can in part be contributed to good governance. Horwich (2000) argues that damage to building and infrastructure was mitigated due to the role of government: enforcement of building codes, infrastructure safety, and other disaster-protective measures.

3.4 Health

3.4.1 Health and Conflict

Civil wars have long-term negative consequences on the health of civilian populations (Ghobarah, Huth, & Russett, 2003). Areas where there has been armed conflict are likely to suffer from food shortages, impacting the nutrition of the affected population (Messer and Cohen, 2011; Gates et al., 2012). Conflict has countrywide detrimental effects on undernourishment, life expectancy, infant mortality, and access to water, all of which have lasting effects beyond the conclusion of violence (Gates et. al, 2012). Without meeting daily caloric needs, the ability of the body to stave off disease and infection is diminished. Combined with the stress of living amongst armed conflict, the immune system is compromised. Displaced populations that do not return to their homes, whether

in refugee or makeshift camps, are prone to poor sanitation and become vectors for infectious disease (Ghobarah et al., 2004). It is also noteworthy that the impact of conflict on health does not diminish at borders: public health in countries situated next to neighboring countries experiencing civil war are also adversely affected.

Resources for prevention and treatment in these compromised communities are strained by the presence of conflict, reducing the capability to respond to growing public health crises. Civil wars can inflict damage on health infrastructure, including clinics, hospitals, water treatment facilities, and electrical grid systems, which can be costly and slow to rebuild (Ghobarah et. al, 2004). The negative economic impact of civil wars on growth can last at least 5 years (Murdoch & Sandler, 2002), and diminishes the tax base available to finance health care. Furthermore, severe violent conflict can prompt the flight of medically trained professionals whose return or replacement may not be reversed until long after the conclusion of the conflict (Ghobarah et al., 2004). In the aftermath of civil war, constrained resources force decision-makers to realign priorities and compromise the redevelopment of public health in the interest of security, particularly military capability (Ghobarah et al., 2004).

3.4.2 Health and Natural Disaster

The World Health Organization (2016) found that malnourished people and people who are ill or have a weak immune system are particularly vulnerable when a disaster strikes. Cannon (2008) examines the link between vulnerability, capacity, and natural disaster outcomes. One of his five key indicators of vulnerability is well-being, which is determined by nutritional status and physical and mental health. Specific factors include the quality of diet, access to healthcare, and level of stress. He claims that all of these factors are likely to affect the “ability to resist the impact of a hazard” (p. 5). In other words, poor nutrition and lower health contribute to greater vulnerability to hazards such as natural disasters. This indicator is in turn closely interconnected with the other indicators of vulnerability, including self-protection.

According to the Red Cross, the vulnerability of a person or household depends greatly on their specific characteristics, including health level. Indeed, they list public health as an important goal when attempting to establish *preventative* measures to reduce human and economic consequences of natural disasters. Not only does health matter at the individual level, but also at the institutional level. The World Health Organization (2016), along with the United International Strategy for Disaster Reduction (2011) emphasize that resilient community health care systems can both lower vulnerability and respond quicker in disaster situations. An insufficient health sector is likely to have poor emergency preparedness and disaster management ability.

In sum, the conceptual framework outlined above highlights the channels through which conflict can be associated with earthquake damage. Of course conflict is never a random event and its occurrence often relates to certain socioeconomic conditions, just as in the case of the armed conflict in Nepal. Without directly modeling and analyzing the occurrence and intensity of conflict events, this paper can't claim the association between conflict experience and earthquake damage to be causal. However, if empirically such association is found to be statistically significant, this paper can conclude that conflict experience can be used as a proxy for vulnerability of a district when hit by an earthquake.

4. Data & Methods

The data used is collected from a variety of sources. The measures of earthquake damage are based on official numbers gathered by the Ministry of Home Affairs in Nepal and the Nepalese police, which were then distributed and translated by United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA). Originally the data was extracted from Humanitarian Data Exchange (HDX), which is an open platform for sharing data. The measure of conflict intensity is based on data provided by Armed Conflict Location and Event Data Project (ACLED), a non-governmental organization in the United States designed for disaggregated conflict analysis mapping by collecting the dates and locations of all reported political violence and protest events in over sixty countries in Africa and Asia. The measure of earthquake intensity is constructed based on the data published by the National Seismological Centre in Nepal.

Information on district characteristics is from the tabulations of the 2011 Nepalese Census. And, the Nepal Human Development Report (2014) provided data for some of the intermediary variables, including life expectancy, the percentage of malnourished children under age five, and GDP per capita (Purchase Power Parity based) by district. The primary school enrollment rate (age 5 to 9, grades 1 through 5) was obtained from an assessment conducted in 2000 by Data Centre in UNESCO Institute for Statistics and the poverty rate data is obtained from the 2011 Nepal census.

With the guidance of the conceptual framework and the availability of controls, the following regression equation is used to analyze the association between the conflict intensity during the 1996-2006 period and the natural disaster damage during and immediately after the earthquakes in 2015:

$$\begin{aligned} DMG_i = \ & \beta_0 + \beta_1 EQ\_intensity_i + \beta_2 Conflict\_intensity_i \\ & + \beta_3 EQ\_intensity_i \times Conflict\_intensity_i + \beta_4 HHI\_caste_i \\ & + \beta_5 HHI\_religion_i + \beta_6 Pop\_density_i + \beta_7 Total\_pop_i \\ & + \beta_8 Dist\_Kathmandu_i + \beta_9 Road/km^2{}_i + \gamma' * REGION_i + \epsilon_i \end{aligned}$$

Where i denotes district i. The outcome variable is earthquake damage (DMG_i), which is measured in three different ways: the number of public buildings damaged, the number of injured persons, and the total number of fatalities. The building damage measure indicates the total number of public buildings, which were partially or entirely damaged due to the earthquake from April 29, 2015 to June 5, 2015. The injured damage measure is the total number of people who were injured due to the earthquakes between April 25, 2015 and June 5, 2015. Fatalities are recorded for the same period as the injury data.

To calculate earthquake intensity in each district ($EQ\_intensity_i$), the attenuation model introduced by Singh, Aman and Prasad (1996) was used to obtain district-specific single value of the total intensity of shaking. This measure is based on the locations of epicenters, distance from centroid of each districts' to all epicenters, and magnitude of each earthquake from April 25, 2015 to June 5, 2015.[9] The locations of epicenters and the magnitude of shaking for each was collected from National Seismological Centre in Nepal. Using GIS tools with the latitude and the longitude information derived the distance from the center of each district to all epicenters.

Conflict intensity ($Conflict\_intensity_i$) measures the total number of armed conflicts including battles, civilian killings, riots and protests by district from 1996 to 2006 during the armed conflict in Nepal. To discover the total number of events by district, using latitude and longitude, each conflict occurrence in Nepal was geocoded. This variable was created in order to see the relationship between conflict intensity and earthquake damage. To allow for the effect between conflict and earthquake intensity to vary, an interaction of the two ($EQ\_intensity_i \times Conflict\_intensity_i$) is introduced.

To control for district initial characteristics, measures of caste diversity (HHI_caste_i) and religious diversity ($HHI\_religion_i$) were included using the HHI. HHI is calculated by squaring the percentage share of each caste in a district then summing the resulting numbers. Because the level of earthquake damage measured by the three variables may positively relate to population and population density, two additional variables were included in the regressions ($Pop\_density_i$; $Total\_pop_i$). To capture the accessibility to local support and aid, a variable measuring road length per square kilometers ($Road/km^2{}_i$) is included. The variable ($Dist\_Kathmandu_i$) measures distance in kilometers from each district to Kathmandu. The distance is calculated using the latitude and longitude information of each district in GIS. Kathmandu, the capital of Nepal, was the sole entry point foreign aid, as it is the only international airport in the country. During the earthquake relief efforts, the international airport was bottlenecked and aid could not get to the rural areas of Nepal. This also complicated rescue missions. This variable measures the accessibility of aid from Kathmandu to other districts. To account for development region fixed effects as well as to partially control for typological characteristics of each district, a vector of development region dummies ($REGION_i$) is included.

[9] The formula of earthquake intensity is the following: LogX = 1.14 + 0.31M - 0.615logR (X= the intensity; M=magnitude; R=distance)

The summary statistics of the above mentioned variables are reported in Table 1.

Table 1. Summary Statistics

Dependent variables	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Total building damage	75	10460.27	20153.81	0	87726
Total injured persons	75	296.25	1023.82	0	7864
Total fatalities	75	116.16	448.27	0	3440
Dependent variables	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Earthquake intensity	75	182.58	73.28	72.9	339.81
Conflict intensity	75	39.83	31.83	0	222
Caste diversity	75	19.5	10.53	5.19	49.89
Religious diversity	75	70.48	20.06	32.69	99.86
Population density	75	304.51	554.89	2.78	4125.44
Total population	75	358357.4	285534.6	6538	1744240
Distance to Kathmandu	75	220.98	140.63	0	512.83
Road/Km2	75	0.089	0.18	0	1.11
Intermediary variables	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Adult literacy	75	57.48	11.39	33.89	84.04
Percentage of malnourished children	75	42.81	10.97	16.2	65.7
GDP per capita	75	1079.83	443.05	487	3166
Poverty rate	75	27.66	13.36	4.09	64.32

5. Results

5.1 Results on Earthquake Damage

The results on building damage are presented in Table 2. The relationship between the amount of physical shaking and the damage outcomes are expectedly highly correlated. The earthquake intensity variable explains 54 percent ($r^2 = 0.537$) of the variation in total damage to buildings (column (1) in Table 1). The earthquake intensity variable, which is constructed with all earthquakes above a 4.0 on the Richter scale, weighted by intensity, and distance from the epicenter, is thus highly correlated with the total amount of damage to buildings.[10]

[10] If a variable using only the major and broadly discussed quake on April 25, then only 35 percent ($r^2 = 0.347$) is explained by the intensity of the quake (not shown).

Table 2. Regression Estimations of Total Building Damage

	(1)	(2)	(3)	(4)	(5)
Earthquake intensity	201.5***	406.6***	376.9***	566.9***	425.2***
	(30.55)	(57.21)	(46.67)	(76.41)	(78.71)
Conflict intensity			165.0***	140.7***	-239.4***
			(53.18)	(37.89)	(56.69)
Conflict intensity × Earthquake intensity					2.140***
					(0.389)
Caste diversity				15.88	-55.70
				(249.5)	(206.1)
Religious diversity				-113.6	-36.32
				(78.12)	(61.66)
Population density				7.065	-18.35**
				(8.153)	(9.126)
Total population				0.00332	0.00458
				(0.00737)	(0.00590)
Distance to Kathmandu				163.7***	130.4***
				(39.17)	(35.48)
Road/km2				-16,181	33,737*
				(19,832)	(19,512)
Constant	-26,327***	-64,841***	-64,802***	-120,581***	-91,892***
	(4,551)	(10,057)	(8,223)	(22,446)	(21,476)
Development Region FE	NO	YES	YES	YES	YES
R-squared	0.537	0.701	0.761	0.816	0.864
Observations	75	75	75	75	75

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Although the total amount of shaking is highly correlated with the damage outcomes, it still leaves nearly half of the variation to be explained, which confirms the assumption that other variables must be considered. Regional dummies are introduced (column (2)) to pick up fixed effects across the different developmental regions, which combined amounts to explaining about 70 percent of the variation in damage outcomes.

When conflict intensity – the amount of events relating to the conflict – is introduced, it is highly significant with a coefficient of roughly 165 (column (3)). An increase in the occurrence of a conflict events between 1996 and 2006 by one event is associated with the damage or destruction of 165 buildings after the earthquake in 2015. Introducing the remaining controls, largely demographic and access variables (column (4)), does not significantly change the coefficient for conflict intensity. It does, however, raise the coefficient for the earthquake shaking variable, which remains highly significant, suggesting that they are measuring important contributions to the level of damage.

An interaction term between earthquake intensity and conflict intensity is introduced, allowing the impact of conflict to differ by earthquake intensity (column (5) in Table 2). The statistical significance of this interaction term at $p<0.01$ and its large coefficient confirms the hypothesis that the impact of conflict depends on the levels of earthquake intensity. In other words, as the intensity of the ground shaking increases, conflict experience during the armed conflict has a greater negative effect on the resilience of a district in the earthquake.

Table 3. Regression Estimations of Total Injuries

	(1)	(2)	(3)	(4)	(5)
Earthquake intensity	6.725***	11.47**	8.185***	9.613***	2.793
	(2.433)	(4.477)	(2.175)	(2.765)	(2.333)
Conflict intensity			18.27*	6.739***	-11.56***
			(9.170)	(2.269)	(3.057)
Conflict × disaster					0.103***
					(0.0189)
Caste diversity				13.80***	10.36**
				(5.081)	(4.765)
Religious diversity				-9.694***	-5.974**
				(3.270)	(2.462)
Population density				1.923***	0.699***
				(0.360)	(0.231)
Total population				-0.000271	-0.000211
				(0.000330)	(0.000215)
Distance to Kathmandu				2.728	1.127
				(1.746)	(1.274)
Road/km2				-1,594	809.0
				(1,516)	(700.5)
Constant	-931.6***	-2,018**	-2,013***	-2,130**	-748.3
	(350.5)	(818.0)	(528.5)	(886.3)	(692.4)
Observations	75	75	75	75	75
Development region FE	NO	YES	YES	YES	YES
R-squared	0.232	0.309	0.595	0.896	0.938

Robust standard errors in parentheses, *** $p<0.01$, ** $p<0.05$, * $p<0.1$

The same general relationship holds when the total number of injured persons in each district is introduced as the dependent variable. The results are reported in Table 3. As is expected, the total amount of damage explained by the amount of physical shaking is significantly lower for injuries, at $r^2 = 0.232$ (column (1) in Table 3), while the single earthquake measures explains a mere half of that (not shown). The conflict coefficient remains highly significant and is relatively large at an added 6.7 injuries (column (4)) associated with each conflict event a district experienced during the armed conflict. The interaction term likewise remains highly significant when the measure of damage is the total amount of injured persons.

Table 4. Regression Estimations of Total Fatalities

	(1)	(2)	(3)	(4)	(5)
Earthquake intensity	2.949**	6.212**	5.709**	10.47	6.264
	(1.238)	(2.924)	(2.828)	(7.039)	(5.148)
		(203.2)	(193.1)	(173.8)	(138.5)
Conflict intensity			2.795***	3.161*	-8.116*
			(0.734)	(1.735)	(4.741)
Conflict × disaster					0.0635*
					(0.0341)
Caste diversity				5.601*	3.478
				(3.138)	(3.426)
Religious diversity				-0.273	2.019
				(2.319)	(2.857)
Population density				-0.224	-0.978
				(0.327)	(0.685)
Total population				0.000264	0.000302
				(0.000194)	(0.000208)
Distance to Kathmandu				3.912	2.926
				(3.390)	(2.809)
Road/km2				415.5	1,896
				(584.2)	(1,263)
Constant	-422.2**	-1,106**	-1,105**	-2,796	-1,945
	(185.2)	(534.4)	(524.5)	(2,000)	(1,549)
Observations	75	75	75	75	75
Development region FE	NO	YES	YES	YES	YES
R-squared	0.232	0.335	0.370	0.440	0.525

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Finally, total fatalities is introduced as a damage measure and the regression results are reported in Table 4. Despite relatively few observations, the conflict intensity coefficient is highly significant and large and 3.1 more fatalities are associated with the increase of a single conflict event during the armed conflict.

Kathmandu is an outlier for the sample in many respects: it has the highest GDP per capita, the highest death toll, the highest population density, and so forth. Accordingly, all results presented were also run with a sample *without* Kathmandu, and the results do not change substantially in any of the regressions presented here.[11]

A source of concern, of course, is that the model has omitted variable bias with respect to selection into conflict. In other words, there is an underlying factor that could explain both conflict occurrence and levels of resilience during a natural disaster — oftentimes

[11] Results are not reported and they are available upon request from the authors.

based on, at least in part, unobservable factors. For this reason, the reader should be careful not to make causal inference from the model. However, the model does show that conflict is a strong signal for disaster resilience, and the model may have significant predictive power even if cause cannot be inferred, considering that in its full form the variables explain 93% of the variation for building damage.

It should also be clear that this model at best shows a 'net' effect of conflict. As a review of the literature demonstrates, there may indeed be some aspects of conflict that could be associated with improvements in levels of resilience. The negative sign of the coefficient on conflict would thus, at best, demonstrate that the net outcome is negative, not that there is no positive effects.

5.2 Results on Intermediary Factors

As explained in the earlier conceptual framework section, the expectation was for a number of intermediary variables to be the vehicles through which conflict affects disaster resilience. While more research is necessary on these relationships, a preliminary test of the relationships between the intermediaries and the conflict variable are carried out here. Each of the intermediaries for which there is data – education (adult literacy), health (percentage of malnourished children) and wealth (GDP per capita and the poverty rate) – are introduced once at a time into the base specification. If indeed the conflict affects disaster resilience through any of these, then it is expected the coefficient of the conflict variable would change in the presence of these before omitted variables. Tables 5-7 present results respectively for each of the three outcome variables: total building damage, total amount of injured persons, and total amount of casualties.

Table 5. Regression Estimations of Total Building Damage with Intermediary Variables

	(1)	(2)	(3)	(4)	(5)
Earthquake intensity	425.2***	436.4***	410.7***	407.4***	430.2***
	(78.71)	(82.59)	(66.49)	(76.07)	(81.94)
Conflict intensity	-239.4***	-264.6***	-265.7***	-245.1***	-272.9***
	(56.69)	(66.62)	(54.70)	(62.85)	(71.31)
Conflict × disaster	2.140***	2.117***	2.246***	2.186***	2.195***
	(0.389)	(0.398)	(0.348)	(0.378)	(0.418)
Adult literacy		190.6			
		(163.9)			
% of malnourished children			-340.8**		
			(150.3)		
Per capita GDP				-4.944**	
				(2.248)	
Poverty rate					-140.8
					(122.5)
Constant	-91,892***	-107,326***	-74,108***	-75,738***	-90,306***
	(21,476)	(22,713)	(20,255)	(23,068)	(22,274)
Observations	75	75	75	75	75
Controls	YES	YES	YES	YES	YES
Development region FE	YES	YES	YES	YES	YES
R-squared	0.864	0.868	0.881	0.869	0.867

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 6. Regression Estimations of Total Injured with Intermediary Variables

	(1)	(2)	(3)	(4)	(5)
Earthquake intensity	2.793	3.214	2.397	3.617	2.845
	(2.333)	(2.520)	(2.274)	(2.365)	(2.360)
Conflict intensity	-11.56***	-12.51***	-12.28***	-11.30***	-11.92***
	(3.057)	(3.099)	(2.890)	(2.693)	(3.216)
Conflict × disaster	0.103***	0.102***	0.106***	0.101***	0.104***
	(0.0189)	(0.0191)	(0.0174)	(0.0179)	(0.0188)
Adult literacy		7.176			
		(8.108)			
% of malnourished children			-9.319		
			(5.934)		
Per capita GDP				0.228	
				(0.152)	
Poverty rate					-1.485
					(4.399)
Constant	-748.3	-1,329	-262.0	-1,494**	-731.5
	(692.4)	(797.1)	(860.0)	(680.7)	(718.2)
Observations	75	75	75	75	75
Controls	YES	YES	YES	YES	YES
Development region FE	YES	YES	YES	YES	YES
R-squared	0.938	0.941	0.943	0.942	0.939

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 7. Regression Estimations of Total Fatalities with Intermediary Variables

	(1)	(2)	(3)	(4)	(5)
Earthquake intensity	6.264	5.754	6.517	6.029	6.160
	(5.148)	(4.884)	(5.421)	(5.095)	(5.121)
Conflict intensity	-8.116*	-6.967	-7.658*	-8.190*	-7.407*
	(4.741)	(4.196)	(4.360)	(4.808)	(4.282)
Conflict × disaster	0.0635*	0.0646*	0.0616*	0.0641*	0.0623*
	(0.0341)	(0.0338)	(0.0322)	(0.0344)	(0.0332)
Adult literacy		-8.709*			
		(5.045)			
% of malnourished children			5.942		
			(6.335)		
Per capita GDP				-0.0652	
				(0.0819)	
Poverty rate					2.979
					(3.838)
Constant	-1,945	-1,240	-2,255	-1,732	-1,979
	(1,549)	(1,376)	(1,803)	(1,502)	(1,570)
Observations	75	75	75	75	75
Controls	YES	YES	YES	YES	YES
Development region FE	YES	YES	YES	YES	YES
R-squared	0.525	0.543	0.535	0.526	0.527

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

The coefficients of the conflict variable remains significant at the 1 percent level throughout, though the variation in the coefficients are not statistically significantly different from the base specification. These initial tests thus yield no conclusive evidence for this part of the hypothesis. More work needs to be done on these tests to show the effect, if any, the intermediary variables have on this relationship. Each intermediary variable must be analyzed closely and specified more carefully than is within the scope of this project.

6. Conclusion

As discussed in the conceptual framework, literature review, and demonstrated empirically, there is a significant relationships between conflict experience and the affect earthquakes have on individuals and households. Increased exposure to the conflict is associated with a lower resilience during and immediately after the earthquakes. Additionally, conflict experience is of greater importance as the amount of shaking increases. The conflict experience may affect disaster resilience through several different factors, including the levels of economic development, health, and education. These findings contribute to a gap in the understanding of natural disaster resilience, and should be expanded on in further studies to better understand the important link between conflict and the impact of natural disasters on communities.

The following policy implications can be applicable to other natural disasters besides earthquakes:

A. *Use developed framework to forecast where earthquakes might most adversely affect country*. Conflict history could be used a predictor for potential weak resilience after a natural disaster. Knowing this could provide more information to help government officials distribute aid to the most vulnerable community post-conflict.

B. *Place additional emphasis on disaster resilience in former conflict areas.* This should include preparations about what to do before the natural disaster, what to do during the natural disaster, and how to rebuild after a natural disaster.

C. Efficient access to and distribution of international aid following a natural disaster can be prohibitive in developing countries. *Improvements in road infrastructure* can help with the coordination, accessibility, and ease with which the aid is dispersed. As seen in previous disasters, a lack of infrastructure, particularly access to roads, has hinder a country's ability to provide the necessary assistance after a natural disaster

D. *NGOs and aid organization should remain alert to continued aftershocks*. Aftershocks can be damaging in vulnerable areas and NGOs and aid organizations should respond accordingly. This continuation of aftershocks will require NGOs and aid organizations to provide continuous response.

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The Impact of Natural Disasters on Child Education Outcomes: Evidence from Nepal

1. Introduction

On April 25 and May 12 of 2015 the small country of Nepal was hit with its greatest natural disaster in over eighty years. Two large earthquakes of magnitudes 7.8 and 7.3 that killed and injured thousands of people, causing enormous amounts of economic damage (United States Geological Survey, 2015). In the years leading up to the earthquake, Nepal's young education system made important strides, honoring their commitment to achieve Millennium Development Goals (MDG) in the education sector and reaching attendance rates of ninety percent and seventy percent in the urban and rural sectors, respectively. However, did the 2015 earthquake and continuing aftershocks affect this progress?

This study will examine the long-term impact of natural disasters on school outcomes by answering the question; *"What was the impact of the 2015 earthquakes on school outcomes in Nepal?"*

While the immediate impact and damage that a natural disaster inflicts on a society is more easily measurable, determining the long-term impact is not as straightforward. This study begins with an analysis of the literature exploring the effect of natural disasters on education through four channels: psychological impact, child labor, infrastructure, and poverty and gender. It has been empirically shown that individuals who might have been adversely impacted by a natural disaster during their school-aged years are linked to lowered levels of educational attainment (Kim, 2008).

Using primary data collected by our team through fieldwork in Nepal and using the Nepal Living Standards Survey (NLSS) 2011 as a baseline, an empirical analysis is conducted by examining the impact of the 2015 earthquakes on school attendance and enrollment. Through this analysis, the findings indicate that an increase in earthquake intensity is associated with decreases in school enrollment and attendance among children aged five to eighteen, and that this impact varies by age, gender, and caste.

Considering the prevalence of earthquakes in Nepal, the age of Nepal's education sector, and the recent progress the country has made towards achieving their targeted MDG, this study is timely and relevant for the country. More broadly, it can contribute to a better understanding of how natural disasters may impact long-run education outcomes.

2. Background

2.1 Natural Disasters

Worldwide, the level of damage due to natural disasters has increased over the past few decades, both in terms of fatalities, injuries, and economic damage (Espinoza, Urzua, & Claro, 2015; Alexander, 1993; Guha-Sapir, Below, & Hoyois, 2009. From 2004 to 2013 the death toll due to natural disasters rose to a high of approximately 100,000 per year on

average. Of all natural disaster-related deaths, earthquakes, and tsunami-induced earthquakes are the cause of fifty-five percent of the total deaths (Centre for Research on the Epidemiology of Disasters, 2015).

Natural disasters are devastating to all countries, but South Asian countries are particularly hard hit. Information provided by the Economic and Social Commission for Asia and the Pacific (2015) said "a person living in Asia-Pacific was twice as likely to be affected by a natural disaster as a person living in Africa, almost six times as likely than someone in Latin America and the Caribbean, and 30 times more likely to suffer from a disaster than someone living in Europe" (p. 7). The number of fatalities is decreased by economic damage caused by natural disasters is increasing in the Asia and the Pacific region. "On average, more than three times as many people died per disaster in low-income countries" (Centre for Research on the Epidemiology of Disasters, 2015, p. 7).

The latest Nepalese earthquakes and aftershocks in 2015, affected approximately 8 million people (USAID 2015). Nine thousand people were killed and another 22,300 people were injured (Wilkes & Sharma, 2015; Government of Nepal National Planning Commission, 2015; USAID 2015). Nearly 750,000 houses were destroyed or damaged in the earthquakes. To rebuild the education sector it is estimated to cost 39.7 billion Nepalese rupees ($397.1 million United States dollars (USD)). Estimates place the amount of total damage that occurred to be around seven million USD (Government of Nepal National Planning Commission, 2015).

2.2 Primary Education in Nepal

The 2015 Nepalese earthquakes caused an estimated $300 million (USD) in total damage on the education sector. More than eighty percent occurring in the fourteen most-affected districts, including Gorkha, Sindhupalchowk, Kathmandu, Lalitpur, Dolakha and Ramechhap[12] (Government of Nepal National Planning Commission, 2015). The majority of public schools in each of these districts were severely damaged and some districts (Gorkha, Nuwakot, Rasuwa, Sindhupalchowk, and Dolakha) were left with no school unaffected; in total, 4,892 public school buildings were destroyed throughout the country (Karuna-Shechen, 2015). Public schools were most adversely affected. However, private institutions may have experienced more of an impact than originally understood due to underreporting.

Nepal has one of the world's youngest education systems, having been established just over sixty years ago (Pherali and Garratt, 2014). Despite its youth, Nepal has made significant strides, honoring their commitments to achieve Millennium Development Goals and the United Nations Education For All (EFA) targets. Improving education has been a top priority for Nepal. The government currently spends 4.7 percent of their GDP on education (increased from less than 2.9 percent in 1999) making the education sector

[12] These six districts are explored in-depth in the empirical section of this paper.

one of the government's largest departments in terms of budget and population served (Government of Nepal National Planning Commission, 2015).

The government has been undergoing a process of decentralization, involving local governments more in the distribution, planning, and implementation of public services, including education. Starting with the *Five Year Plan for Education in Nepal (1956-1961)*, curriculum was set nationally and taught exclusively in the Nepali language, prohibiting the use of other languages in state schools (Pherali & Garratt, 2014). This exclusionary education policy has had long-term impacts on opportunity outcomes: according to the Centre for Development Studies in Kathmandu, privileged castes (who are more likely to speak Nepali) constituted approximately thirty percent of the population in 2001 held roughly seventy-five percent of all elite professional positions (Pherali & Garratt, 2014).

Within Nepal, there are two types of schools: public ('community') schools and private ('institutional') schools. Most students attend public schools, but private school attendance has been recently increasing, particularly among high secondary students. Schools are open for an average total of 188 days per year. Although the Nepalese constitution states that education shall be free through primary school, there is a provision to allow public schools to raise donations to maintain the facility (O'Malley, 2010).

The government of Nepal supports public schools through a series of grants for administration, textbooks/scholarships, classroom/toilet construction, and by paying teachers' salaries. Public schools (especially in the rural areas) are of especially poor quality: the lessons lack relevance, focusing instead on rote memorization instead of developing critical thinking skills. Given the opportunity costs of attending school instead of contributing to the household's welfare, many families will opt for children to work instead of attend class. Most private schools are established as companies and are supported by student fees. Only a few private schools set up as trusts are able to receive grants from the government. (Government of Nepal National Planning Commission, 2015).

School attendance is uneven: between rural and urban areas, and across ethnic, caste, and gender divisions. According to a study conducted by the Education Policy and Data Center (2012), net attendance over time improved across the entire country, but the attendance rates were dramatically different between the urban and rural students. From 1995 to 1999, the net attendance rate in urban Nepal was just above eighty percent, and rose to nearly ninety percent from 2000 to 2004; in rural Nepal, the net attendance rate was just above sixty percent and rose to seventy percent. It is important to note the linguistic diversity of Nepal. There are ninety-two different languages spoken across the country, and although Nepali is the official language, less than half (forty-nine percent) of the population speaks it. Lack of linguistic congruence between students and schools can discourage children from attending school (Government of Nepal National Planning Commission, 2015).

3. Literature Review: the Linkage between Natural Disaster and School Outcomes

In order to look at the effect natural disaster has education, this paper reviews literature on the issue, which emphasizes four channels of the effects: psychological impact of a natural disaster on children, the shifts in child labor, school infrastructure damage, and the inability of households to recover from a natural disaster through the lens of gender and poverty.

3.1 Psychological Impact

Natural disasters have a negative impact on mental health and psychological state of people for various reasons (Freedy, Saladin, Kilpatrick, Resnick, & Saunders, 1994). The perception of a life-threatening situation (such as continuing earthquake tremors in Nepal, for example), "may carry a particularly high mental health liability" (p. 258). Kemp, Helton, Richardson, Blampied, and Grimshaw (2011) stated; "natural disasters in general, and earthquakes in particular, have detrimental effects on psychological functioning is well-known" (p. 11)

Mental stress as a result of exposure to a natural disaster is comparable to post-traumatic-stress disorder (PTSD), with symptoms including anxiety, depression, and sleep disruption (Espinoza, Urzúa, & Claro, 2015). Norris, Perilla, Riad, Kaniasty, and Lavizzo (1999) found PTSD symptoms are well documented in adults following natural disasters with effects possibly lasting up to five years later. Disasters have also been shown to affect the "cognitive disruption" (Helton & Head, 2012 p. 189) of individuals, which manifests in the form of intrusive thoughts. After experiencing a natural disaster, especially one that inflicted damage on the home, an individual is more likely to be distracted and bothered by thoughts and flashbacks about the disaster.

Loss of resources due to natural disaster is another mechanism by which natural disasters, such as earthquakes, impact an individual's psychology negatively. Indeed, resource loss is one of the most telling indicators of psychological distress. Helton and Head (2012) found both increased anxiety and depression were associated with individuals who reported severe damage to their houses following the 2010 Christchurch, New Zealand earthquake. This is an important finding for this study, as one of the most significant impacts of the 2015 earthquakes on families today is the lack of resources (specifically housing, as seen in the field work completed for this study). The impact of psychological stress and mental trauma has even been found across cultural, ethnic, age, and gender differences, and this impact increases with degree of exposure to the natural disaster (Espinoza, Urzua, & Claro, 2015)

All of the symptoms mentioned above, PTSD-like symptoms, distraction, intrusive thoughts, mood swings, depression, and anxiety, are especially damaging to school-aged children, and are likely to hinder their academic performance. There is evidence that PTSD and certain mental health conditions inhibit a student's ability to thrive in an

academic setting (Espinoza, Urzua, & Claro, 2015). Decreased levels of school performance were found following the 2010 New Zealand earthquake, which was attributed to higher levels of stress and intrusive thoughts. Yasin and Dzulkifli (2009) found the psychological condition of students is directly related to their academic performance, with higher levels of depression, stress, and anxiety being reported from lower achieving students.

3.2 Child Labor

A variety of research points to the relationship between natural disasters, child labor, and education. A study conducted by Islam (2013) found that, among other causes, natural disasters are a contributing factor to child labor and such labor often deprives children of education. According to research on how children cope with natural disasters in Zimbabwe, Mudavanhu, and Bongo (2015) found children are often forced by their family to work by doing activities such as paid labor, gathering and selling wild fruits and firewood, and distributing food aid. One effect of such labor is that the children missed or dropped out of school. Since external shocks, such as natural disasters, can interrupt the normal livelihoods of adults, children may be required to participate in income-earning activities to make up for the loss. The authors pointed out time constraints can force children to choose between work and school.

The view that children must choose between work and school is echoed by evidence from Sudan, where conflict and natural disasters, such as famine, have displaced millions of people (Abdelmoneium, 2005). In the case of Sudan, children worked for a variety of reasons: often because they were forced by their parents but sometimes by choice in order to meet their own needs or even to pay for their own schooling. High dropout rates in the wake of natural disasters may be partly due to the fact that, when faced with a choice between work and school, children are more likely to choose work. Since child labor is often the result of pressure from parents or family members, children may feel forced to choose work over school even when they may actually prefer to attend school instead of work.

While time constraints are an important factor in the decision to choose work over school, this is not always the case. A study conducted in Guatemala showed that child labor is often used to cope with the effects of natural disasters and socio-economic shocks (Vasquez & Bohara, 2010). However, even though child labor is used for coping, especially among poor households, this does not necessarily translate into less schooling. In the case of Guatemala, the authors concluded school attendance can actually increase after a natural disaster. One reason for increased school attendance may be a decrease in domestic production, as a result of the disaster, which leaves children more time overall to both work and participate in school. Coping strategies that do involve child labor and school reduction also jeopardize both the current and the future welfare of those children due to unsafe working environments and the loss of potential benefits from schooling, such as poverty alleviation, disease reduction, and fertility choices.

3.3 Infrastructure

Natural disasters that destroy physical infrastructure have negative effects on immediate and long-term educational attainment. Damage to public infrastructure (including public schools and roads) caused by natural disasters decreases the possibility of attendance and increases the costs of attending school. Destruction of business infrastructure and physical capital following a disaster can diminish the demand for education; the potential returns on additional schooling are reduced if the places to work are operating below capacity (Hermida, 2014). The destruction of homes following the 1976 earthquake in Guatemala left twenty percent of the population homeless, prompting many families to migrate to the capital (USAID, 1978). Despite the population shift, schools left standing in the affected areas of Guatemala continued to operate above capacity. Reconstruction efforts experienced delays due to administrative and dispersion inefficiencies. A study conducted twenty four years after the 1976 earthquake focused on better understanding the long-term effects of natural disasters on individual education attainment, Hermida concluded that on average, students aged four to nine received 0.4 less years of school due to classroom destruction. Beyond attendance, the destroyed school buildings left in the wake of a natural disaster also have injurious effects on scholarly achievement. Espinoza, Urzua, & Claro (2015) found differences in academic performance caused by inadequate school infrastructure following the 8.8 magnitude Chilean earthquake in 2010. Students who attended public secondary schools that were damaged had lowered test scores of roughly three to four percent, compared to the minimum eight percent decrease in scores from students at heavily damaged schools.

3.4 Unequal Gender/Poverty Impact

Overall, the education outcomes for poorer students and females are more difficult to achieve following a shock such as a natural disaster. According to a research study done on family dynamics, gender, and schooling, Binder (1998) found if parents believe there is a higher opportunity cost from sending a boy to school rather than a girl, the boy will be sent to school. Often in developing countries when boys grow up they are expected to take care of their parents and an education will provide the child with more opportunities to make money. Male children are unlikely to leave the household, while girls, once married, will leave the household permanently. “Schooling attainment for boys appears to be more sensitive to their number of siblings, household wealth and parent’s desired schooling” (Binder, 1998, p. 54). Sending boys to school rather than girls is, in part, a way for parents to ensure that they are taken care of in the future. She also noticed if parents own their house, they are more likely to send a male child to school, while the greater number of siblings that child has the less likely he is to go to school. For girls, attending school is more likely if they live in a household with just their nuclear family and if the girl is born first (Binder, 1998).

Looking specifically at Indonesia after a major financial crisis in 1998, Thomas, Beegle, Frankenberg, Sikoki, Strauss, and Teruel (2004) noticed spending on education and the percentage dedicated to schooling in households declined from 1997 to 1998. The decline was most prevalent in households considered to be the poorest. School enrollment also

declined during this period, most notably in children from poorer households. However, older siblings were more likely to be in school if they had younger siblings who were not attending. Younger siblings did not attend school if they had older siblings in school (Thomas et al., 2004). This coincides with Binder's (1998) theory that birth order matters when parents decide which child will go to school. Thomas and his colleagues (2004) believed this indicates "that low-resource households have sought to protect their investments in the schooling of older children at the expense of the education of their younger children" (p. 82).

While richer families bear the cost burden of natural disasters because the value of their homes and possessions are much higher, for people who do not have the financial resources to rebuild or relocate, the recovery time is much longer (Masozera, Bailey, & Kerchner, 2006). Turner, Nigg, and Paz (1986) showed that preparedness for a natural disaster increases with income level. Looking at previous natural disasters in the United States, Fothergill and Peek (2004) said:

> Socioeconomic status is a significant predictor in the pre- and post-disaster stages, as well as for the physical and psychological impacts. The poor are more likely to perceive hazards as risky; less likely to prepare for hazards or buy insurance; less likely to respond to warnings; more likely to die, suffer injuries, and have proportionately higher material losses; have more psychological trauma; and face more obstacles during the phases of response, recovery, and reconstruction (p. 103).

Poorer families are more likely to have medium- and long-term impacts from a natural disaster (Thomas et. al, 2004). Families affected by natural disaster can fall into the "critical minimum asset threshold" (Carter & Barrett, 2006, p. 186). Falling below this minimum threshold results in families being unable to support themselves and includes families being unable to send children to school (Carter, Little, Peter, Mogues, & Negatu, 2007).

4. Data and Empirical Approach

The data used here was collected through a survey questionnaire created and administered to school-aged children at twelve schools in six districts of Nepal during March 2016 by a group of researchers at Texas A&M University at the Bush School of Governance and Public Service. Data collection was supported by Routahat Development Trust, a local non-governmental organization in Nepal. Two schools in each of six districts – Kathmandu, Lalitpur, Sindhuplchowk, Gorkha, Ramechap, and Dolakha – were selected and approximately 30 students were interviewed in each school. These students provided information on themselves and their siblings – in total data was collected for 337 students and 497 siblings.

The questionnaire was designed to capture child characteristics like age, gender and caste, parent characteristics like level of reading and writing, as well as information on the level of attendance and enrollment of the students and siblings in the household.

To test the effect of the 2015 earthquakes on school outcomes, a double-difference framework is employed. The double difference framework allows a comparison of the districts after the earthquakes, with their baseline before the earthquake, while letting the result vary with the intensity of earthquakes among districts. The following regression equation is used to analyze the relationship:

Baseline DD Specification:

$$School_{ijt} = \beta_0 + \beta_1 EQ_j + \beta_2 Yr16_t + \beta_3 EQ_j \times Yr16_t + CCharacteristics'_{ijt}\beta_4 + PCharacteristics'_{ijt}\beta_5 + HConditions'_{ijt}\beta_6 + \varepsilon_{ijt}$$

Where i denotes child i, j denotes district j and t denotes time t. The outcome variables ($School_{ijt}$) are school enrollment and school attendance, which are captured through two indicators: the school enrollment variable indicates whether the child attends school or not (1 if yes, 0 if no), and the school attendance variable indicates the number of days of school a child missed in the last week.

The earthquake intensity variable (EQ_j) was created based on the distance from each district to all epicenters, magnitude of each epicenter, and locations of epicenters from April 25, 2015 to June 5, 2015 – that is, the variable is a measure of the total sum of shaking from *all* the earthquakes in the period, weighted by distance from the epi-center and the magnitude of the shake[13].

The variable ($Yr16_t$) differentiates between the data from year 2016 of the National School Children Survey (NSCS) and those from National Living Standard Survey (NLSS) in 2011. Of a total of 1234 observations, 834 are from the NSCS while the remaining 400 are from NLSS in 2011.

To control for the characteristics of a child and how they determine school outcomes, the following variables were included in the vector controlling for child characteristic ($CCharacteristics'_{ijt}$): age, gender, and caste. Of the total 833 observations, fifty-one percent of the students surveyed were female and forty-nine percent were male. The average age was twelve. Castes of the children were identified based on their family names by the interviewers, who were able to determine the castes through the surnames of the children[14]. Around forty-five percent of children in the sample are from the Janajati ethnic group, while forty-two percent are from the Brahmin/Chhetri castes, 8.7 percent from Newar and 8.2 percent from the Dalit caste (formerly known as untouchables).

To control for parent characteristics, another vector is included ($PCharacteristics'_{ijt}$), containing information on each parent's ability to read or write. A large majority of children said their fathers can read a letter (seventy-five percent) and write a letter (sixty-eight percent), while only thirty-three percent of mothers in the sample can read while thirty-one percent can write a letter. Further the regression controls for a number of

[13] The formal model for calculating this intensity measure is reviewed in Singh, Aman and Prasad (1996)

[14] Interviewers were collaborators from Rautahat Development Trust in Nepal.

housing conditions, that function as proxies for household welfare, namely the source of lighting, quality of the house's roof and the quality of the toilet in the vector ($HConditions'_{ijt}$). Among 834 observations, electricity is the main source of lighting in eighty-nine percent of households, followed by solar at 4.56 percent. With regard to the type of toilets used, seventy-four percent of children mentioned household non-flush, followed by eleven percent who use communal latrine. Only 8 percent have household flush connected to the municipality. Seven percent said they had no toilet. Sixty-five percent of students reported having a roof made of tin. Concrete/cement is the second most common with thirteen percent, followed by twelve percent of roofs made with tiles/slate. Those with other and straw/thatch roofs accounted for seven and four percent, respectively. To control for district fixed effects a modified double-difference equation is employed because the earthquake intensity measure is district specific – district fixed effects will capture this characteristic, and so (EQ_j) if left out in the final model:

DD with District Fixed Effects:

$$School_{ijt} = \alpha_0 + \alpha_1 Yr16_t + \alpha_2 EQ_j \times Yr16_t + CCharacteristics'_{ijt}\alpha_3 + PCharacteristics'_{ijt}\alpha_4 + HConditions'_{ijt}\alpha_5 + v_j + e_{ijt}$$

Table 1. Summary Statistics

Dependent variables	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Attendance of school	834	0.967659	0.1770978	0	1
Number of missed school days last week	337	0.305638	0.8686321	0	1
Independent variables	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Age	834	12.14508	3.068925	1	18
Gender	833	0.518607	0.499953	0	1
Caste	834	3.097122	1.889865	1	7
Education of parents (father can read)	813	0.776137	0.417087	0	1
Education of parents (father can write)	811	0.759556	0.427616	0	1
Education of parents (mother can read)	818	0.336186	0.4726924	0	1
Education of parents (mother can write)	816	0.311274	0.4632988	0	1
Earthquake intensity	834	309.3009	29.33633	256.9	339.8
Intermediary variables	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Source of lighting	834	1.213429	0.7669725	1	9
Type of toilets	834	3.088729	0.841192	1	5
Condition of dwelling roof	834	4.514388	1.447906	1	9

Table 2 compares Nepal School Children Survey (NSCS), created for this research, and the Nepal Living Standard Survey (NLSS), which was conducted by the Central Bureau of Statistics, a national Statistical organization of the Government of Nepal, with financial and technical support from the World Bank. The third round of NLSS conducted in 2010/2011 was used for comparison.

The NSCS survey was created based on the design of the NLSS for the sake of comparability. The NLSS is based on interviews with adults in households and the data for the NSCS was collected in primary and secondary schools from children in fifth and sixth grade, who also provided information about their siblings between the ages of five to eighteen. The NSCS was carried out in six districts, chosen based on advice from local collaborators – all six were selected from among the districts hardest hit by the earthquakes. The NLSS is an expansive survey, therefore only the relevant data for the present analysis was extracted from the NSCS.

Table 2. Main variables comparison between NSCS and NLSS

	NSCS (2016)	**NLSS (2011)**
Independent variables	**Mean (S.D)**	**Mean (S.D)**
Age (5 to 18)	12.05 (3.77)	11.83 (3.47)
Girls	0.52 (0.50)	0.51 (0.50)
Brahmin/Chhetri	0.42 (0.49)	0.36 (0.48)
Janajati	0.45 (0.50)	0.35 (0.48)
Father Read	0.78 (0.42)	0.68 (0.47)
Father Write	0.76 (0.48)	0.68 (0.47)
Mother Read	0.34 (0.47)	0.33 (0.47)
Mother Write	0.31 (0.46)	0.30 (0.46)
Dependent variables		
Days missed (last week)	0.31 (0.87)	3.09 (2.67)
Enrollment	0.98 (0.18)	0.57 (0.50)
Missed any school (last week)	0.13 (0.34)	0.72 (0.45)

The mean age of children in both samples is approximately twelve years. The proportion of girls in both surveys are around fifty percent. Mother's ability to read and write is also almost same in both surveys, unlike the ability of fathers to do the same – in the NSCS, the literacy levels are considerably higher at 0.76-0.78 compared to .68 for both reading and writing in the NLSS – and the difference is statistically significant.

The dependent variables – school outcomes – improved considerably between 2011 and 2015, which is consistent with the expectation discussed in the literature review. "Days missed" measures the amount of days missed by a student in the past week. In the NSCS,

students missed on average 0.3 days, while in the NLSS it is higher by a factor of ten, at more than three days out of six possible days.

Likewise, “enrollment”, which indicates whether a child attends school or not, shows an average of 98 percent of the students in the NSCS survey go to school, while the NLSS survey shows that 57 percent of the students go to school.

“Missed any school” is coded as 1 if any school was missed, and 0 if the student attended school on every school day in the past week. In the NSCS sample, thirteen percent of the students missed at least a day of school last week, while in the NLSS seventy-two percent of the students missed at least one day of school.

This improvement in school outcomes are mainly attributed to the following three reasons. First, the school outcome has generally increased overtime nationwide from seventy-three percent in 2000 to ninety-five percent in 2014 for primary school (World Bank, 2016). Second, children in the NSCS may be better off in terms of school attendance because a higher proportion of students are Brahmin than in the NLSS, which is the highest class in the caste system of Nepal. Third, in the NSCS there is a higher proportion of children whose fathers can read and write and educated parents are more likely to send their children to school (Binder, 1998).

School outcomes by age and gender

Figure 1 shows school attendance by gender. The solid line represents girls while dotted line represents boys. In general the trend shows that girls are more likely to attend school than boys, however, after the age of twelve, the attendance of both girls and boys drop significantly.

Figure 1.

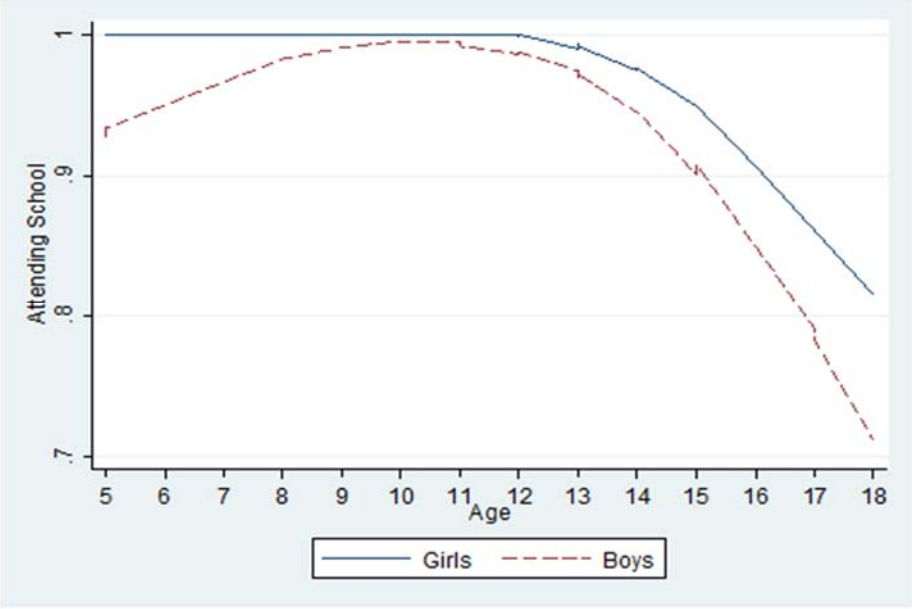
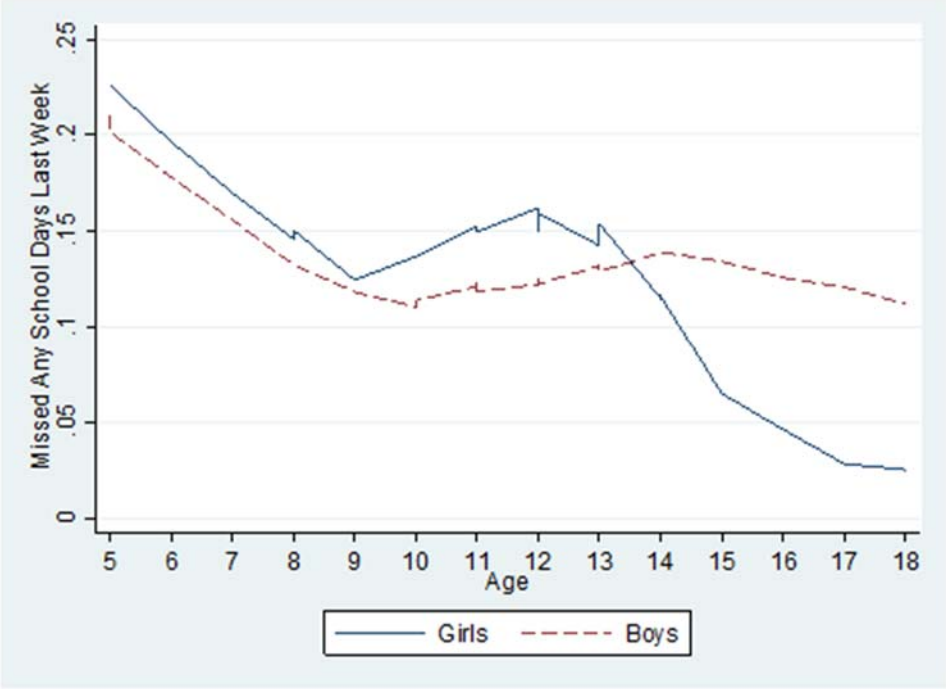


Figure 2 shows the days students missed in the last week. The dotted line represents boys and the solid line represents girls. It is clear that from age five to fourteen, absentee rate is higher for girls than for boys. However, past the age of 14, the absentee rate for girls decreases drastically. From ages fifteen to eighteen, girls are less likely to be absent than boys.

Figure 2.



5. Results

The results on school attendance are presented in table 3. Attendance refers to the average number of days a child missed school last week. The interaction term between earthquake intensity and year allows earthquake intensity to be dependent upon the binary year16 variable, which separates the 2016 NSCS from the 2011 NLSS. The control vectors are added to the model one at a time.

Table 3. School Attendance

VARIABLES	(1)	(2)	(3)	(4)
Earthquake intensity	-0.0100**	-0.00955	-0.0160***	
	(0.00466)	(0.00583)	(0.00571)	
× Year 2016	0.0128***	0.0106*	0.0188***	0.0195***
	(0.00483)	(0.00600)	(0.00594)	(0.00589)
Year 2016	-6.694***	-5.749***	-8.017***	-8.281***
	(1.522)	(1.894)	(1.872)	(1.849)
Constant	3.831**	6.978***	5.991***	0.728
	(1.719)	(2.067)	(1.911)	(0.733)
Child characteristics	YES	YES	YES	YES
Parent literacy	NO	YES	YES	YES
Housing conditions	NO	NO	YES	YES
District fixed effects	NO	NO	NO	YES
Observations	715	594	556	556
R-squared	0.353	0.359	0.396	0.412

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

The relationship between the school attendance and the interaction term ($EQ_j \times Yr16_t$) are highly correlated. The earthquake intensity variable explains about thirty-five percent (r^2=0.353) of the variation in school attendance (table 3, regression 1). In the final specification (table 3, regression 4) the interaction term has a positive coefficient of 0.0195. The positive coefficient means that in a district, which experienced a higher earthquake intensity, children are more likely to miss days of school. For a one standard deviation (29.34) increase in earthquake intensity, an associated 0.57 more days are missed than would have been the case without the increased shaking.

Table 4 presents the results on school enrollment, a binary variable where 1 means the child goes to school while a 0 means the child is not.

Table 4. School Enrollment

VARIABLES	(1)	(2)	(3)	(4)
Earthquake intensity	0.00260***	0.00206*	0.00365***	
	(0.000866)	(0.00111)	(0.00112)	
× Year 2016	-0.00299***	-0.00212*	-0.00392***	-0.00389***
	(0.00483)	(0.00600)	(0.00594)	(0.00589)
Year 2016	1.325***	1.016***	1.515***	1.510***
	(0.276)	(0.355)	(0.359)	(0.357)
Constant	3.831**	6.978***	5.991***	0.728
	(1.719)	(2.067)	(1.911)	(0.733)
Child characteristics	YES	YES	YES	YES
Parent literacy	NO	YES	YES	YES
Housing conditions	NO	NO	YES	YES
District fixed effects	NO	NO	NO	YES
Observations	715	594	556	556
R-squared	0.353	0.359	0.396	0.412

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Here too the coefficient for the interaction (table 4, regression 4) is highly significant. It is negative, suggesting that the earthquake lowers the level of enrollment. A one standard deviation increase in earthquake intensity (29.34) is associated with a decrease of 11.4% in enrollment compared to a district that did not experience the increased shaking.

In order to test whether certain groups of children a more susceptible to earthquake intensity than others, a triple difference model is introduced:

$$School_{ijt} = \alpha_0 + \beta_1 Yr16_t + \beta_2 EQ_j \times Yr16_t + \beta_3 EQ_j \times Yr16_t \times Z' + CCharacteristics'_{ijt}\beta_3 + PCharacteristics'_{ijt}\beta_4 + HConditions'_{ijt}\beta_5 + v_j + e_{ijt}$$

Where Z' is one of four dummy variables that are 1 when yes and 0 when no. The first three are for students belonging in the following groups: Aged 15-18, Students who do not belong to the top three casts, student whose households have electricity *and* access to a toilet (flush or non-flush) in the house. The fourth is gender, where 1 when female and 0 when male. Each of these variables are interacted with the previous interaction variable to test whether these groups account for a disproportional part of the effect of the interaction term. In all but gender terms, these vulnerable groups – children over 15, children from families of lower casts and from families with lower levels of housing conditions – are found to be more prone to both lower attendance and lower enrollment.

Table 5 shows the results of each triple interaction on enrollment while table 6 shows the results of each triple interaction on attendance. In both cases all variables from the base specification are in the model, but not displayed in the tables.

Table 5. Triple interactions on enrollment

VARIABLES	(1)	(2)	(3)	(4)
Interaction	-0.00445***	-0.00410***	-0.00376***	-0.00385***
	(0.00116)	(0.00117)	(0.00115)	(0.00119)
Year16	1.612***	1.583***	1.674***	1.541***
	(0.363)	(0.366)	(0.358)	(0.373)
Interaction x Gender	0.000245			
	(0.000177)			
Interaction x Age15-18		-0.000507**		
		(0.000223)		
Interaction x Top3Casts			-0.000890***	
			(0.000238)	
Interaction x Housing Conditions				-0.000418**
				(0.000196)
Constant	0.913***	0.882***	0.805***	0.794***
	(0.109)	(0.113)	(0.156)	(0.112)
Controls	YES	YES	YES	YES
Observations	1,035	1,035	1,035	1,035
R-squared	0.304	0.310	0.315	0.310

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 6. Triple interactions on attendance

VARIABLES	(1)	(2)	(3)	(4)
Interaction	0.0217***	0.0213***	0.0179***	0.0192***
	(0.00641)	(0.00617)	(0.00624)	(0.00639)
Year16	-8.615***	-8.885***	-8.853***	-8.431***
	(1.967)	(1.916)	(1.945)	(2.000)
Interaction x Gender	-0.000290			
	(0.00104)			
Interaction x Age15-18		0.00136		
		(0.00195)		
Interaction x Top3Casts			0.00492***	
			(0.00140)	
Interaction x Housing Conditions				0.00289**
				(0.00113)
Constant	1.063	0.183	1.562	1.486
	(0.946)	(0.979)	(1.206)	(0.903)
Controls	YES	YES	YES	YES
Observations	556	556	556	556
R-squared	0.415	0.428	0.424	0.426

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Thus, it is clear that for enrollment children aged 15-18, children from households with worse housing conditions and those who are from the lower casts are more likely to have their enrollment affected by the earthquake. For attendance, the same holds true for those children from lower casts and from households with worse housing conditions.

Policy Recommendations

The empirical evidence from the study has important policy implications.

1. Recognizing that a lack of children's school can be negatively affected by earthquakes, as found in our literature review and empirical analysis, it is *crucial for NGOs and aid organizations to prioritize the rebuilding of school infrastructure after an earthquake.*
2. The most vulnerable groups after a natural disaster are the children ages 15 and older and children who are not in the Brahmin, Chhetri, or Newari caste and students whose wealth is limited comparatively. *Additional resources should be distributed to families who have members in the most vulnerable castes to ensure the children can remain in school and continue their education.*

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