Essays on Women's Empowerment and Natural Disaster:

The Case of Nepal

A Dissertation

Submitted to the National Graduate Institute for Policy Studies (GRIPS)

in Partial Fulfillment of the Requirements for the Degree of

Ph.D. in Development Economics

by

Chandan Sapkota

December 2019

Abstract

Outmigration is an increasing trend in many developing countries. In Nepal, where remittances exceed 20% of GDP, outmigration is dominated by male household members due to cultural and legal constraints on women. Various social impacts of outmigration are well examined in the literature; however, the impact of male-dominated outmigration on women's empowerment and employment is relatively undocumented. The first part of this dissertation examines the impact of male outmigration on women's employment and empowerment. We employ ethnicity-specific migration network and favorable rainfall shock as instruments to address endogeneity in male outmigration. Our empirical evidence shows that married women in households with male out-migrants are more likely to be self-employed. These women are also less likely to be in polygamous relationships and more likely to have the final say on their own health issues. However, further investigation demonstrates that these women are less likely to have freedom to visit their family or relatives, which is probably due to increased cohabitation with their parents-in-law.

The second part of the dissertation focuses on the impact of a catastrophic 7.6 magnitude earthquake on 25 April 2015. It resulted in widespread loss of lives and properties, disrupted public infrastructure and services, and dented economic growth. Although there is ample literature on the impact of natural disasters on a range of outcome variables over medium to long run, there are limited studies on the impact of a large earthquake on private and public coping strategies, especially in response to loss of properties or lives, in the short-term. We study the effect of the 2015 earthquake on private and public coping strategies in response to death of household member and loss of property using a unique census of all the houses destroyed by the earthquake. To address the endogeneity of severity of housing damage, we utilize distance of ward from the epicenter of the earthquake as an instrumental variable. Our empirical evidence shows that the

severity of housing damage do not affect change in school dropout, change in pregnant women getting regular checkup, change in immunization among children, and change in employment (quit or change job). However, we find evidence that the severity of housing damage affects public transfers and the likelihood of displacement from own house. Moreover, controlling for house fixed effects, we show that having a dead or injured household member affects change in school dropout and change in employment. Our results imply that large public transfers and rapid restoration of public services might have offset the expected negative effect during the short-term.

We also present supplementary analysis on the impact of the earthquake on health outcomes using nationally representative demographic and health survey done before and after the earthquake. The difference-in-differences estimation shows that while adults are more likely to be thin immediately after the earthquake in the affected districts, there is no statistically significant change in child health outcomes related to malnutrition. As abovementioned, the results imply that the massive post-earthquake relief operations, and the rapid restoration of health services in addition to substantial public and private cash and in-kind assistance to the affected households might have more than offset the expected negative effects on children's health outcomes in the short-term.

Acknowledgement

Foremost, I would like to thank my supervisor Prof. Dainn Wie for continuous guidance, supervision and encouragement through each stage of the process. I could not have gotten a better adviser and mentor. Without her persistent guidance and help, this dissertation would not have been possible. I would also to like to express my sincere gratitude to the rest of my doctoral dissertation committee— Prof. Chikako Yamauchi, Prof. Yoko Kijima, Prof. Soohyung Lee, and Prof. Yusuke Takagi — for constructive feedback to improve the chapters included in the dissertation. My sincere thanks also goes to Kenichi Yokoyama, who encouraged and supported my decision to pursue doctoral degree in economics, and provided continuous guidance on academic, policy and career fronts.

I would like to acknowledge the support of Student Office at GRIPS in helping sort out all the administrative tasks, including assistance in accommodation. Similarly, thank you to AST, IPT and GAT staff who supported my academic life at GRIPS. I would like to acknowledge the financial support extended by MEXT (Monbukagakusho scholarship) to complete Ph.D. at GRIPS.

To all the friends and relatives who supported this undertaking, thank you.

Finally yet importantly, I cannot thank enough Rita Shrestha, my wife, for all the love and support during the whole process.

Dedicated to Rita Shrestha, my wife

Table of Contents

List of Tables

List of Figures

Chapter 1
Introduction

1.1 Background for the Study on Women's Employment and Empowerment

Large-scale male-dominated outmigration for work and the income they remit back home have become a defining feature of Nepali economy. As a share of gross domestic product, Nepal consistently ranks among the top five countries in terms of remittance inflows. Remittances have supported household consumption, reduced absolute poverty, eased household and banking sector liquidity constraints, and boosted foreign exchange reserves (Sapkota, 2013). Nepal's overseas migration is driven by its civil war, which lasted from 1996 to 2006. The conflict had its root in a number of factors, including landless, ethnicity-based discrimination, poverty, underdevelopment, unemployment and lack of economic opportunities (Do and Iyer, 2010). Since the intensification of the civil war in 2001, male-dominated large-scale outmigration has been a prominent feature of Nepali households and the economy. Male outmigration creates space for women to enhance their intrahousehold bargaining power as they become head of household or elevate their relative position within the household. Remittances sent by husbands also affect women by relaxing their financial constraints and allows them to make meaningful and strategic life choices, which are an important factor constituting women's empowerment (Sen, 1999; Malhorta et al, 2002; Kabeer, 2001; Alsop et al, 2006; Klugman et al, 2014).

Although there is ample literature on the effect of outmigration on women's employment, the literature on women's empowerment is limited. Male outmigration tends to affect women's employment negatively due to the income effect of remittances on women's labor force participation but it increases self-employment (Funkhouser, 1992; Amuedo-Dorantes and Pozo, 2006; Yang, 2008; Binzel and Assaad, 2011). The literature on the impact on women's

empowerment shows mixed results. Following male outmigration, women's agency increased in Guatemala (Stanley, 2015), and decision-making power improved in Bangladesh (Debnath and Selim, 2009) and in Nepal (Maharjan, Bauer and Kneer, 2012; Kar et al, 2018). However, Sinha, Jha and Negi (2012) found no significant relationship in India and burden on women increased in Morocco (de Hass and Rooij, 2010).

Against this backdrop, the first part of this dissertation examines the impact of male outmigration on women's employment and empowerment in Nepal. We use two rounds of nationally representative Demographic and Health Survey (2006 and 2011) and address endogeneity of male outmigration by utilizing ethnicity-specific migration network and favorable rainfall shock as instruments. The findings of the study has important policy implication, especially given the fact that male outmigration is not going to slowdown anytime soon in Nepal due to high unemployment rate and low wages.

1.2 Background for the Study on the Impact of the 2015 Earthquake

The second part of the dissertation focuses on the impact of the catastrophic 2015 earthquake in Nepal. Nepal lies in one of the most seismically active regions in the world and remains vulnerable to earthquakes caused by the collision between the Indian and the Eurasian continental plates in the Himalaya (Wei-Hass, 2019). A 7.6 magnitude earthquake struck the country on 25 April 2015, resulting in widespread loss of lives and properties. The epicenter was at Barpark, about 76 kilometer northwest of Kathmandu, in Gorkha district. The earthquake killed nearly 9,000 people and injured 22,309. It fully and partially damaged 602,257 and 285,099 private houses, respectively. To prioritize rescue and relief operations and based on severity of damage, the government declared 14 districts as severely affected and an additional 17 as affected. Over 95% of death and injury occurred in these 31 districts.

Natural disasters like earthquake negatively affect lives and properties, nutrition intake, education, health and income-generating processes. In additional to these direct effects, there are indirect effects too— fiscal constraints, general equilibrium effects on prices and earnings, higher poverty levels, and tighter household budget constraints. In the aftermath of an earthquake, households tend to reduce consumption (Sawada and Shimizutani, 2008) and readjust labor hours for either household work or toward high paying nontradable sectors such as construction (Kirchberger, 2017). The government responds by transferring funds to affected households to make-up for the dent in consumption and income in the short-term (Park and Wang, 2017). It could also lead to a reduction in net migration (Hilliday, 2006). Earthquakes increase risk of low birthweight (Tan et al., 2009), and affect nutrition intake among adults and children, resulting in lower body mass index, weight-for-age, and weight-for-height (Baez, de la Fuente and Santos, 2010). These short-term effects continue to have long-term conseuqences. For instance, children born with low brithweight are less likely to attend preschool than normal birthweight siblings (Datar, Kilburn and Loughran, 2010), and more likely to have worse outcomes in terms of one-year mortality rates and longer run educational attainment, earnings, IQ, and adult height (Currie and Hyson, 1999; Conley and Bennett, 2000; Black, Devereux and Salvanes, 2007).

Against this backdrop, we examine the effect of the 2015 earthquake in Nepal on private and public coping strategies in response to type of damage— loss of properties or lives. We use a unique census of all the houses damaged by the earthquake and address the endogeneity of severity of housing damage by using ward distance from the epicenter of the earthquake as an instrumental variable. To supplement this analysis, we also examine the effect of the earthquake on adult and children health outcomes using nationally representative surveys conducted before and after the earthquake (2011 and 2016).

1.3 Main Contribution and Findings

The main contribution of the second chapter on the effect of male outmigration on women's employment and empowerment is that we provide rigorous empirical evidence by controlling for endogeneity of male outmigration. The existing evidence in literature comes from small-scale case studies, one-year cross-sectional data, or empirical observation without properly controlling for endogeneity. We employ two rounds of nationally representative household surveys in Nepal (2006 and 2011), which allows us to examine a broad range of measures related to women's empowerment, including women being in a polygamous relationship and having a bank account, the final say for their own healthcare, and the freedom to visit their own family or relatives.

Our empirical evidence shows that married women in households with male outmigrants are more likely to be self-employed. Our data do not cover remittances; however, we conjecture that remittances raised the women's reservation wage but alleviated liquidity constraints, allowing some women to start their own small business. Concerning women's empowerment, we find evidence that married women in households with male outmigrants are less likely to report being in polygyny. They are also more likely to have a final say on matters related to their own healthcare. However, we also found that these women with out-migrating male household members are less likely to have the freedom to visit their family/relatives and are more likely to live with their parents-in-law.

The main contribution of the chapters on the impact of the 2015 earthquake is that they provide, to the best of our knowledge, the first census-based and household survey-based empirical evidence of the earthquake's effect on private and public sectors coping strategies, and on child and adult health outcomes in Nepal. Moreover, it is also the first study to evaluate private response by type of damage— loss of lives or properties. It contributes to the limited literature on the short-

term effects of an earthquake by providing evidence on the impact on coping strategies and health outcomes, and the role of well-coordinated public transfers in offsetting the expected negative results.

Our empirical evidence shows that severity of housing damage does not affect the change in school dropout, change in pregnant women getting regular checkup, change in immunization among children, and change in employment (quitting or changing job). However, we find evidence that the severity of housing damage affects public transfers and the likelihood of being displaced from own house. Moreover, controlling for house fixed effects and public transfers, we show that having dead or injured household member affects change in school dropout and change in employment. Our results imply that the large public transfers and rapid restoration of public services might have offset the expected negative effect during the short-term. In addition, the difference-in-differences based empirical estimate shows that while adults in the earthquake-affected districts are more likely to be thin compared to the control group, there is no statistically significant effect on child underweight and body mass index, and low birthweight among newborn children. The estimation from the supplementary analysis is consistent with the previous analysis, where we do not find statistically significant effect on health related outcomes.

1.4 Organization of the Dissertation

The remainder of the dissertation is organized as follows: Chapter 2 examines the effect of male outmigration on women's employment and empowerment. Chapter 3 focuses on the analysis of household and public responses after the 2015 Gorkha earthquake. Chapter 4 provides supplementary analysis on the effect of the earthquake on adult and child health outcomes. Chapter 5 summarizes the main findings, highlights pertinent policy issues, and indicates areas for further research.

Chapter 2

The Effect of Outmigration on Women's Employment and Empowerment in Nepal

2.1 Introduction

Outmigration is an increasing trend in many developing countries. In Nepal, where remittances exceed 20% of GDP, outmigration is dominated by male household members due to legal[1] and cultural constraints on women. Various social impacts of outmigration are well examined in the literature; however, the impact of male-dominated outmigration on women's empowerment and employment is relatively undocumented.

Male outmigration creates space for women to enhance their intrahousehold bargaining power as they become head of household or elevate their relative position within the household. Remittances sent by husbands also affect women by relaxing their financial constraints, allowing women to make meaningful and strategic life choices. Women's ability to make meaningful and strategic choices is identified as an important factor constituting women's empowerment (Alsop et al, 2006; Kabeer, 2001; Klugman et al, 2014; Malhorta et al, 2002; Sen, 1999).

Men's absence and remittances also affect women's economic activities. As surveyed in Blundell and MaCurdy (1999), married women in Nepal make labor supply decisions in the context of the family (Lokshin and Glinskaya, 2009). Remittances would pull them out of the

[1] For instance, women's outmigration to the Gulf countries was prohibited until 2010. Furthermore, in 2012 the government banned women below 30 years of age from migrating for work to the Arab countries (ILO, 2015).

formal labor market; however, women left behind are also expected to provide labor for the family business or farm to fill the gap created by the absence of male household members.

In this paper, we study how male outmigration affects women's empowerment and employment in Nepal. To address the endogeneity of male outmigration, we utilize an ethnicity-specific migration network and favorable rainfall shock as instrumental variables for male outmigration. The caste (ethnicity) system is deeply rooted in every aspect of life in Nepal, although discrimination based on caste is banned according to the constitution. The distribution and migration network in each ethnicity would affect women's empowerment and employment only through male outmigration when region-specific fixed characters are controlled. A positive income shock driven by favorable rainfall is also a relevant instrumental variable because outmigration is costly due to various bureaucratic processes.

There are a limited number of studies on the impact of male outmigration on women's empowerment, and the results are mixed. Stanley (2015) found that male outmigration improves women's agricultural agency in Guatemala because these women assume the role of hiring and managing workers. A similar positive effect on women's decision-making was also observed in the state of Uttar Pradesh in India (Paris et al., 2005), in Bangladesh (Debnath and Selim, 2009), and in Nepal (Maharjan, Bauer and Kneer, 2012; Kar et al, 2018). On the other hand, Sinha, Jha, and Negi (2012) found no significant relationship between male outmigration and women's empowerment in India using the National Family Health Survey. Similarly, de Hass and Rooij (2010) reported that male outmigration increased the burden and responsibility rather than the empowerment of the women left behind.

The literature on the impact of male outmigration on women's employment shows a negative income effect of remittances on women's labor force participation and an increase in self-

employment in Nicaragua (Funkhouser, 1992), Mexico (Amuedo-Dorantes and Pozo, 2006), Egypt (Binzel and Assaad, 2011), and the Philippines (Yang, 2008). A positive impact of household migration on women's increased self-employment and farm activities is also reported by Mendola and Carletto (2012), Stanley (2015), and Mu and van de Walle (2011). Of the few studies related to Nepal, Lokshin and Glinskaya (2009) found a negative impact on the level of labor market participation among women in migrant-sending households, and Slavchevska et al. (2016) showed that women were increasingly compensating for the lost labor hours in agriculture, leading to the 'feminization of agriculture'.

Although these previous studies provide us with interesting insight about the potential impact of male outmigration and women's empowerment, their evidence comes from small-scale case studies, one-year cross-section data, or empirical observation without properly controlling endogeneity.[2] In this paper, we employ two rounds of nationally representative household surveys

[2] For instance, on women's employment, Lokshin and Glinskaya (2009) use the proportion of internal and international migrants at the ward level in 2001 as IVs, and argue that male migration network should not affect women's decision to participate in the labor market. However, failure to control for local economy, which reflects migrant network, can have direct impact on women's labor market participation as well. Slavechevska et al. (2016) provides descriptive evidence and proposes indicators for feminization of agriculture due to male outmigration. Kar et al. (2018)'s study is also based on a single year survey in five rural districts and use current migration network at ward level and family migration history as IVs. On women's empowerment, Kar et al. (2018)'s results are based on OLS estimates, and Maharjan, Bauer and Kneer (2012)'s paper is based on a case study in the hilly regions of Nepal.

in Nepal (2006 and 2011), which allows us to examine a broad range of measures related to women's empowerment, including women being in a polygamous relationship and having a bank account, the final say for their own healthcare, and the mobility to visit their own family or relatives. We believe that the article contributes to the literature by providing evidence of the impact of male outmigration on extensive aspects of women's empowerment and employment using a rigorous empirical approach.

Our empirical evidence shows that married women in households with male outmigrants are more likely to be self-employed. Our data do not cover remittances; however, we conjecture that remittances raised the women's reservation wage but alleviated liquidity constraints, allowing some women to start their own small business. Concerning women's empowerment, we find evidence that married women in households with male outmigrants are less likely to report being in polygyny. They are also more likely to have a final say on matters related to their own healthcare. However, we also found that these women with out-migrating male household members are less likely to have the freedom to visit their family/relatives and are more likely to live with their parents-in-law. Although the male absence created by outmigration clearly lowers the probability of polygamous marriage, our results imply that the impact of male outmigration on women's empowerment depends on the context of the women left behind.

The remainder of the paper is organized as follows: Section 2.2 provides an overview of the historical context of Nepal's recent increase in male outmigration and trends in remittances. Section 2.3 discusses the survey data, measures of women's empowerment, summary statistics and simple OLS regression results. Section 2.4 focuses on the instrumental variable identification strategy and the relevant estimation results. Section 2.5 provides concluding remarks and highlights some pertinent policy issues.

2.2 Overview of Outmigration in Nepal

2.2.1 Historical Backgrounds of Nepal's Civil War, Economic Distress, and Male Outmigration

Nepal's overseas migration is driven by its civil war, which lasted from 1996 to 2006. The conflict had its root in a number of factors, including landless, ethnicity-based discrimination, poverty, underdevelopment, unemployment and lack of economic opportunities (Do and Iyer, 2010). A fractious political regime with frequent changes in government leadership resulted in an ineffective state response to contain the spread of insurgency in the initial years. Consequently, an insurgency that started in a rural district in 1996 spread to approximately 35 of the 75 districts by 2000 (Pivovarova and Swee, 2015), and the level of violence escalated in 2001 when the Maoist rebels staged simultaneous assaults in 42 districts. On 26 November 2001, the government declared a nationwide state of emergency, which led to the suspension of basic rights and the diversion of fiscal resources to fight the insurgency (UNOHCHR, 2012). On 9 August 2006, the political parties and the Maoist rebels signed a Comprehensive Peace Accord, formally ending the decade-long insurgency.

Since the intensification of the Maoist insurgency in 2001, male-dominated large-scale outmigration has been a prominent feature of Nepali households and the economy. Figure 2.1 shows that more men emigrated than women during and after the decade-long armed conflict (1996-2006), particularly after the intensification of conflict in 2001. In 1991, the absentee population was 3.4% of the total population, marginally decreasing to 3.2% in 2001 and increasing to 7.3% in 2011 (CBS, 2012).

<Figure 2.1 to be Inserted Here>

The spread and escalation of conflict throughout the country affected outmigration in two ways. First, not only did men represent a disproportionately larger share of the victims, but they were also forced to out-migrate for fear of forced recruitment (Shrestha, 2017). Second, the deterioration of economic conditions because of the conflict severely affected economic activities, forcing even more people to seek employment overseas. The negative effect of the conflict on investment and output persisted even after its end, further fueling outmigration. The industrial sector was hit the hardest, as its contribution to GDP slumped from a high of 22.3% in 1996 to 16.7% in 2006 and 14.9% in 2011— a declining trend that has been labeled "premature deindustrialization" (ILO, 2017). Merchandise exports also dropped from 13% of GDP in 2001 to approximately 9% in 2006 and 4.7% in 2011.

2.2.2 Trends of Remittances, Outmigration, and Migration Costs

The National Population and Housing Census 2011 (CBS, 2012) shows that of the total absentee population, defined as the number of individuals absent from households and gone abroad for at least six months before the census date, 37.6% went to India and the Middle East[3]. The next largest destination was the ASEAN (Association of Southeast Asian Nations) region (13%), which includes Malaysia. This composition of migrants' destinations is quite different from that recorded in the 2001 population and housing census. In 2001, approximately 77.3% of the total migrant workers went to India, but migrants to the Middle East and ASEAN countries represented only 14.5% and 1.3%, respectively.

[3] Here, the Middle East constitutes Saudi Arabia, Qatar, Kuwait, UAE, and Bahrain.

The liberalization of passport issuance to district headquarters in 2001 (World Bank, 2006), the escalation of conflict, the oil price boom in the destination countries, and the opening of new sectors[4][5] for employment to Nepali migrant workers by Malaysia in 2010 (Shishido, 2011) contributed to the surge in migration to destinations other than India. Migration to India is for temporary work, does not require official travel documents, and usually occurs during the lean agricultural period (WFP, 2008). Migration to the Middle East (particularly the Gulf Cooperation Council countries) is for manual and semiskilled jobs for at least a year, and it requires work approval by the government (GIZ, 2013). The demand for workers, thanks to high investment in natural resource and commodity sectors in the GCC and Malaysia, and comparatively high wages in the destination countries primarily drive outmigration (Sapkota, 2013; Shrestha, 2017). To some extent, outmigration pattern largely resemble the ethnic profile. For instance, only few ethnicities or castes were allowed entry into the British and the Indian armed forces (called "Gurkhas") and that they came from the hilly regions. Similarly, ethnicities such as Terai janjatis and other Terai based castes tend to migrate to India, where the cost of migration is low (Gartaula and Niehof,

[4]A total of 25 sectors, including security services, casinos, textiles, mining, hotels and automobile workshops. Employment in security services sector was opened in 2006 but closed in 2009 amidst the global financial crisis. It was reopened again in 2010 for Nepalese workers. See: https://www.ceslam.org/index.php?pageName=newsDetail&nid=1601

[5] 'Maintain Nepalese-only policy for security jobs", Free Malaysia Today. 20 may 2017: https://www.freemalaysiatoday.com/category/nation/2017/05/10/maintain-nepalese-only-policy-for-security-jobs/

2013). Muslims, Dalits and Hill janajatis tend to migrate to the Middle East and Malaysia (Shishido, 2011).

Because of the large-scale outmigration, workers' remittances started to increase and played a crucial role in reducing poverty and spurring economic activities. The Nepal Living Standards Survey shows that approximately 55.8% of households received remittances in 2010/11, up from 31.9% in 2003/04 and 23.4% in 1995/96 (CBS 2011). According to Nepal Rastra Bank (the central bank), officially recorded workers' remittance inflows increased from just 1.7% of GDP in 1996 to 3.3% of GDP in 2000 and approximately 20% of GDP in 2011 (Figure 2.2). Migrant workers sent approximately three-quarters of remittance income through personal connections, i.e., not through the formal banking channel. This indicates that the officially recorded workers' remittances are an underestimation of the true value of remittance inflows.

<Figure 2.2 to be Inserted Here>

Personal and migrant work-related networks, including recruitment agencies located in Kathmandu[6], influence prospective migrants' decisions to migrate overseas for work (DoFE, 2014). Approximately 95% of potential outmigrants approach recruitment agencies through direct referral or local brokers (ILO, 2017). Even when migrants use informal channels, personal or social networks in the destination countries often help them identify job opportunities and protect them from abuses by agents or employers.

[6] It is estimated that there are about 50,000 unlicensed brokers, who recruit between 300 and 1000 workers per year (ILO, 2017).

Outmigration is costly not only due to informational constraints about job prospects overseas but also due to the need to fulfill the bureaucratic processes required to obtain a legal working permit from the Department of Foreign Employment (Figure 2.3). These costs include upfront recruitment payment to recruitment agencies and brokers, medical checkup, airfare, airport tax, contribution to the Foreign Employment Welfare Fund, health and life insurance, passport issuance, skills certification, police report, final work approval by the government agency, and transportation to and accommodation expenses in Kathmandu during the application period. The Nepal Migration Survey 2009 shows that, on average, a migrant paid approximately NRs 92,000 (approximately $1200 based on the official exchange rate in fiscal year 2009) for overseas employment (Shishido, 2011). This was seven times their monthly income and 11 times their monthly savings. For a predominantly agricultural economy such as Nepal, a good agricultural harvest—thanks to favorable monsoon rainfall—and the ensuing bump in income and savings enables potential migrants to cover part of the upfront outmigration cost.

<Figure 2.3 to be Inserted Here>

2.3 DHS Data and Measures of Women's Employment and Empowerment

We use the Demographic and Health Survey (DHS) (Ministry of Health, Nepal; New Era; and ICF, 2017), which is jointly conducted by the Ministry of Health and Population in Nepal and the United States Agency for International Development, for 2006 and 2011. The DHS is a cross-sectional survey conducted every five years, covers the population up to age 49 and is nationally representative. It includes detailed data on demographics, fertility, contraceptive use, healthcare,

infant and child mortality, violence against women, women's empowerment, and nutrition, among others. DHS 2006 and 2011 covered 8,707 households and 10,826 households, respectively.[7]

We look at three main employment-related indicators, specifically married women's type of employment, covering both agricultural and nonagricultural sectors: whether she works for a family member or a nonfamily member or is self-employed. Additionally, we look at if married women are working either in agricultural or nonagricultural sector to get a sense of the extensive margin. We expect that income effects from remittances would drive married women with male outmigrants in the household to reduce their labor market participation, while the male absence push them to readjust their working hours to household or nonpaid agricultural work[8] in family plots. Furthermore, if remittances alleviate the liquidity constraints to start small businesses, then we expect married women to be self-employed. As our data do not provide information about remittances and household income, we cannot empirically examine the mechanism in detail.

---

[7] The household response rate (households interviewed/households occupied) was 99.6% in DHS 2006 and 99.4% in DHS 2011. The sampling frame, which is a comprehensive list of all sampling units that covers the target population, is derived from the decennial population and housing census. The geographic region forms the basis of stratification, and each stratum is divided into enumeration areas, classified as either rural or urban. Samples were independently selected from each stratum following a two-stage stratified cluster sampling.

[8] Household cooperative model asserts that outmigration should increase married women's household labor hours unless the women have more bargaining power. Non-cooperative decision-making within household reduces women's household labor hours because it is difficult to monitor individual time allocation (Chen, 2006).

Choosing indicators for women's empowerment is never an easy job. Kabeer (1999) defined women's empowerment as the ability to make a meaningful choice. She also further defined what constitutes such an ability to make a choice: access to resource, agency, and well-being outcomes. We focus on five indicators that reflect those three dimensions of women's empowerment. We first look at whether a married woman's husband has more than one wife (polygyny). Polygyny is an old and prevalent practice in Nepal, although it is not legally acceptable. Strauss (2012) argues that traditional polygyny embeds inequalities in its very structure. Within the polygyny structure, co-wives are required to cooperate for home production, family farm activities and reproductive areas while competing for household resources and the husband's attention. Bove and Valeggia (2009) showed that polygyny is associated with women's anxiety and depression. McDermott and Cowden (2015) also showed that the polygyny relationship is related to increased violence toward women and children and disempowerment for already married women.

The second measure of women's empowerment we exploit is ownership of a bank account. Owning a bank account increases a woman's ability to take control of income (Holloway, Niazi and Rouse, 2017; Schaner, 2016) and obtain financial autonomy (Kabeer, 1999). Next, we explore whether a married woman has a final say in her own healthcare and visits to family or relatives. Health and nourishment are considered basic fundamentals of survival and therefore well reflect the empowerment of women. Health condition itself may be affected by the increased income due to remittances from a woman's husband; however, whether a woman has the final say about her own health shows whether she can actually exercise decisions regarding her own health care.

Women's freedom of mobility is one of most frequently used measures of women's empowerment, as it shapes women's social capital (Kabeer, 1999). Women's mobility is relevant

to empowerment, especially in the patriarchal context, where women are bound to the home (Mahmud et al., 2012). Hashemi et al. (1996) showed that rural credit programs empower women, including in the aspect of mobility.

We also explore whether married women in households with male outmigrants are more likely to live with their in-laws to cope with the absence of the male household members and obtain support for child-rearing. However, such a living arrangement could have disempowering effects because women living with in-laws are more likely to be subordinate to the authority of a senior woman in the household, with lower agency and mobility (Kabeer, 1999; Glennerster et al., 2018). Living in an extended family setting reduces married women's bargaining power, particularly their autonomy (de Hass and Rooij, 2010; Sinha, Jha and Negi, 2012).

We restrict our sample to the same age cohort (15-49 years in 2006 and 20-54 years in 2011) of married women born after 1980 and married before the end of the conflict in August 2006. The sample restriction is intended to exclude the impact of changes in marriage market dynamics after the end of the decade-long Maoist conflict (1996-2006). Valente (2011) showed that conflict intensity and Maoist abductions during school age increased the probability of early marriage.

<Table 2.1 to be Inserted Here>

We present the summary statistics of relevant variables used in the analysis in Table 2.1. Male out-migrants is a binary variable indicating that any male member in the household is currently in a foreign country. We can observe that 28.3% of married women were living in households with male outmigrants in 2011 compared to 20.1% in 2006. The share of married women working for family members drastically increased from 25.8% in 2006 to 57.6% in 2011.

In addition, the share of married women who are self-employed declined from 45.5% in 2006 to 8.8% in 2011.

Concerning women's empowerment, the summary statistics show that the percentage of women in polygamy declined from 42.9% to 34.3%. Additionally, the share of women with their own bank account increased from 47.3% to 66.7%. Similarly, there is an improvement over the survey period in all the empowerment indicators: having a final say in own healthcare and visits to family or relatives. We can also observe that fewer married women live with in-laws in 2011 (26.7%) than in 2006 (36.1%).

2.4 Empirical Specification and Results

2.4.1 Ordinary Least Squares Estimation

To examine the relationship between living in households with male migrants outside the country and women's empowerment, we estimate the following regression:

$$Y_{ihpdt} = \beta_0 + \beta_1 M_{ihpdt} + \theta X_{ihpdt} + \gamma E_{pt} + District_d + Year_t + \varepsilon_{ihpdt} \quad (1)$$

where Y_{ihpdt} is an outcome variable for woman *i* in household *h* and ward *p*[9] of district *d* in year *t*. M_{ihpdt} indicates that individual *i* is living in household *h* with at least one male out-migrant at the time of the survey, *t*. X_{ihpdt} is a set of control variables including an urban indicator,

[9] Nepal consists of 75 districts across different ecological zones. The districts are divided into wards or municipalities, which are further categorized as urban and rural areas. The primary sampling unit in DHS data is the ward. In rural areas, the wards are small, including 104 households, on average, while in urban areas, the wards are larger, comprising approximately 800 households.

woman's age, education of the woman and her husband, years of marriage fixed effects, ethnicity-specific fixed effects, wealth level fixed effects, and number of children in the household. Local economic conditions may encourage male outmigration and affect the labor market outcomes of the women left behind. We additionally control the set of region-level variables E_{pt} to address potential omitted variable bias. E_{pt} contains nighttime light[10] reflecting the level of economic activity and the share of agricultural workers to show the level of industrialization in each ward p in year t. District and survey year fixed effects are also controlled to capture the constant characteristics of each region and the time trend. Error terms are calculated in consideration of the survey setting.

<Table 2.2 to be Inserted Here>

Table 2.2 provides OLS estimates of the impact of male outmigration on women's employment: currently working, working for family, working for someone else, and self-employed. It shows that married women in households with male outmigrants are more likely to work for their own family and less likely to be self-employed. This is consistent with the findings of previous studies in Nepal and other countries that show a negative effect of male outmigration on women's employment, especially a retreat from the labor market and a shift toward household and unpaid agricultural activities.

<Table 2.3 to be Inserted Here>

The OLS regression estimates related to women's empowerment in Table 2.3 show that married women in households with male outmigrants are more likely to own a bank account and

[10] Nighttime light is a good proxy for local GDP growth (Vernon, Storeygard and Weil, 2012).

to have a final say in their own healthcare. They are also likely to be living with in-laws. The OLS regression also suggests a decline in polygyny. However, there is no significant evidence that having male outmigrants in the household has any impact on the wife's freedom to visit her family or relatives.

OLS estimates may entail errors because of the endogeneity of male outmigration. First, omitted variable bias could confound our results due to unobserved individual-level characteristics or local economic conditions. For instance, more assertive women have higher bargaining power (Brown, 2009) concerning the kind of job they will take after marriage and whether any member of the household should migrate, contingent upon household budgetary needs. In this case, our OLS estimates on the impact of male outmigration on women's bargaining power would be underestimated. Moreover, the prospect of deteriorating local economic conditions that cannot be fully controlled by our proxy variables for regional economic conditions could increase the likelihood of outmigration and affect the available job opportunities in the local market. In this case, the OLS results showing a positive impact of male outmigration on the likelihood that women work for family members rather than other employers would be overestimated.

Second, simultaneity bias could be a threat if women's decision-making power over household resources could affect the probability that their husbands migrate (Nobles and McKelvey, 2015). Using data from Mexico, the authors show that variation in women's decision-making authority and control over resources predicts the subsequent emigration of their husbands to the US.

2.4.2 Instrumental Variable Specification and First-Stage Results

To control for the endogeneity of male outmigration, we use two instrumental variables: caste (ethnicity)-specific migration network and rainfall. Migration network can be thought of as

interpersonal connections linking migrants, non-migrants, and former migrants in destination and origin areas through bonds of friendship, common community origin, and kinship (Massey, 1990). Migration costs decrease as the size and history of the migration network grows (Mckenzie and Rapoport, 2007; Munshi, 2003). For this reason, the migration network has been employed as an instrumental variable for migration decisions in many empirical studies (McKenzie and Rapoport, 2007; Adams and Cuecuecha, 2010; Mendola, 2008).

To reflect Nepal's context, we construct an ethnicity-specific migration network calculated as the present share of ethnicity-specific households with male migrants at the ward level. Here, we further group the eleven ethnicities into five broad categories, namely, Brahmin and Chhetri, Newar and Janajati, Terai Madhesi, Dalit, and Muslim and others.[11] The migration network lowers the financial cost of acquiring information about employment destinations as well as the bureaucratic procedures required for outmigration. For instance, people from the same ethnicity and locality exchange information about potential opportunities for overseas employment, which reduces the perceived risk of moving to a new place away from home. The variation of the caste-specific migration network across regions and time comes from two sources: the original

[11] This reflects the five broad caste categories practiced in Nepal, where over 80% of the population follows Hinduism. Since DHS 2006 covers nearly 100 ethnicities but DHS 2011 has just eleven broad categories representing the ethnicities, we categorize the DHS 2006 ethnicities into the eleven broad ethnicities following the classification in (Bennett, Dahal and Govindasamy, 2008). The eleven broad categories are as follows: Hill Brahmin, Hill Chhetri, Terai Brahmin/Chhetri, Newar, Hill and Mountain Janajati, Terai Madhesi and other caste, Hill Dalit, Terai Madhesi Dalit, Muslim, and others.

distribution of castes in each area and the change in migrants' distribution across different ethnicities over time. We argue that change in the distribution of migrants over time across ethnicities is driven mainly by the exogenous change in the destination country's demand for workers, as described in section 2.2. The ethnicity-specific migration will then affect women's empowerment and employment only through male outmigration controlling for region-specific fixed effects.

We use rainfall as an additional instrumental variable that affects migration but has no direct relationship with women's empowerment and labor market participation conditional on regional economic activities. Rainfall has been extensively employed in the literature because it exogenously affects migration in developing countries. It has been shown that rainfall shocks, especially lower than average rainfall, push people to migrate in Mexico (Munshi, 2003; Chalfin, 2013) and Indonesia (Kleemans and Magruder, 2018). However, Dustmann et al. (2017) also showed that higher levels of rainfall induce an unexpected and positive shock in income, which allows potential migrants to pay the cost for an imminent illegal migration. Recently, Kaur (2019) showed that a positive rainfall shock in India increased wages and income of agricultural households.

In Nepal's context, we argue that a favorable rainfall just before the survey years compared to the long-period average[12] increases the agricultural harvest, which consequently increases the income of households dependent on agriculture. Prospective outmigrants then use the additional income, or savings, to cover the various costs related to migration described in section 2. Since approximately three-quarters of the total households depend on agriculture for livelihood and

[12] Referred to as twenty year average

cultivate paddy (the major summer crop that is entirely dependent on rain-fed irrigation), agriculture is the most important source of household income and savings (CBS, 2011).

We estimate the following equation as a first-stage estimation:

$$M_{ihpdt} = \alpha_0 + \alpha_1 Network_{pdt} + \alpha_2 Rainfall_{dt} + \psi X_{ihpdt} + \eta E_{pt} + District_d + Year_t + \varepsilon_{ihpdt} \qquad (2)$$

where M_{ihpdt} indicates having a male out-migrant in the household. $Network_{hpdt}$ is an ethnicity-based migration network calculated as the share of migrants in each ethnicity in each ward. For rainfall $Rainfall_{dt}$, we constructed a standard rainfall z-score based on the district-level average precipitation over the three years prior to the survey year and the district-level long period average (twenty-year average). We also constructed an indicator for a rainfall shock that corresponds to an absolute value of a z-score greater than one for the three years prior to the survey year.

<Table 2.4 to be Inserted Here>

Table 2.4 presents the first-stage regression estimates. Regression (1) shows that the ethnicity-specific migration network measured at the ward level significantly predicts household-level male outmigration, with an F-statistic of 2502.76, which is well above the Stock and Yogo (2005) recommended critical values for rejecting the possibility of weak identification. In regression (2), rainfall measured as a district-level z-score significantly predicts an increase in household-level outmigration, with an F-statistic of 9.62. On the other hand, regression (3) shows that a rainfall shock decreases male outmigration by 0.027. The results demonstrated in Table 4 are consistent with previous findings and the argument made by Dustmann et al. (2017) and

Chalfin (2013) that favorable rainfall enables potential migrants to cover high upfront costs, while an extreme rainfall shock imposes real binding constraints on potential migrants, reducing their migration.

Regression (4) shows that both the ethnicity-based migration network and rainfall are strong instrumental variables. Because rainfall rather than rainfall shock is a stronger instrument, we employ rainfall and migration network as our instruments in the main analyses. Having two instruments also enables us to test the exogeneity of our instruments using an overidentification test.

2.4.3 Instrumental Variable Estimation Results and Interpretation

<Table 2.5 to be Inserted Here>

Table 2.5 presents the 2SLS estimates on the effect of male household member outmigration on women's employment and employment type. Regression (1) shows that having male outmigrants in households is positively associated with women's employment, although it is not significant. Regressions (2) and (3) show that having male outmigrants in households does not affect the likelihood that women will work for family or someone else. However, regression (4) shows that compared to married women in households without male outmigrants, married women in households with male outmigrants were 5.6 percentage points more likely to report that they were self-employed.

This result is plausible if we consider the possibility that remittances alleviate liquidity constraints, thus allowing married women in households with male outmigrants to start their own small-scale businesses, where they remain self-employed. Additionally, the direction of the

estimates in regression (3) indicates that married women in households with male outmigrants retreat from the labor market, which is consistent with findings from the previous studies by Chen (2006), Lokshin and Glinskaya (2009), Slavchevska et al. (2016), and Kar et al. (2018).

The results from the 2SLS estimation are contrary to the OLS results, where male outmigration is positively associated with the likelihood that women work for family and negatively associated with the likelihood that women are self-employed. Addressing endogenous selection into migration, the 2SLS estimate shows that male outmigration actually increases women's probability of being self-employed rather than working at a family business. Hansen's J-test statistics presented in Table 2.4 also imply that male outmigration affects women's employment type only through the absence of male labor and remittances and not through local labor market conditions.

<Table 2.6 to be Inserted Here>

Table 2.6 presents the instrumental variable regression estimates on the effect of male outmigration on women's empowerment. It shows that married women in households with male outmigrants were 24.9 percentage points less likely to be in a polygamous relationship. As we restricted the sample to women who were already married in 2006, the result can be interpreted that some polygamous unions became monogamous due to absence of men.

Regression (2) shows that unlike Kar et al. (2018), we do not find a statistically significant impact on the probability that married women own a bank account. However, regression (3) shows that married women in households with male outmigrants were 8.2 percentage points more likely to report having a final say on matters related to their own healthcare. While the instrumental variable estimates for polygamy and final say in own healthcare are in the same direction as the

OLS estimates, the magnitude is larger in the case of the former. This indicates that endogenous selection into migration leads to biased results in the OLS estimates.

While we observe empowering effects on issues related to polygamy and own healthcare, the results also show a disempowering effect on visits to family or relatives. Regression (5) shows that married women in households with male outmigrants were 6.3 percentage points less likely to report having a final say on visits to family or relatives. We further explored whether this had anything to do with married women living with in-laws because living in an extended family setting reduces married women's bargaining power (de Hass and Rooij, 2010; Sinha, Jha and Negi, 2012). The last column in Table 6 indicates that compared to married women in households without male outmigration, married women in households with male outmigration were 11.1 percentage points more likely to be living with in-laws, which in turn could have reduced their bargaining power on matters related to visiting family or relatives.

2.4.4 Internal Migration and Outmigration

In Nepal, internal migration is as prevalent as international migration. Domestic migrants are usually hired as temporary workers at farms for several months during a busy farming season. Domestic migrants also head for Kathmandu, the capital city of Nepal, to work as temporary workers and prepare for outmigration at the same time. This subsection examines the impact of internal migration as well as male outmigration for two reasons. Internal migration serves as a preparation stage for outmigration, and the economic conditions and preferences for internal migration and outmigration are very likely to be correlated. In these cases, not controlling for internal migration could cause omitted variable bias in our estimates. In addition, the impact of internal migration itself could be of interest.

<Table 2.7 to be Inserted Here>

We employ rainfall and ethnicity-based network for internal migration and outmigration as our instruments[13] to address the endogeneity of male household members' internal and outmigration. Table 2.7 demonstrates the impact of internal and external migration on employment outcomes for the women left behind. It shows that controlling for internal migration does not affect the probability that women work for family members or for someone else. However, the probability to be self-employed becomes nonsignificant when we control for internal migration. Internal migration affects women's employment by lowering self-employment and increasing the probability of working for family members. This suggests that male household members' internal migration may drive women to compensate for their absence and that remittance income from internal migration is not large enough to alleviate liquidity constraints.

<Table 2.8 to be Inserted Here>

Table 2.8 shows that the impact of outmigration on women's empowerment remains the same when we control for internal migration, although the impact has a smaller magnitude. Regression (1) shows that married women in households with male internal migrants are 15.8 percentage points less likely to be in polygamous relationships. They are also 9.0 percentage points more likely to report having a final say on matters related to their own healthcare. However, male member's internal migration has no significant impact on women having a final say on visiting their family or relatives. Regression (6) shows that internal migration does not significantly promote cohabitation with in-laws, while outmigration does. This finding supports our conjecture that cohabitation with in-laws due to male outmigration has a disempowering impact on the women

[13] The first-stage F-statistic is 397.15.

left behind.[14] Note that Table 2.9 to Table 2.12 provide the IV estimates for the entire sample of married women. The estimates do not differ except for self-employment being insignificant.

2.5 Conclusion

Outmigration is a prevalent and increasing trend in many developing countries. We examine the impact of outmigration in Nepal, where migration is mostly dominated by male household members. Male outmigration unexpectedly affects women's agency in households through increased income and male absence. Utilizing rainfall and ethnicity-specific migration network as instrumental variables for male outmigration, we find that male outmigration increases women's self-employment. Women in households with male outmigration are also less likely to report being in a polygamous relationship and more likely to report having a final say on their own health care.

[14] Since we have multiple outcome variables, a q-value may be more appropriate than p-value. We address false Discovery Rate (FDR) in multiple hypothesis testing using Bonferroni correction. In the case of polygamy, final say on own healthcare and cohabitation, the estimates are significant at 1%, so we do not have to worry about these. In the case of having final say on visit to family or relatives, we may not be able to reject the null hypothesis. In this case, the results imply that more income (from remittances) and male absence may not empowerment women in terms of their freedom to visit family or relatives. So, the impact of male outmigration on women's empowerment is not something guaranteed and that it depends on context (cohabitation with in-laws).

Although we cannot identify whether the impact of male outmigration is through remittances or male absence, it is very likely that women's self-employment increased due to relaxed capital constraints, while polygamy decreased due to male absence. We also report that male outmigration disempowers women by increasing cohabitation with in-laws and decreasing their mobility to visit their family or friends.

Given the high unemployment rate and low income per capita, male-dominated outmigration will continue to be a defining feature in Nepal, and remittances will continue to play a major role in supporting household consumption and the economy (Sapkota, 2013). Women will continue to play a crucial role in managing household chores, economic activities and child-rearing, including decision-making concerning the children's education and training. Against this backdrop, technical and vocational education and training to promote women's entrepreneurship and decision-making would contribute to their empowerment and employability. Policies that facilitate linkages between production by self-employed women and local supply chains would increase women's access to markets and income. Similarly, promoting women led local self-help groups as well as community support programs while initiating development projects at the local level will help in empowering women, especially in promoting their freedom of mobility to visit friends or relatives. Legally mandated political representation may also help to enhance mobility and bargaining power of women. It is worth noting here that the Nepali constitution promulgated in 2015 mandates 33% women representation in federal parliament and a minimum 40% representation in local governments.

Chapter 3

Household and Public Responses after the 2015 Gorkha Earthquake

3.1 Introduction

The frequency of natural disasters such as earthquakes, extreme droughts and monsoons, floods, mudslides, hurricanes, cyclones and wildfires has increased due climate change (Liu, Linde and Sacks, 2009; McGuire, 2016). It has resulted in humanitarian, environmental, infrastructural and health crises. Baez, de la Fuente and Santos (2010) argue that natural disasters negatively affect lives and properties, nutrition intake, education, health and income-generating processes. In additional to these direct effects, there are indirect effects too— fiscal constraints, general equilibrium effects on prices and earnings, higher poverty levels, and tighter household budget constraints.[15]

Nepal lies in one of the most seismically active regions in the world and remains vulnerable to earthquakes caused by the collision between the Indian and the Eurasian continental plates in the Himalaya (Wei-Hass, 2019). A catastrophic 7.6 magnitude earthquake on 25 April 2015 resulted in widespread loss of lives and properties, disrupted public infrastructure and services, and dented economic growth. Households respond to these events by adjusting their labor hours in favor of household work or by switching employment to high paying jobs in construction sector. Displacement from residency is also common in case of housing damage and disruption to regular healthcare services is likely due to the destruction of public assets such as hospitals and clinics. The government tends to transfer funds to households to help them cope with short-term shocks to income or consumption.

[15] See Baez, de la Fuente and Santos (2010) for a review of the impact of natural disasters.

In this paper, we study the effect of the 2015 earthquake on private and public coping strategies in response to death of household member and loss of property. To address the endogeneity of severity of housing damage, we utilize distance of ward from the epicenter of the earthquake as instrumental variable. The variation in ward distance from the epicenter would affect our outcome variables only through the severity of housing damage.

Baez, de la Fuente and Santos (2010) show that although there is ample literature on the impact of natural disasters on a range of outcome variables over medium to long run, there are limited studies on the impact of a large earthquake on private and public coping strategies, especially in response loss of properties or lives, in the short-term. Households reduced consumption after the Kobe earthquake and their most common risk-coping mechanism was private and public transfers (Sawada and Shimizutani, 2008). Kirchberger (2017) finds a positive effect on labor market after the 2006 Yogyakarta earthquake in Indonesia, particularly the agricultural wage growth was higher and that wages across sectors converged rapidly. This was primarily due to the shift of workers from agricultural sector to construction sector or non-tradable sectors. It in turn raised marginal product of labor in the agricultural sector.

The prospect of higher earnings across high growth sectors as well as lucrative jobs in non-tradable sectors such as construction might also reduce migration from the earthquake-affected areas. Hilliday (2006) finds that there was a substantial decrease in net migration to the US after the 2001 earthquake in El Salvador, primarily due to the retention of labor within households for either household related work or post-earthquake related reconstruction work.[16] Earthquake also

[16] Yang (2008) contends that the slowdown in migration may be due to costly access to credit and disruption to intra-household assistance networks that usually facilitate migration.

affects education attainment over the long-term. In an assessment of the long-term impact of the 1998 earthquake in Nepal's eastern region, Paudel and Ryu (2018) find that infants born in the severely affected districts were 13.8% less likely to complete middle school and 10% less likely to complete high school.[17] Caruso and Miller (2015) show that children born to women that were exposed to the 1970 Peruvian earthquake during pregnancy had lower education attainment compared to children whose mothers were not exposed to the earthquake.

Nepal was highly commended by the international community for its swift and fairly well coordinate response after the earthquake. Specifically, the swift response of security forces, the government's appeal for international assistance within few hours of the disaster, immediate mobilization of trained medical personnel as well as volunteering efforts in coordination with local administrations were considered to be the strongest aspects of post-earthquake rescue and relief operations (NPC, 2015; Mullan, 2015). Park and Wang (2017) find that the overwhelming government response and subsidies to households after the 2008 Wenchuan earthquake in China increased mean income per capita and reduced poverty rate in the earthquake-affected areas. In Ache of Indonesia, although poverty headcount rate increased after the tsunami, the likelihood of escaping poverty increased by 23% to 43% when households received government and NGO aid (World Bank, 2008). Gignoux and Menendez (2016) show that well-designed post-earthquake

[17] Note that the earthquake occurred near the Nepal-India border, measured 6.7 magnitude on the Richter scale, severely affected just three districts, and killed 721 people. In this study, we provide the first census-based empirical assessment of the impact of the earthquake by analyzing the short-term effect of a much stronger and catastrophic earthquake that occurred in the mountain region and affected nearly half of the districts of Nepal.

interventions in terms of public transfers and quick replacement of the stock of productive capital such as rural roads and electrification contributed to income and welfare gains over the medium and long term despite short-term losses in Indonesia.

There is scant literature on short-term private and public responses after an earthquake. To the best of our knowledge, there exists almost no literature regarding household and public responses by type of damage, i.e. life and property loss due to the earthquake. In this paper, we use a unique housing census conducted after the earthquake to evaluate the impact of severity of housing damage on change in school enrollment (or school dropout), change in getting pregnancy checkup, change in child immunization, change in employment (change or quit job), and change in residency (displacement from house). We believe the main contribution of the study is that it provides the first census-based household level evidence of the effect of the 2015 earthquake on public and private responses. Furthermore, it is also the first paper to evaluate private response by type of damage— loss of lives or properties.

Our empirical evidence shows that severity of housing damage does not statistically affect the change in school dropout, change in pregnant women getting regular checkup, change in immunization among children, and change in employment (quitting or changing job). However, we find evidence that the severity of housing damage affects public transfers and the likelihood of being displaced from own house. Moreover, controlling for house fixed effect and public transfers, we show that having a head or injured household member affects change in school dropout and change in employment. Our results imply that the large public transfers and rapid restoration of public infrastructure and services might have offset the expected negative effect during the short-term.

The remainder of the chapter is organized as follows: Section 3.2 provides and overview of the 2015 Gorkha earthquake. Sector 3.3 provides an overview of data and summary statistics. Section 3.4 focuses on the instrumental variable identification strategy, house fixed effects and the relevant estimation results. Section 3.5 discusses conclusion and highlights relevant policy implication.

3.2 Overview of the Gorkha Earthquake

A 7.6 magnitude earthquake struck Nepal on 25 April 2015 at 11:56 local time. The epicenter was at Barpark, about 76 kilometer northwest of Kathmandu, in Gorkha district.[18] There were numerous aftershocks, including 6.7 magnitude in April 26 and 7.3 magnitude in May 12, that affected the central and western hilly and mountainous regions. According to post disaster needs assessment (PDNA) prepared by National Planning Commission (NPC, 2015), 9,000 people were dead and 22,309 injured due to the earthquake. 602,257 private houses were fully damaged and 285,099 private houses were partially damaged. Furthermore, public buildings fully and partially damaged totaled 2,673 and 3,757, respectively. To prioritize rescue and relief operations based on the severity of damage, the government declared 14 districts as severely affected and an additional 17 as affected. Over 95% of death and injury occurred in the 31 districts (Figure 3.1).

<Figure 3.1 to be inserted here>

[18] The last time such a powerful earthquake (8.4 magnitude) hit the Kathmandu Valley in 1934, resulting in over 10,000 deaths (NPC, 2015).

The total value of damages and losses caused by the earthquake was about $7 billion, equivalent to 33% of gross domestic product in 2014/15.[19] Of the total estimated disaster related damages and losses, 58% was in social sectors (of which 86% was in housing sector). Productive sectors accounted for 25% of total estimated damages and losses, infrastructure sectors (19%), and cross-cutting issues (7%). Cultural heritage, health, education and housing and human settlements constitute social sectors. Tourism, finance, agriculture, irrigation and industry constitute productive sectors. Water and sanitation, community infrastructure, electricity, transport and communications constitute infrastructure sectors. Cross-cutting issues refer to environment and forestry, governance, and disaster risk reduction.

Post-earthquake rescue and relief operations were swift and coordinated (NPC, 2015; Mullan, 2015). While Nepali security forces were in action already immediately after the earthquake, the Indian National Disaster Response Force, Indian Air Force, and Indian Army Medical Corps arrived for search and rescue operations within hours. Altogether 134 teams from 34 countries joined the operations. Over 90% of the Nepali security forces were reassigned to rescue and relief operations. Similarly, 22,500 civil servants and 4,000 government and private healthcare workers were also mobilized to aid rescue and relief operations. International donors pledged about $4.1 billion for post-earthquake reconstruction in June 2015.

According to National Reconstruction Authority, of the 1,197 hospitals and clinics damaged (544 completely and 653 partially), over 60% were reconstructed (either prefabricated

[19] Post-Disaster Recovery Framework (PDRF) prepared in May 2016 re-estimated it to be $8.38 billion (NRA 2016).

structures or retrofitting existing buildings) by 2016/17.[20] Follow-up treatment of the injured, resumption of health services, and adequate supply of drugs and medical necessities were the first priority in healthcare sector as a part of post-earthquake reconstruction efforts (Aguayo, Sharma and Raj, 2015). A network of volunteers and non-government organizations also swiftly worked to aid the operations. The government noted, in the PDNA, the crucial role played by youth volunteers and professionals such as doctors and engineers in treating the injured people, setting up temporary shelters and supplying essential food and healthcare needs. The opportunity to build back better public and private infrastructure after the earthquake contributed to a large extent to boost overall economic activities (IMF, 2019). However, loss of household member could lead to lower education attainment (Cas et al., 2014) and higher child labor (Caruso, 2017) as they readjust available hours to household work. There are reports of children missing school to complete household chores such as fetching water from the nearest well, which takes about two to three hours, and child labor in brick factors as demand for bricks increased as reconstruction picked up.[21]

3.3 Data and Summary Statistics

The Household Registration for Housing Reconstruction Program was conducted in 2016/17 to identify beneficiaries of the housing support program in the 31 earthquake-affected

[20] According to National Reconstruction Authority's progress report in 2016/17, the total number of health facilities in the country is 4,506. These include hospital, primary health post, health post, ayurvedic dispensaries, and sub-health post. About 84% are health posts.

[21] https://www.cbc.ca/news/world/nepal-earthquake-anniversary-children-sasa-petricic-1.3548955

districts.[22] It was also a precondition for donor supported housing grants and social protection schemes. All earthquake-affected residential houses and the households residing there were surveyed, essentially making it a census of all houses damaged by the earthquake.[23]

The data includes information about casualty and injury, socio-economic condition of the households, details about damaged buildings, and changes to educational, health and employment outcomes after the earthquake. Unlike self-reported information about severity of property damage in the existing literature, the post-earthquake housing census in Nepal includes information about housing damage independently assessed by trained surveyors (including engineers). In addition, it includes information about losses to lives at the household level. Most of the existing literature employ aggregated regional level data on losses to lives and properties. Finally, the census documents household level changes in school enrollment, employment, and access to healthcare that are directly attributable to the earthquake.

[22] The housing census covers 1.036 million households in the 31 earthquake-affected districts. It is almost 50% of the total number of households in population census in 2011.

[23] Specifically, the CBS used census method in 11 districts and rural areas of Lalitpur district. These were Okhaldhunga, Sindhuli, Ramechhap, Dolakha, Sindhupalchok, Kavrepalanchok, Rasuwa, Nuwakot, Makawanpur, Dhading, and Gorkha districts. Verification method was used in municipal areas of Kathmandu, Lalitpur and Bhaktapur districts, and the rest of the 17 districts, i.e. information was collected from the households that enlisted their house as being damaged by the earthquake and was certified by local or municipal authorities. This essentially makes the survey a census of all houses destroyed or damaged by the earthquake.

The government classified damage to houses in five grades. The first two grades are classified as habitable as the load carrying capacity of houses is not reduced appreciably. The next three grades are labelled as severely damaged, as they would require significant structural repair or are totally collapsed. Accordingly, we consider the last three categories of the condition of a house as severely damaged. Figure 3.2 shows the geographical distribution of destroyed houses by damage categories. The houses closer to the epicenter of the earthquake generally have higher damage grade, i.e. they are uninhabitable.

<Figure 3.2 to be inserted here>

The housing census was done primarily to collect information about the severity of housing damage so that the government could efficiently target public transfers and reduce fiscal leakages. It does not include the wide range of outcome variables related to health, demography and human capital examined in the literature. However, it includes retroactive questions on changes to certain outcome variables directly attributable to the earthquake. First, the household head was asked if any student attending up to grade 10 dropped out of school due to the earthquake. This variable indicates household's coping behavior, particularly the adjustment of labor hours for household work or security concerns arising from continued aftershocks and the destruction of public infrastructure. The second question related to household coping behavior is if any household member aged 10 or above had to quit or change job due to the earthquake. Third, questions related changes to healthcare include quitting regular pregnancy checkup for pregnant woman and missing regular immunization of children below 5 years of age. These variables indicate household's response to the impact of the earthquake.

Fourth, a question related to displacement from house or ward was also asked to the head of the household. Finally, we look at the total earthquake-related public transfers received by households, indicating the government's response after the earthquake. It amounts to a maximum of Rs78,000 up to the survey date.[24] To put the transfers in perspective, about 85% of the households in the earthquake affected districts had average monthly income below Rs20,000, and that the per capita GDP in 2017 was Rs93,141.

The literature largely indicate a worsening of these outcome variables due to natural disasters (Hilliday, 2006; Sawada and Shimizutani, 2008; Baez, de al Fuente and Santos, 2010; Bustelo, Arends-Kuenning and Luchetti, 2012). We expect similar effect in Nepal after the earthquake. However, in the case of large-scale public transfers and restoration of public infrastructure and services, we may not see the expected effect on the outcome variables (Gignoux and Menendez, 2016; Park and Wang, 2017; Kirchberger, 2017).

Table 3.1 presents summary statistics. We can observe that in the 31 earthquake-affected districts, households with severely damaged houses reported larger changes in school dropout, missed regular pregnancy checkup and child immunization, and quit or change jobs. They also had larger change in displacement from house. Similarly, households with severely damaged houses received more public transfer than those with partially damaged houses. Note that the changes in

[24] These include victim relief cash grants immediate assistance to cover basic housing expense for displaced households, grant to purchase clothing and blankets to get through the winter season, additional social security allowance, and first installment of housing reconstruction grant. If we include emergency grant to cover funeral costs, then the maximum grants received up to the survey date would be Rs111,000.

the outcome variables are attributed directly to the earthquake. It must have changed after the earthquake and have stayed that way until the survey date.If there was a change after the earthquake but things returned back to normal by the survey date, then the survey does not consider that to be a change.

Note that the numbers in Table 3.1 reflect the changes in the outcome variables due to the earthquake for the first five variables. Another way to interpret it is that 6.9 households per 1000 households that had partially damaged houses reported that students attending up to grade 10 dropped out of school[25] due to the earthquake. Among the households with severely damaged houses, it was 9.1 per 1000 households. Similarly, while 0.7 households per 1000 households that had partially damaged houses reported that a pregnant woman had to quit going to regular checkup due to the earthquake, it was 1.1 per 1000 households among those with severely damaged houses. 1.2 in every 1000 households with partially damaged houses reported a child below 5 years had to miss taking regular immunization due to the earthquake. It was 1.3 per 1000 households with severely damaged houses. Likewise, for quitting or changing a job due to the earthquake, it was 1.3 per 1000 households with partially damaged houses but 7.2 per 1000 households with severely damaged houses. While 135 per 1000 households with partially damaged houses reported being

[25] To put the numbers in perspective, net enrollment rate at basic education level (Grade 1 to 8) and secondary level (grade 9-12) was 93% and 43.9%, respectively, in 2016. Primary education was free and compulsory in Nepal in public schools. Since 2016, the government extended this up to the basic education level. However, the country lacks effective mechanism to implement the mandatory provision.

displaced from house due to the earthquake, it was 664 per 1000 households with severely damaged houses.

Table 3.1 also shows that, on an average, households with severely damaged houses received 2.5 times more public transfers than the one received by households with partially damaged houses. There is not much difference between the age of household head and household size too between the households with severely damaged and partially damaged houses, but age of house in severely damaged category is slightly higher than in partially damaged category. The number of dead and injured is much higher among severely damaged houses than partially damaged houses.

3.4 Empirical Evidence About The Impact of Property Damage

3.4.1 Ordinary Least Squares and IV Estimation

To examine the relationship between the severity of housing damage by the earthquake and the outcome variables, we estimate the following regression:

$$Y_{ihrd} = \beta_1 + \beta_2\, Damage_{ihrd} + \theta\, X_{ihrd} + District_d + \epsilon_{ihrd} \quad (1)$$

Here, i indexes a household living in a house h, and r indexes a ward in an earthquake-affected district d. Y_{ihrd} is a vector of outcome variables— change in school enrollment (school dropout) due to the earthquake; change in getting pregnancy checkup due to the earthquake; change in child child's regular immunization due to the earthquake; change in employment (quit or change job) due to the earthquake; change in residency (displaced from house) due to the earthquake; and public transfers. $Damage_{ihrd}$ represents a dummy for household with severely damaged house. X_{ihrd} represents a vector of control variable such age of house, age of household head, education of household head, household size, ward level population prior to the earthquake, house

foundation[26] or ethnicity fixed effects. These control variables are predetermined and thereby exogenous. $Damage_d$ represents district fixed effect. The fixed effects control for overall house structure, ethnicity, and district level factors, respectively, that may influence the variation in outcome changes that are correlated with initial household-level differences. We cluster errors,ϵ_{ihrd}, at the ward level.

Table 3.2 provides ordinary least squares (OLS) estimates related to specification (1). It shows that households with severely damaged houses are more likely to report that someone from the household attending up to grade 10 dropped out of school due to the earthquake. Similarly, pregnant women from households with severely damaged houses are more likely to miss regular pregnancy checkup and members of the household are more likely to either quit their job or change job due to the earthquake. They are also more likely to be displaced from their house but receive larger public transfers.

Here, although the earthquake was completely unanticipated and so the severity of housing damage, we cannot fully rule out endogeneity concerns, which means our OLS estimates may be biased. Omitted variable bias could confound results due to unobserved household level or ward level characteristics. It is likely that poorer households are more vulnerable to housing damage due to the earthquake owing to the quality of their housing (especially, un-reinforced masonry houses).

[26] The damage to a building vary depending on whether the foundation of the house is made up of fired brick/stone in mud, fired brick/stone in cement, reinforced concrete pads, and bamboo/timber posts.

Kirchberger (2017) argues that due to low quality of houses poorer households suffered relatively more housing damage after the 2006 earthquake in Yogyakarta, Indonesia.

To control for the potential endogeneity of severity of housing damage, we construct an instrument variable related to distance of ward from the epicenter of the earthquake, which is also employed by Park and Wang (2017) in a similar study in China. We estimate the centroid of each ward from the official ward-level administrative GIS map and then compute the distance to the epicenter based on WGS 84/UTM zone 45N projected coordinate reference system[27]. There were 1,435 wards in the 31 earthquake-affected districts. We were able to match 99.5% of the wards from the GIS map to the wards covered in the Household Registration for Housing Reconstruction Program survey (Figure 3.3).

<Figure 3.3 to be inserted here>

The geographical characteristics (distance of ward from the epicenter of the earthquake) could be related to level variables such as school enrollment, employment and access to healthcare. However, it is unlikely that the ward distance from the epicenter directly affects changes in those variables unless there was an earthquake. Specifically, it does not directly affect the changes in school enrollment (school dropout), health outcomes (change in getting pregnancy checkup and

[27] WGS stands for World Geodetic System and it provides geo-coordinates for locations in Earth. WGS 84 is the latest revision to the coordinate system and is used by the Global Positioning System (GPS). Universal Transverse Mercator (UTM) coordinate system assigns horizontal geographical coordinates to specific locations by treating the Earth as a perfect ellipsoid. The Earth is divided into 60 time zones, which are then projected to a flat plane. For location coordinates in Nepal, 45 North zone is recommended. https://epsg.io/32645

child immunization missed), change in employment (quit or change job), change in residency (displacement from house) and public transfers. Meanwhile, it is closely related to the severity of housing damage by the earthquake. We estimate the following equation as first stage estimation:

$$Damage_{ihrd} = \alpha_1 + \alpha_2\, Distance_{rd} + \rho\, X_{ihrd} + District_d + \varepsilon_{ihrd} \qquad (2)$$

Column (1) in Table 3.3 shows that ward distance from the epicenter, $Distance_{rd}$, significantly predicts the severity of housing damage with an F-statistics of 36.89, which is well above the Stock and Yogo (2005) recommended critical values for rejecting the possibility of weak identification. It indicates an inverse relationship between ward distance from the earthquake's epicenter and severity of house damage. Specifically, 100 kilometers farther from the epicenter reduces the likelihood of a house being severely damaged by 21.6 percentage points.

The results from IV estimation in Table 3.3[28] differ from the OLS estimation in Table 3.2. Specifically, the OLS estimation shows that the severity of housing damage significantly affects change in school dropout, change in pregnancy checkup, change in employment, and displacement from district. However, the IV estimation that addresses endogeneity of housing damage shows no significant effect of housing damage on these outcome variables. The no impact on the outcome variables may indicate that public transfers between households with severely and partially damaged houses were fairly distributed. Meanwhile, the OLS and IV estimation results regarding public transfer and displacement from house are similar but the latter has larger magnitude. The

[28] We ran the same estimation for a subsample excluding households that had migrated out of ward or district. The results do not change notably. As for reference, less than 5% of the households reported change of residence after the earthquake.

results imply that households with severely damaged houses are likely to receive 1634% more transfers than households with partially damaged houses. Similarly, household with severely damaged houses are cent percent likely to be displaced from house.

Columns (2) to (8) in Table 3.3 presents the instrumental variable estimates of the effect of severity of housing damage on the outcome variables. The results indicate statistically insignificant effect on change in school dropout, change in pregnancy checkup, change in child immunization, and change in employment (quit or change job). However, severity of housing damage affects public transfers and displacement from house. The positively significant relationship between severity of housing damage and government transfers is consistent with the findings of Park and Wang's (2017) study in China after the 2008 Wenchuan earthquake. Although we find that households are more likely to be displaced from their house if it is severely damaged, we do not find statistically significant result in the case of displacement from ward or district. Vulnerable households typically migrate out of the ward or district after large-scale damage from earthquake. However, they also have an incentive to stay in the same ward to avail the large public and private grants and relief assistance. Our result on displacement is inconsistent with the migration pattern after hurricanes Katrina and Rita in the US (Frey and Singer, 2006) and the Kobe earthquake in Japan (Horwich, 2000), but consistent with the one in Ache in Indonesia (World Bank, 2008) and in El Salvador (Hilliday, 2006; Yang, 2008).

As robustness check, we examine if the severity of housing damage affects the other kind of government transfers (placebo outcomes such as social security related transfer). We estimate the effect of the severity of housing damage on child protection assistance and elderly allowance. The IV estimation in Table 3.4 shows that these outcome variables are not affected by the severity of housing damage.

3.4.2 House Fixed Effects Estimation

Although the number of nuclear households is increasing in recent years, Nepali society is still characterized by an extended family setup, i.e. households tend to live in the same parental house or shared house. This is especially true among rural or poor households. We exploit this setting to estimate the impact of having dead member in household controlling for property damage by house fixed effects. Normally, it is difficult to estimate separately the impact of property damage and loss of household member due to natural disaster. In the case of an earthquake, casualty due to damaged building or house is quite common and the failure to properly control for property damage would lead to overestimation of the impact of the loss of household member. We will need at least two instruments to measure the impact of the two type of losses separately, which may not be always feasible. Hence, we employ house fixed effects to control for property damage. Specifically, among households with same property damage, we estimate the effect of loss of household member on household's coping strategy. It ensures that having dead or injured member in households could mostly be random and that luck, foundation of house, age and other physical characteristics would create the variation across households living in the same house.

We estimate the following house fixed effect specification:

$$Y_{ihrd} = \tau_1 + \tau_2\, Death_{ihrd} + \vartheta\, X_{ihrd} + District_d + House_h + \epsilon_{ihrd} \qquad (3)$$

Here, $Death_{ihrd}$ indicates the existence of dead member in a household i in house h of ward r in district d. $House_h$ refers to house fixed effect. In addition to the controls mentioned above, X_{ihrd} includes public transfers. The estimation in Table 3.5 shows that having a dead household member significantly affects change in school enrollment and change in employment. The results hold even if we include households with dead or injured or both in the regression (Table

3.6). Death or injury of household members could have forced students to drop out of school and individuals to quit or change jobs in order to devote more time to take care of needy household members or to contribute labor to complete household chores.

Although we did not see immediate effect of the earthquake in the previous estimations, the result in Table 3.5 and Table 3.6 indicate symptom of a long-term impact and disruption to household welfare and labor market. In fact, previous studies show an increase in child labor after the earthquake in severely affected areas (Baez, de la Fuente and Santos, 2010; Caruso, 2017). In this case, the potential loss of human capital could be much more pronounced if public support to severely affected households terminate prematurely and that reconstruction of destroyed infrastructure is delayed. Paudel and Ryu (2018) show that the 1989 earthquake in the eastern region of Nepal had long-term negative impact on human capital accumulation. In the short-term, the substantial government transfers[29] immediately after the earthquake and restoration of basic public services including medical services and educational facilities might have offset the expected negative effect of the earthquake on the outcome variables in the immediate term.

3.5 Conclusion

Natural disasters like earthquake affect household's coping strategies and their welfare, public coping stragegy (public transfers), and displacement from residence. We examine household level impact of the severity of housing damage due to the earthquake on change in school enrollment, change in pregnancy checkup, change child immunization, and change in

[29] There were non-governmental transfers too, but these were mostly in-kind in nature or capacity building initiatives to enhance resilience. Private insurance market is immature and is not popular in Nepal.

employment (quitting or changing job). We also examine household response by type of damage—loss of lives or properties. Utilizing distance of ward from the epicenter of the earthquake, we find that the severity of housing damage has statistically insignificant effect on the outcome variables. However, households are more likely to be displaced from their house and at the same time receive large public transfers.

These are short-term effects. Baez, de la Fuente and Santos (2010) argue that without rapid restoration of destroyed physical assets such as schools and public infrastructure, it is likely that the effects will be more pronounced in the long-term. For instance, lack of timely reconstruction of schools affects learning environment. Similarly, delayed reconstruction of public infrastructure such as roads, water supply and electricity lines will hamper factor mobility and income-generating opportunities. The long-term impact also depends on continued public transfers to make up for the income shock suffered by the households and timely restoration of destroyed public infrastructure with better ones— often referred to as 'build back better'— as in the case in Indonesia (Gignoux and Menendez 2016; Kirchberger 2017). For the vulnerable population, well-targeted and flexible social assistance programs (such as conditional cash transfers and public workfare programs) may be more effective.

Although the substantial public transfers might have played a crucial role in offsetting the expected negative effects on the outcome variables, one limitation of this paper is that we cannot disentangle the net effects, i.e., the effects of destruction by the earthquake and the large public transfers. Furthermore, affected households might have received more remittances after the

earthquake that might have helped them cope better with the effects of the disaster.[30] Higher non-governmental transfers might also have contributed to cope better. Due to data limitation, we cannot fully control for the impact from private transfer or savings. These are important to establish a full picture of the immediate effects of the earthquake on health, education and employment related outcomes. With new household surveys, and population and housing census in the offing, this might be an important topic for further research.

[30] Workers' remittances increased from 27.7% of GDP in 2013/14 to 29% in 2014/15 and 29.5% in 2015/16.

Chapter 4

Supplementary Analysis: Impact of the 2015 Gorkha Earthquake on Health Outcomes

4.1 Introduction

This chapter provides supplementary analysis on the impact of the 2015 Gorkha earthquake. Specifically, we examine the short-term effect of the earthquake on adult and child health outcomes. The literature on the impact of natural disasters, including earthquake, shows a negative impact on children and adult health and education outcomes. For instance, earthquakes have increased the risk of low birthweight in China (Tan et al., 2009) and in Taiwan (Chang et al., 2002). Low birthweight has long-term consequences as children with low birthweight are less likely to attend preschool than normal birthweight siblings (Datar, Kilburn and Loughran, 2010). They also tend to have worse outcomes in terms of one-year mortality rates and longer run educational attainment, earnings, IQ, and adult height (Currie and Hyson, 1999; Conley and Bennett, 2000; Black, Devereux and Salvanes, 2007).

Natural disasters also affect nutrition intake among adults and children, resulting in lower body mass index, weight-for-age, weight-for-height, and height-for-age (Baez, de la Fuente and Santos, 2010). For instance, stunting during the prenatal period and the first 24 months after birth is strongly associated with later cognition, executive function, and school attainment (Fernald et al., 2014). The 1999 Colombian earthquake negatively affected child nutrition and schooling in the short-term as the earthquake forced households to decrease their investment in children's human capital (Bustelo, Arends-Kuenning and Lucchetti, 2012).

The effects could be intergenerational too as the exposure to disasters during childhood and infancy (and even *in utero* exposure) has long-term effects on health and educational outcomes

well into adulthood (Almond, 2006; Neelsen and Stratmann, 2011; Currie and Almond, 2011; Caruso, 2017). Women exposed in utero to the Peruvian earthquake in 1970 bore children decades later who suffered lower educational attainment than their peers whose mothers had not been similarly exposed (Caruso and Miller, 2015). In Nepal, Paudel and Ryu (2018) find a negative impact on human capital accumulation among adults exposed to the 1989 earthquake in the eastern region.

A rigorous empirical analysis of the immediate impact of the 2015 earthquake in Nepal remains undocumented so far. The earthquake disrupted not only household consumption, housing and supply chains, but also educational and health condition of children and adults. NPC (2015) provides a general assessment of the effect on all sectors as a part of the post disaster needs assessment done few months after the earthquake. In this paper, we provide the first household survey based empirical evidence on the effect of the earthquake on adult and child health related outcomes, particularly low birthweight, underweight, and body mass index. The data allows us to examine the immediate or short-term effects[31] of the earthquake as the last Demographic and Health Survey (DHS 2016) was completed within two years of the earthquake. Our difference-in-differences based empirical estimate shows that while adults in the treatment districts are more likely to be thin compared to the control districts, there is no statistically significant effect on child underweight and body mass index, and low birthweight among newborn children.

[31] Note that weight-for-age (underweight) and weight-for-height (wasting) reflect short-term effects of malnutrition, but height-for-age (stunting) reflects long-term effects of malnutrition (Baez, de la Fuente and Santos, 2010).

The remainder of the chapter is organized as follows: Section 4.2 discusses survey data, measures of malnutrition, and summary statistics. Section 4.3 focuses on difference-in-differences identification strategy and results. The last section provides concluding remarks and highlights pertinent policy issues.

4.2 Data and Summary Statistics

We use two rounds of nationally representative DHS data (2011 and 2016). DHS 2011 survey was conducted between January and June. DHS 2016 survey was completed within one and a half years after the earthquake (June 2016 to January 2017). The survey includes detailed information on weight-for-age, birthweight and body mass index for children. It also includes information on body mass index for adults. Underweight among children is defined as weight-for-age z-score less than minus two (-2) standard deviations below the mean on the World Health Organization (WHO) Child Growth Standards (Croft, Marshall and Allen, 2018). Meanwhile, a newborn, within 12 months of the survey, weighing less than 2500 grams is considered to have low birthweight. Anyone with a body mass index less than 18.50 is considered thin. The body mass index is calculated as weight in kilograms divided by the square of height in meters.

Choosing indicators that are immediately affected by the earthquake, but also covered in a household survey completed within two years of the earthquake is not an easy task. DHS includes data on nutritional status of children and adults. Since weight-for-age (underweight) and weight-for-height (wasting) reflect short-term effects of malnutrition, but height-for-age (stunting) reflects long-term effects of malnutrition (Baez, de la Fuente and Santos, 2010), we focus on the first two. However, wasting is inconsistent with parallel trend assumption. We also examine the effect on birthweight of newborn children (less than 12 months old at the time of survey). Finally, we look at the effect on body mass index of adults and children, particularly if they are thin.

We expect children to be underweight, newborn to have lower birthweight, and both adults and children to be thin (or lower BMI) in the earthquake-affected areas. This might happen due to the disruption to residential housing, public infrastructure such as roads and hospitals, breakdown of local supply chains, and loss of livelihood (particularly agricultural land as well as harvest). However, the expected negative effects on these outcome variables may not be realized in the case of large-scale, well-targeted immediate relief and assistance packages (Gignoux and Menendez, 2016; Park and Wang, 2017)— by government and non-government sectors— for the affected households.

We restrict our sample to those who have been continuously living in the household even after the earthquake.[32] For children's sub-sample, only those 5 years and younger are included. For low birthweight, the sample includes newborns within the last 12 months of the survey. Adult's sub-sample includes those between 15 and 49 years old. We present summary statistics of relevant independent and dependent variables used in the analysis in Table 4.1. The differences in observable characteristics between control and treatment groups over survey years are relatively minor. We can observe that the proportion of thin adults in treatment group in both 2011 and 2016 is lower than in the control group, but decline was faster in control group. Specifically, while 21%

[32] This restriction is important because migration between treatment and control districts poses a threat to validity of our DID estimates. If households displaced by the earthquake moved to control districts and experienced better outcomes, then it biases our treatment effect estimates downwards. According to the Household Registration for Housing Reconstruction Program survey conducted in 2016/17 (CBS, 2017), less than 5% of the household reported as being displaced from their ward or district of residence after the earthquake.

and 10% of adults are thin in control and treatment groups, respectively in 2011, 10% and 5% are thin in control and treatment groups in 2016. Similarly, the proportion of underweight children is lower in treatment group than in the control group in both the years. In the control groups, 33% of children are underweight in 2011 but 32% in 2016. In the treatment group, 21% of children are underweight in 2011 but 18% in 2016, indicating that the treatment group actually had lower proportion of underweight children after the earthquake.

The proportion of low birthweight children, which is an indicator variable indicating a newborn weighing less than 2500 grams, is higher in treatment group in 2011 but lower in 2016. In 2011, while 12% of newborn in the control group have low birthweight, it is 11% in the case of treatment group. In 2016, 13% of newborn in the control group have low birthweight but 9% in the case of treatment group. Lower proportion of children were thin in treatment group than in control group in both the years. In fact, while the proportion of thin children marginally increased in control group between the two years, it declined in the treatment group.

4.3 Empirical Specification and Results

We employ difference-in-differences strategy to empirically examine the immediate effect of the earthquake on child and adult health outcomes, particularly underweight, birthweight and body mass index (or thin). The intensity of earthquake varies with topographical features and its distance from the epicenter, potentially making the impact on our outcome variables idiosyncratic even within small geographical areas. The earthquake was completely unanticipated. We compare the outcome variables before and after the earthquake among the residents of districts affected and not affected by the earthquake. Our main regression specification is the following equation:

$$Y_{irdt} = \beta\ Post_t + \alpha\ Treat_{rd} + \partial\ Post_t * Treat_{rd} + \ \theta'\ X_{irdt} + \varepsilon_{irdt}$$

Here *i* indexes an individual, *r* indexes ward in district *d* and *t* indexes the two DHS survey rounds. $Post_t$ is difference-in-difference dummy that is equal to one in the time period after the earthquake (2016) and zero before the earthquake. $Treat_{rd}$ is a dummy variable with value equal to one if the district was affected by the earthquake (31 earthquake-affected districts in total) and zero otherwise. The coefficient of interest ∂ identifies the impact of the earthquake, i.e. the difference between the treatment and control groups that is attributable to the earthquake. X_{irdt} includes a range of individual, households and region-level characteristics such as urban indicator, education (mother's education for outcome variables related to children's sample), age, age squared, household size, and household income. We also control for time-invariant ethnicity-specific and district-specific characteristics by including ethnicity and district fixed effects. Wealth fixed effects are also controlled for. The errors, ε_{irdt} , are clustered at the year-ward level.

We present the estimation results in Table 4.2. It shows no effect on children underweight, lower birthweight and thin. In other words, individuals living in the earthquake-affected areas had, on average, statistically indistinguishable outcomes from those living in the control areas. However, adults in treatment districts are more likely to be thin. Specifically, adults in treatment districts are 6.4 percentage points more likely to be thin. It is understandable that adults in earthquake-affected districts are likely to be thin because of disruption to agriculture production, housing, and availability of food products, among others that affect nutrition intake. Similarly, we expected to see some effect on children's health related indicators, but the regression results do not show statistically significant effect.

Two factors might have been at play here. First, children and maternal healthcare might have been the primary focus and that resources were either diverted from elsewhere or/and additional resources were devoted for this purpose. Second, nutrition intake of the adults might

not have been a top priority (for government, non-government and donor assistance) or that adults consumed less nutritious food to provide enough for their children. This probably explains why we do not observe deterioration in many of the children healthcare related indicators in the treatment districts immediately after the earthquake. There was a particular focus on restoring maternal and child healthcare services immediately after the earthquake, and this was indicated as a priority in post-earthquake reconstruction and recovery strategy/framework (NPC, 2015; NRA, 2016). The government covered all medical expenses irrespective of treatment in public or private hospitals. Resources were transferred from other districts and/or increased by the government to the earthquake affected areas to ensure that basic healthcare and educational infrastructure and services are up and running (see Figure 4.1). Similarly, INGOs and NGOs too mobilized large amount of resources in these areas (see Figure 4.2).

<Figure 4.1 to be inserted here>

<Figure 4.2 to be inserted here>

The government also provided immediate cash grants to the earthquake-affected households. These were emergency grants to cover funeral costs (Rs30,000) for those households that lost a member; Rs15,000 for household with fully damaged house; and Rs3,000 for households with partially damaged house. A majority of the households received Rs15,000 in the severely affected areas (TAF, 2016). These cash grants were distributed through the local governments. The government gave an additional Rs10,000 cash grant to all households to purchase clothing, blankets and fuel to get through the winter season in 2015. In October 2016, the government started providing Rs300,000 (in three installments of Rs50,000, Rs150,000 and Rs100,000) to the earthquake-affected households to rebuild damaged buildings. Furthermore, an additional Rs3,000 was distributed as social security allowance.

A key identifying assumption in difference-in-differences identification strategy is that outcome trends would be the same in both control and treatment groups in the absence of treatment, and that the treatment (earthquake shock) induces a deviation from the common trend. Figure 4.3 shows DID graphs of the mean of the outcome variables for three survey periods (2006, 2011 and 2016). The parallel trend assumption is satisfied in the case of underweight, low birthweight and body mass index for children, and thin for adults.

We also inspect if there was any heterogeneous treatment effect, especially on gender. Table 4.3 shows that although the results are pretty much the same for both gender, male children in general are less likely to have low birthweight and but more likely to be thin. Specifically, male children are 11.9 percentage points less likely to have low birthweight and that they are 6.6 percentage points more likely to be thin. The effect is not statistically significant for the rest of the outcome variables like in the regression for the whole sample for children in Table 4.2.

4.4 Conclusion

In addition to negatively affecting lives and properties, nutrition intake, education, health and income-generating processes, natural disasters such as earthquake also affect fiscal stability, inflation, poverty, and household budgets. As a supplementary analysis to the study covered in chapter 3, we examine the immediate impact of the catastrophic 7.6 magnitude earthquake that struck Nepal on April 25, 2015 on child and adult health outcomes. The difference-in-differences estimation shows that while adults are more likely to be thin immediately after the earthquake in the affected areas there is no statistically significant effect on child health outcomes related to malnutrition.

Although due to data limitation we cannot pinpoint the exact mechanism for the observed results, it is very likely due to the massive relief operations and assistance to affected households, and prompt restoration of public infrastructure, particularly health services. However, this does not imply that the results will hold over the long-term too. In the absence of sustained resumption of services and reconstruction of public infrastructure, the long-term consequences may still be worse as seen in other countries. For instance, older children completed fewer years of school because of the necessity to shoulder in parental responsibilities after their parents died due to the 2004 Indian Ocean tsunami in Indonesia (Cas et al., 2014). Paudel and Ryu (2018) find a negative effect on human capital accumulation among children affected by the 1989 earthquake in the eastern region. Hence, resilient and sustained restoration of public infrastructure and services—adhering to 'build back better' principle—, and income generating activities are crucial to ensure continued progress in adult and child health outcomes in the earthquake-affected areas.

Chapter 5

Conclusion

This dissertation examined the impact of two prominent features of Nepali economy—outmigration and natural disaster. First, it examined the effect of male outmigration on women's employment and empowerment. Second, it examined private and public coping strategies in response to loss of lives and properties due to the 2015 earthquake.

Given the high unemployment rate and low income per capita, male-dominated outmigration will continue to be a defining feature in Nepal and remittances will play a crucial role in supporting household consumption and macroeconomic stability. Meantime, women will continue to play a crucial role in managing household chores, economic activities and child-rearing. A key motivation for the second chapter was to understand this dynamics using empirically rich analysis.

Meantime, Nepal is also particularly prone to natural disasters such as earthquakes as it lies in one of the most seismically active regions in the world. Periodically yet unexpectedly occurring large earthquakes take a huge toll on lives and properties, disrupt public infrastructure and services, dent economic growth, and affect nutrition intake and human capital accumulation over varying time horizons. Households respond to such natural shocks by adjusting labor hours in favor or household work or by switching employment to high paying jobs during the reconstruction phase. Against this backdrop, a key motivation for the third and fourth chapters was to understand the short-term effects of the 2015 earthquake on private and public coping strategies, and on adult and child health outcomes.

5.1 Male Outmigration and Women's Employment and Empowerment

In chapter 2, we examined how male outmigration affected women's employment and empowerment in Nepal. We addressed endogeneity of male outmigration using ethnicity-specific migration network and favorable rainfall shock as instrumental variables. Our empirical evidence shows that married women in households with male out-migrants are more likely to be self-employed. These women are also less likely to be in polygamous relationships and more likely to have the final say on their own health issues. However, further investigation demonstrated that these women are less likely to have freedom to visit their family or relatives, which is probably due to increased cohabitation with their parents-in-law. Although we could not identify whether the impact of male outmigration is through remittances or male absence, it is very likely that women's self-employment increased due to relaxed capital constraints, while polygamy decreased due to male absence. Moreover, male outmigration probably disempowered married women by increasing cohabitation with in-laws and decreasing their mobility to visit their family or friends.

Since women will continue to play a crucial role in managing household chores, economic activities and child-rearing, policies that promote technical and vocational education and training that enhance women's entrepreneurship and decision-making ability would contribute to their empowerment and employability. Furthermore, policies that facilitate linkages between production by self-employed women and local supply chains would increase women's access to markets and income.

5.2 Effect of the 2015 Gorkha Earthquake

In chapter 3, we examined the coping strategies of households and government in the aftermath of the earthquake on 25 April 2015. We used a unique census of all houses destroyed by

the earthquake to investigate empirically the household level impact of severity of housing damage and loss of lives or injury in household on change in school enrollment, change in pregnant women getting regular checkup, change in getting child immunized, and change in employment (quit or change job). Utilizing distance of ward from the epicenter of the earthquake as an instrumental variable, we find that severity of housing damage has statistically insignificant effect on the outcome variables. However, households are more likely to be displaced from their own house. They are also more likely to receive larger public transfers. House fixed effect estimation shows that having dead or injured family member significantly affects change in school enrollment and change in employment. Our results imply that large public transfers and rapid restoration of public infrastructure might have offset the expected negative effect during the short-term.

In chapter 4, we provided supplementary analysis on the impact of the earthquake on adult and child health outcomes, especially those related to malnutrition. We used nationally representative household surveys conducted before and after the earthquake and employed difference-in-differences estimation. Our results show that while adults are more likely to be thin immediately after the earthquake in the earthquake affected areas, there is no statistically significant effect on children's body mass index, underweight and birthweight.

Note that our analysis pertains to short-term coping strategy and effects on health outcomes. Without rapid restoration of destroyed physical assets such as schools and public infrastructure, we might see negative effects in the long-term. For instance, lack of timely reconstruction of schools affects learning environment. Similarly, delayed reconstruction of public infrastructure such as roads, water supply and electricity supply will hamper factor mobility and income-generating opportunities. The long-term impact is contingent upon continued public transfers to make up for the income shock suffered by the households and timely restoration of destroyed

public infrastructure with better ones. For the vulnerable population, well-targeted and flexible social assistance programs (such as conditional cash transfers and public workfare programs) may be more effective.

5.3 Prospect for Future Research

In chapter 2, we argue that the impact of male outmigration on women's empowerment and employment might be through either remittances or male absence. We could not pinpoint the exact mechanism due to data limitation regarding remittances received by households. A better dataset covering employment and empowerment indicators as well as remittances might allow for more interesting empirical analysis and policy implications. Furthermore, further exploration of the implications of large-scale male outmigration on internal labor market related general equilibrium effects is another area for future research.

In chapters 3 and 4, we argue that the substantial public transfers might have played a crucial role in offsetting the expected negative effects on the outcome variables. However, due to data limitation we could not disentangle the net effects, i.e. the effect of destruction of lives and properties by the earthquake, and the large public transfers. This could be important to establish a full picture of the immediate effects of the earthquake on health, education and employment related outcomes.

Furthermore, although this dissertation treats the topics on women's empowerment and earthquake as standalone analysis, there remains a possibility to further explore linkages between the two topics. For instance, due to the huge demand for post-earthquake related construction jobs many women are actively participating in the labor market. The government is facilitating this by providing free technical and vocational education on masonry and carpentry skills. This obviously

raises the women's income because the wage premium in construction sector is high, leading to not only increase in labor force participation but also their empowerment through higher income and skills. Examining the sectoral shifts in employment, especially towards high paying construction jobs, and its implication on women's labor market participation and empowerment would be interesting and that it provides an appropriate setting to link the two seemingly independent topics explored in this dissertation. This may be possible using the recently released Nepal Labor Force Survey 2018 data and the upcoming Housing and Population Census 2021.

References

Adams, Richard, and Alfredo Cuecuecha. 2010. "Remittances, Household Expenditure and Investment in Guatemala." *World Development* 38 (11): 1626-1641.

Aguayo, Victor M, Anirudra Sharma, and Subedi Giri Raj. 2015. "Delivering Essential Nutrition Services for Children after the Nepal Earthquake." *The Lancet Global Health* 3 (11): 665-666.

Almond, Douglas. 2006. "Is the 1918 Influenza Pandemic Over? Long-Term Effects of in utero Influenza Exposure in the Post-1940 US Ppopulation." *Journal of Political Economy* 114 (4): 672-712.

Alsop, Ruth, Mette Bertelsen, and Jeremy Holland. 2006. *Empowerment in Practice: From Analysis to Implementation.* Directions in Development, Washington, DC: World Bank.

Amuedo-Dorantes, Catalina, and Susan Pozo. 2006. "Migration, Remittances, and Male and Female Employment Patterns." *The American Economic Review* 96 (2): 222-226.

Baez, Javier, Alejandro de la Fuente, and Indhira Santos. 2010. *Do Natural Disasters Affect Human Capital? An Assessment Based on Existing Empirical Evidence.* Discussion Paper No. 5164, Bonn: Institute for the Study of Labor.

Bennett, Lynn, Dilli R Dahal, and Pav Govindasamy. 2008. *Caste, Ethnic and Regional Identity in Nepal: Further Analysis of the 2006 Nepal Demographic and Health Survey.* Maryland: Macro International Inc.

Binzel, Christine, and Ragui Assaad. 2011. "Egyptian Men Working Abroad: Labour Supply Responses by the Women Left Behind." *Labour Economics* 18 (S1): S98-S114. doi:10.1016/j.labeco.2011.03.002.

Black, Sandra E, Paul J Devereux, and Kjell G Salvanes. 2007. "From the Cradle to the Labor Market? The Effect of Birth Weight on Adult Outcomes." *Quarterly Journal of Economics* 122 (1): 409-439.

Blundell, Richard, and Thomas Macurdy. 1999. "Labor supply: A Review of Alternative Approaches." In *Handbook of Labor Economics, Vol 3 Part A*, by Orley Ashenfelter and David Card, 1559-1695. North Holland: Elsevier.

Bove, Riley, and Claudia Valeggia. 2009. "Polygyny and Women's Health in Sub-Saharan Africa." *Social Science & Medicine* 68 (1): 21-29.

Brown, Phillip. 2009. "Dowry and Intrahousehold bargaining: Evidence from China." *The Journal of Human Resources* 44 (1): 25-46.

Bustelo, Monserrat, Mary P. Arends-Kuenning, and Leonardo Lucchetti. 2012. *Persistent impact of natural disasters on child nutrition and schooling: Evidence from the 1999 Colombian earthquake.* IZA Discussion Papers, No. 6354, Bonn: Institute for the Study of Labor.

Caruso, German D. 2017. "The legacy of natural disasters: The intergenerational impact of 100 years of disasters in Latin America." *Journal of Development Economics* 127: 209-233.

Caruso, German, and Sebastian Miller. 2015. "Long Run Effects and Intergenerational Transmission of Natural Disasters: A Case Study on the 1970 Ancash Earthquake." *Journal of Development Economics* 117: 134–150.

Cas, Ava G, Elizabeth Frankenberg, Wayan Suriastini, and Duncan Thomas. 2014. "The Impact of Parental Death on Child Well-being: Evidence From the Indian Ocean Tsunami." *Demography* 51 (2): 437–457.

CBS. 2017. *Household Registration for Housing Reconstruction Program Survey .* Kathmandu: Central Bureau of Statistics.

CBS. 2012. *National Population and Housing Census 2011.* Kathmandu: Central Bureau of Statistics.

CBS. 2011. *Nepal Living Standards Survey III.* Kathmandu: Central Bureau of Statistics.

—. 2001. *Population Monograph of Census 2001.* Kathmandu: Central Bureau of Statistics.

Chalfin, Aaron. 2013. "What is the Contribution of Mexican Immigration to U.S. Crime Rates? Evidence from Rainfall Shocks in Mexico." *American Law and Economics Review* 16 (1): 220–268.

Chang, Hseuh-Ling, Ting-Chang Chang, Tzou-Yien Lin, and Shian-Shu Kuo. 2002. "Psychiatric Morbidity and Pregnancy Outcome in a Disaster Area of Taiwan 921 Earthquake." *Psychiatry and Clinical Neurosciences* 56 (2): 139-144.

Chen, Joyce J. 2006. "Migration and Imperfect Monitoring: Implications for Intra-Household Allocation." *American Economic Review* 96 (2): 227-231.

Conley, Dalton, and Neil G Bennett. 2000. "Is Biology Destiny? Birth Weight and Life Chances." *American Sociological Review* 65 (3): 458-467.

Croft, Trevor N, Aileen MJ Marshall, and Courtney K Allen. 2018. *Guide to DHS Statistics DHS-7.* Rockville, Maryland: ICF.

Currie, Janet, and Douglas Almond. 2011. "Human Capital Development Before Age Five." *Handbook of Labor Economics* 4 (B): 1315-1486.

Currie, Janet, and Rosemary Hyson. 1999. "Is the Impact of Shocks Cusioned by Socioeconomic Status? The Case of Low Birth Weight." *American Economic Review* 89 (2): 245-250.

Datar, Ashlesha, Rebecca M Kilburn, and David S Loughran. 2010. "Endowments and parental investments in infancy and early childhood." *Demography* 47 (1): 145-162.

de Hass, Hein, and Aleida van Rooij. 2010. "International Migration on the Position of Women Left Behind in Rural Morocco." *Oxford Development Studies* 38 (1): 43-62. doi:10.1080/13600810903551603.

Debnath, Priyanka, and Nasheeba Selim. 2009. "Impact of Short Term Male Migration on their Wives Left Behind: A Case Study of Bangaldes." In *Gender and Labour Migration in Asia*, by IOM, 121-150. Geneva: Internaitonal Organization for Migration.

Do, Quy-Toan, and Lakshmi Iyer. 2010. "Geography, Poverty and Conflict in Nepal." *Journal of Peace Research* 47 (6): 735-748.

DoFE. 2014. *Labour Migration for Employment: A Status Report for Nepal 2013/14.* Kathmandu: Department of Foreign Employment.

Dustmann, Christian, Francesco Fasani, and Biagio Speciale. 2017. "Illegal Migration and Consumption Behavior of Immigrant Households." *Journal of European Economic Association* 15 (3): 654–691.

Fernald, Lia C. H., Elizabeth Prado, Patricia Kariger, and Abbie. 2017. Raikes. 2014. *A Toolkit for Measuring Early Childhood Development in Low- and Middle-Income Countries.* Washington, DC: World Bank.

Frey, William H, and Audrey Singer. 2006. *Katrina and Rita Impacts on Gulf Coast Populations: First Census Findings.* Washington, DC: The Brookings Institution.

Funkhouser, Edward. 1992. "Migration from Nicaragua: Some Recent Evidence." *World Development* 20 (8): 1209-1218. doi:10.1016/0305-750X(92)90011-J.

Gartaula, Hom Nath, and Anke Niehof. 2013. "Migration to and from the Nepal Terai: Shifting Movements and Motives." *The South Asianist* 2 (2): 29-51.

Gignoux, Jeremie, and Marta Menendez. 2016. "Benefit in the wake of disaster: Long-run effects of earthquakes on welfare in rural Indonesia." *Journal of Development Economics* 118: 26-44.

GIZ. 2013. *Migration Analysis Nepal.* Kathmandu: Deutsche Gesellschaft für Internationale Zusammenarbeit.

Glennerster, Rachel, Claire Walsh, and Lucia Diaz-Martin. 2018. *A Practical Guide to Measuring Women's and Girls' Empowerment in Impact Evaluations.* Cambridge: Abdul Latif Jameel Poverty Action Lab.

Hashemi, Syed M, Sidney R Schuler, and Ann P Riley. 1996. "Rural credit programs and women's empowerment in Bangladesh." *World Development* 24 (4): 635-653.

Hilliday, Timothy. 2006. "Migration, Risk, and Liquidity Constraints in El Salvador." *Economic Development and Cultural Change* 54 (4): 893-925.

Holloway, Kyle, Zahra Niazi, and Rebecca Rouse. 2017. *Women's Economic Empowerment Through Financial Inclusion: A Review of Existing Evidence and Remaining Knowledge Gaps.* New Haven: Innovation for Poverty Action.

Horwich, George. 2000. "Economic Lessons of the Kobe Earthquake." *Economic Development and Cultural Change* 48 (3): 521-542.

ILO. 2017. *Nepal Labour Market Update.* Kathmandu: International Labour Organization.

ILO. 2015. *No Easy Exit- Migration Bans Affecting Women From Nepal.* Geneva: International Labour Organization.

ILO. 2017. *The Migrant Recruitment Industry: Profitability and Unethical Business Practices in Nepal, Paraguay and Kenya.* Geneva: International Labour Organization.

IMF. 2019. *Nepal: 2018 Article IV Consultation.* IMF Country Report, Washington, DC: International Monetary Fund.

Kabeer, Naila. 2001. *Resources, Agency, Achievements: Reflections on the Measurement of Women's Empowerment-Theory and Practice.* SIDA Studies No. 3, Stockholm: Swedish International Development Cooperation Agency.

Kabeer, Naila. 1999. "Resources, Agency, Achievements: Reflections on the Measurement of Women's Empowerment." *Development and Change* 30 (3): 435-464.

Kar, Anuja, Vanya Slavchevska, Susan Kaaria, Sanna Lisa Taivalmaa, Erdgin Mane, Riccardo Ciacci, Yurie Tanimichi Hoberg, Robert Townsend, and Victoria Stanley. 2018. *Male Outmigration and Women's Work and Empowerment in Agriculture : The Case of Nepal and Senegal.* Washington, DC: World Bank.

Kirchberger, Martina. 2017. "Natural disasters and labor markets." *Journal of Development Economics* 125: 40-58.

Kleemans, Marieke, and Jeremy Magruder. 2017. "Labour Market Responses To Immigration: Evidence From Internal Migration Driven By Weather Shocks." *The Economic Journal* 128 (613): 2032–2065.

Klugman, Jeni, Lucia Hanmer, Sarah Twigg, Tazeen Hasan, Jennifer McCleary-Sills, and Julieth Santamaria. 2014. *Voice and Agency : Empowering Women and Girls for Shared Prosperity.* Washington, DC: World Bank.

Liu, ChiChing, Alan T Linde, and Selwyn Sacks. 2009. "Slow Earthquakes Triggered by Typhoons." *Nature* 459: 833–836.

Lokshin, Michael, and Elena Glinskaya. 2009. "The Effect of Male Migration on Employment Patterns of Women in Nepal." *World Bank Economic Review* 23 (3): 481–507. doi:10.1093/wber/lhp011.

Maharjan, Amina, Siegfried Bauer, and Beatrice Kneer. 2012. "Do Rural Women Who Stay Behind Benefit from Male Out-migration? A Case Study in the Hills of Nepal." *Gender, Technology and Development* 16 (1): 95-123.

Mahmud, Simeen, Nirali M Shah, and Stan Becker. 2012. "Measurement of Women's Empowerment in Rural Bangladesh." *World Development* 40 (3): 610-619.

Malhotra, Anju, Sidney Ruth Schuler, and Carol Boender. 2002. *Measuring Women's Empowerment as a Variable in International Development.* Washington, DC: World Bank.

Massey, Douglas. 1990. "Social Structure, Household Strategies, and the Cumulative Causation of Migration." *Population Index* 56 (1): 3-26.

McDermott, Rose, and Jonathan Cowden. 2015. "Polygyny and Violence Against Women." *Emory Law Journal* 64 (6): 1768-1809.

McGuire, Bill. 2016. "How Climate Change Triggers Earthquakes, Tsunamis and Volcanoes." *The Guardian*, October 16.

McKenzie, David, and Dean Yang. 2012. "Experimental Approaches in Migration Studies." In *Handbook of Research Methods in Migration*, by Carlos Vargas-Silva, 249-270. Northampton, MA: Edward Elgar. doi:doi.org/10.4337/9781781005231.00019.

Mckenzie, David, and Hillel Rapoport. 2007. "Network Effects and the Dynamics of Migration and Inequality: Theory and Evidence from Mexico." *Journal of Development Economics* 82 (1): 1-24. doi:10.1016/j.jdeveco.2006.11.003.

Mendola, Mariapia. 2008. "Migration and Technological Change in Rural Households: Complements or Substitutes?" *Journal of Development Economics* 85 (1-2): 150-175.

Mendola, Mariapia, and Calogero Carletto. 2012. "Migration and gender differences in the home labour market: Evidence from Albania." *Labour Economics* 19 (6): 870-880. doi:10.1016/j.labeco.2012.08.009.

Ministry of Health, Nepal; New Era; and ICF. 2017. *Nepal Demographic and Health Survey 2016.* Kathmandu: Ministry of Health.

Mu, Ren, and Dominique van de Walle. 2011. "Rural Roads and Local Market Development in Vietnam." *Journal of Development Studies* 47 (5): 709-734.

Mullan, Zoe. 2015. "Rebuilding Nepal." *The Lancet Global Health* 3 (11): 654.

Munshi, Kaivan. 2003. "Networks in the Modern Economy: Mexican Migrants in the U. S. Labor Market." *The Quarterly Journal of Economics* 118 (2): 549-599.

Neelsen, Sven, and Thomas Stratmann. 2011. "Effects of Prenatal and Early Life Malnutrition: Evidence from the Greek Famine." *Journal of Health Economics* 30 (3): 479-488.

Nobles, Jenna, and Christopher McKelvey. 2015. "Gender, Power, and Emigration from Mexico." *Demography* 52 (5): 1573–1600.

NPC. 2015. *Post Disaster Needs Assessment.* Kathmandu: National Planning Commission.

NRA. 2016. *Post Disaster Recovery Framework 2016-2020.* Kathmandu: National Reconstruction Authority.

NRB. 2018. *Macroeconomic Situation 2017/18.* Kathmandu: Nepal Rastra Bank.

Paris, Thelma, Abha Singh, Joyce Luis, and Mahabub Hossain. 2005. "Labour Outmigration, Livelihood of Rice Farming Households and Women Left Behind: A Case Study in Eastern Uttar Pradesh." *Economic and Political Weekly* 40 (25): 2522-2529.

Paris, Thelma, Truong Thi Ngoc Chi, Maria Fay Rola-Rubzen, and Joyce Luis. 2009. "Effects of Out-migration on Rice-farming Households and Women Left Behind in Vietnam." *Gender, Technology and Development* 13 (2): 169-198.

Park, Albert, and Sangui Wang. 2017. "Benefiting from Disaster? Public and Private Responses to the Wenchuan Earthquake." *World Development* 94: 38-50.

Paudel, Jayash, and Hanbyul Ryu. 2018. "Natural Disasters and Human Capital: The Case of Nepal's Earthquake." *World Development* 111: 1-12.

Pivovarova, Margarita, and Eik Leogn Swee. 2015. "Quantifying the Microeconomic Effects of War Using Panel Data: Evidence from Nepal." *World Development* 66: 308-321. doi:10.1016/j.worlddev.2014.08.026.

Sapkota, Chandan. 2013. "Remittances in Nepal: Boon or Bane?" *Journal of Development Studies* 49 (10): 1316-1331.

Sawada, Yasuyuki, and Satoshi Shimizutani. 2008. "How Do People Cope with Natural Disasters? Evidence from the Great Hanshin-Awaji (Kobe) Earthquake in 1995." *Journal of Money, Credit and Banking* 40 (2-3): 463-488.

Sawada, Yasuyuki, and Yoshito Takasaki. 2017. "Natural Disaster, Poverty, and Development: An Introduction." *World Development* 94: 2-15.

Schaner, Simone. 2016. "The Cost of Convenience? Transaction Costs, Bargaining Power, and Savings Account Use in Kenya." *The Journal of Human Resources* 1-29. doi:10.3368/jhr.52.4.0815-7350R1.

Sen, Amartya. 1999. *Development as Freedom.* New York: Oxford University Press.

Shishido, Hisanobu. 2011. *Large-scale Migration and Remittances in Nepal: Issues, Challenges and Opportunities.* Washington, DC: World Bank.

Shrestha, Maheshwor. 2017. "Push and Pull: A Study of International Migration from Nepal." *Policy Research Working Paper 7965* (World Bank).

Sinha, Babita, Smita Jha, and Nalin Singh Negi. 2012. "Migration and Empowerment: The Experience of Women in Households in India where Migration of a Husband has Occurred." *Journal of Gender Studies* 21 (1): 61-76.

Slavchevska, Vanya, Susan Kaaria, and Taivalmaa Sanna-Liisa. 2016. *Feminization of Agriculture in the Context of Rural Transformations: What Is the Evidence?* Washington, DC: World Bank.

Stanley, Victoria. 2015. *Women in Agriculture : The Impact of Male Out-migration on Women's Agency, Household Welfare, and Agricultural Productivity.* Washington, D.C.: World Bank.

Stock, James H, and Motohiro Yogo. 2005. "Testing for Weak Instruments in Linear IV Regression." In *Identification and Inference for Econometric Models: Essays in Honor of Thomas Rothenberg*, by Donald WK Andrews and James H Stock, 80-108. Cambridge University Press.

Strauss, Gregg. 2012. "Is Polygyny Inherently Unequal." *Ethics* 122 (3): 516-544.

Tan, Cong E, Hong Jun Li, Xian Geng Zhang, Hui Zhang, Pie Yu Han, Qu An, Wei, Jun Ding, and Mi Qu Wang. 2009. "The Impact of the Wenchuan Earthquake on Birth Outcomes." *PLoS ONE* 4 (12): e8200.

UNOHCHR. 2012. *Nepal Conflict Report.* Geneva: United Nations Office of the High Commissioner for Human Rights.

Valente, Christine. 2011. "What Did the Maoists Ever Do for Us? Education and Marriage of Women Exposed to Civil Conflict in Nepal." *Policy Research Working Paper Series 5741* (World Bank).

Vernon, Henderson J, Adam Storeygard, and David N Weil. 2012. "Measuring Economic Growth from Outer Space." *American Economic Review* 102 (2): 994-1028.

Wei-Hass, Maya. 2019. "Devastating quakes are priming the Himalaya for a mega-disaster." *National Geographic*, January 17.

WFP. 2008. *Passage to India: Migration as a Coping Strategy in Times of Crisis in Nepal.* Kathmandu: World Food Programme.

World Bank. 2006. *Resilience amidst conflict: An assessment of poverty in Nepal, 1995–96 and 2003–04.* Washington, DC: World Bank.

World Bank. 2008. "The impact of the conflict, the Tsunami and reconstruction on poverty in Aceh : Aceh poverty assessment 2008." (World Bank).

Yang, Dean. 2008. "International Migration, Remittances and Household Investment: Evidence from Philippine Migrants' Exchange Rate Shocks." *The Economic Journal* 118 (528): 591-630. doi:10.1111/j.1468-0297.2008.02134.x .

Yang, Dean. 2008. "Risk, Migration, and Rural Financial Markets: Evidence from Earthquakes in El Salvador." *Social Research: An International Quarterly* 75 (3): 955–992.

Tables

Table 2.1: Summary Statistics

	2006		2011	
Variables	Mean	Standard deviation	Mean	Standard deviation
Household male outmigration	0.201	0.4	0.283	0.45
Women employment				
Working	0.723	0.448	0.678	0.467
Work for family member	0.258	0.437	0.576	0.494
Work for someone else	0.119	0.324	0.144	0.351
Self-employed	0.455	0.498	0.088	0.284
Women empowerment				
Polygamous	0.429	0.495	0.343	0.475
Owns a bank account	0.473	0.499	0.667	0.471
Final say in own healthcare	0.456	0.498	0.684	0.465
Final say on visits to family	0.536	0.499	0.673	0.469
Living with in-laws	0.361	0.48	0.267	0.443
Control variables				
Living in urban area	0.265	0.441	0.276	0.447
Woman's education	2.628	3.786	3.138	3.93
Husband's education	5.587	4.207	5.839	3.97
Wealth index	2.984	1.437	3.048	1.464
Age	29.276	7.89	33.444	7.393
Husband's age	33.591	9.176	37.987	8.883
Share of workers in agriculture	0.454	0.25	0.3	0.213
Nighttime light	0.412	1.01	0.491	1.234
Number of children (<5 years)	1.084	1.083	0.783	0.926
Observations	7493		7477	

Note: The sample is restricted to the same age cohort (15-49 years in 2006 and 20-54 years in 2011) of married women born after 1980 and married before the end of the conflict in 2006. All means and standard deviations are calculated in consideration of the survey setting in the DHS datasets.

Table 2.2: Male Outmigration and Women's Employment

Dependent variable	Working	Work for family member	Work for someone else	Self-employed
Household outmigration	0.012	0.026**	-0.009	-0.019**
	[0.011]	[0.012]	[0.009]	[0.009]
Living in urban area	-0.030	-0.051**	0.052***	-0.057***
	[0.020]	[0.021]	[0.019]	[0.021]
Education	0.001	-0.010***	0.009***	0.002
	[0.002]	[0.002]	[0.001]	[0.002]
Husband's education	-0.001	0.011***	-0.013***	-0.002
	[0.001]	[0.002]	[0.001]	[0.001]
Age	0.004***	-0.002	-0.001	0.005***
	[0.002]	[0.002]	[0.001]	[0.002]
Husband's age	-0.003***	-0.006***	-0.001	0.004***
	[0.001]	[0.001]	[0.001]	[0.001]
Share of workers in agriculture	0.365***	0.385***	-0.181***	0.070*
	[0.050]	[0.047]	[0.033]	[0.042]
Nighttime light	0.002	0.006	-0.005	-0.012
	[0.007]	[0.010]	[0.012]	[0.009]
Number of children	-0.008	0.018***	-0.016***	-0.014***
	[0.005]	[0.005]	[0.003]	[0.005]
Constant	0.823***	0.377***	0.311***	0.296***
	[0.104]	[0.096]	[0.060]	[0.100]
Observations	14,833	14,833	14,833	14,833
R-squared	0.256	0.273	0.150	0.265

Note: The sample is restricted to the same age cohort (15-49 years in 2006 and 20-54 years in 2011) of married women born after 1980 and married before the end of conflict in 2006. All estimates are calculated in consideration of the survey setting in the DHS datasets. Survey year, ethnicity, district, and year of marriage fixed effects are controlled in all regressions. The set of control variables includes indicators for the year, urban area, women's education, husband's education, women's age, share of agricultural workers at ward level, local economic activity (nighttime light), and number of children less than five years of age. Standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

Table 2.3: Male Outmigration and Women's Empowerment

Dependent variable	Polygamous	Owns a bank account	Final say in own healthcare	Final say on visits to family or relatives	Living with in-laws
Male outmigration	-0.175***	0.029**	0.059***	0.014	0.076***
	[0.012]	[0.012]	[0.011]	[0.011]	[0.011]
Living in urban area	0.008	-0.008	0.002	0.018	-0.031*
	[0.014]	[0.023]	[0.021]	[0.019]	[0.016]
Education	0.002	0.012***	0.014***	0.010***	0.002
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Husband's education	-0.004**	0.011***	-0.005***	-0.005***	0.013***
	[0.002]	[0.002]	[0.002]	[0.001]	[0.001]
Age	0.001	0.003*	0.005***	0.009***	0.001
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Husband's age	-0.001	0.000	0.000	0.001	-0.009***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Share of workers in agriculture	0.111***	0.030	-0.177***	-0.193***	0.145***
	[0.032]	[0.050]	[0.044]	[0.040]	[0.035]
Nighttime light	0.000	0.001	0.003	0.002	0.006
	[0.006]	[0.009]	[0.007]	[0.007]	[0.006]
Number of children	0.016	0.001	-0.038***	-0.052***	0.060***
	[0.010]	[0.006]	[0.005]	[0.006]	[0.007]
Constant	0.381***	0.208*	0.545***	0.496***	0.267**
	[0.105]	[0.123]	[0.113]	[0.110]	[0.104]
Observations	14,833	14,833	14,833	14,833	14,833
R-squared	0.057	0.232	0.154	0.164	0.153

See the note for Table 2.2.

Table 2.4: First-Stage Estimation: The Impact of Rainfall and Ethnicity-Specific Migration Network on Outmigration

Dependent variable	Having a Male Outmigrant in the Household			
	(1)	(2)	(3)	(4)
Ethnicity-based migration network	0.904***			0.899***
	[0.018]			[0.018]
Rainfall (z-score)		0.052***		0.026***
		[0.017]		[0.007]
Rainfall shock (binary indicator)			-0.027*	
			[0.014]	
F-statistics on instruments	2502.76	9.62	3.64	1279.64
Constant	0.286***	0.300***	0.341***	0.269***
	[0.079]	[0.094]	[0.094]	[0.080]
Observations	14,833	14,833	14,833	14,833
R-squared	0.209	0.097	0.095	0.210

Note: See the note for Table 2.2. The district-level rainfall z-score is calculated based on the past three years of precipitation compared to the long-run (1986-2015) average of precipitation in each district. A rainfall shock is defined as an indicator for an absolute value of the z-score greater than one for the past three years in each district. Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 2.5: Instrumental Variable Estimation: Male Outmigration and Women's Employment

Dependent variable	Working	Work for family member	Work for someone else	Self-employed
	(1)	(2)	(3)	(4)
Male outmigration	0.059	0.012	-0.030	0.056*
	[0.037]	[0.043]	[0.034]	[0.034]
Share of workers in agriculture	0.364***	0.386***	-0.180***	0.069*
	[0.049]	[0.047]	[0.033]	[0.041]
Nighttime light	0.002	0.006	-0.005	-0.012
	[0.007]	[0.010]	[0.012]	[0.009]
J-test†	0.351	1.052	0.063	1.204
(p-value)	0.351	0.305	0.801	0.273
Observations	14,833	14,833	14,833	14,833
R-squared	0.2538	0.273	0.149	0.260

See the note for Table 2.2 for the definition of all control variables included in the model. See the note for Table 2.4 for the construction of instrumental variables. †J-test and p-value are acquired from instrumental variable estimation in consideration of the sampling weight, but not the full survey setting.

Table 2.6: Instrumental Variable Estimation: Male Outmigration and Women's Empowerment

Dependent variable	Polygamous	Owns a bank account	Final say in own healthcare	Final say on visits to family or relatives	Living with in-laws
	(1)	(2)	(3)	(4)	(5)
Male outmigration	-0.249***	0.000	0.082**	-0.063*	0.111***
	[0.030]	[0.046]	[0.035]	[0.036]	[0.025]
Share of workers in agriculture	0.112***	0.031	-0.177***	-0.192***	0.145***
	[0.031]	[0.051]	[0.044]	[0.040]	[0.035]
Nighttime light	0.001	0.001	0.003	0.003	0.006
	[0.006]	[0.009]	[0.007]	[0.007]	[0.006]
J-test†	0.051	0.028	1.727	0.001	0.499
(p-value)	0.821	0.867	0.189	0.978	0.480
Observations	14,833	14,833	14,833	14,833	14,833
R-squared	0.053	0.231	0.154	0.159	0.152

See the note for Table 2.2 for the definition of all control variables included in the model. See the note for Table 2.4 for the construction of instrumental variables. †J-test and p-value are acquired from instrumental variable estimation in consideration of the sampling weight but not the full survey setting.

Table 2.7: Internal Household Migration, Outmigration and Women's Employment: Instrumental variable Estimation using Migration Network and Rainfall

Dependent variable	Work for family member	Work for someone else	Self-employed
	(1)	(2)	(3)
Male outmigration	0.055	-0.049	0.035
	[0.043]	[0.034]	[0.034]
Male internal migration	0.188**	-0.083	-0.090*
	[0.076]	[0.052]	[0.053]
Constant	0.265***	0.306***	0.203**
	[0.088]	[0.051]	[0.082]
J-test	1.190	0.085	1.269
(p-value)	0.28	0.77	0.26
Observations	14,833	14,833	14,833
R-squared	0.266	0.144	0.260

See the note for Table 2.2 for the definition of all control variables included in the model. See the note for Table 2.4 for the construction of instrumental variables. †J-test and p-value are acquired from instrumental variable estimation in consideration of the sampling weight but not the full survey setting.

Table 2.8: Internal Household Migration, Outmigration and Women's Empowerment: Instrumental Variable Estimation using Migration Network and Rainfall

Dependent variable	Polygamous	Owns a bank account	Final say in own healthcare	Final say on visits to family or relatives	Living with in-laws
	(1)	(2)	(3)	(4)	(5)
Male outmigration	-0.285***	0.005	0.103***	-0.076**	0.127***
	[0.031]	[0.048]	[0.036]	[0.037]	[0.029]
Male internal migration	-0.158***	0.022	0.090*	-0.055	0.069
	[0.049]	[0.067]	[0.051]	[0.051]	[0.049]
Constant	0.392***	0.170	0.355***	0.276***	0.434***
	[0.078]	[0.109]	[0.100]	[0.092]	[0.094]
J-test	0.092	0.026	1.821	0.002	0.452
(p-value)	0.76	0.87	0.18	0.96	0.50
Observations	14,833	14,833	14,833	14,833	14,833
R-squared	0.050	0.231	0.153	0.159	0.154

See the note for Table 2.2 for the definition of all control variables included in the model. See the note for Table 2.4 for the construction of instrumental variables. †J-test and p-value are acquired from instrumental variable estimation in consideration of the sampling weight but not the full survey setting.

Table 2.9: Instrumental Variable Estimation: Male Outmigration and Women's Employment (Full Sample)

Dependent variable	Work for family member	Work for someone else	Self-employed
	(2)	(3)	(4)
Male outmigration	0.009	-0.020	0.047
	[0.041]	[0.031]	[0.031]
Share of workers in agriculture	0.389***	-0.179***	0.062
	[0.047]	[0.031]	[0.040]
Nighttime light	0.005	-0.003	-0.010
	[0.009]	[0.011]	[0.009]
J-test	1.723	0.088	1.817
(p-value)	0.189	0.767	0.178
Observations	15,926	15,926	15,926
R-squared	0.274	0.142	0.264

See the note for Table 2.2 for the definition of all control variables included in the model. See the note for Table 2.4 for the construction of instrumental variables. †J-test and p-value are acquired from instrumental variable estimation in consideration of the sampling weight, but not the full survey setting. The sample includes all married women.

Table 2.10: Instrumental Variable Estimation: Male Outmigration and Women's Empowerment (Full Sample)

Dependent variable	Polygamous	Owns a bank account	Final say in own healthcare	Final say on visits to family or relatives	Living with in-laws
	(1)	(2)	(3)	(4)	(5)
Male outmigration	-0.228***	0.008	0.072**	-0.063*	0.119***
	[0.029]	[0.044]	[0.034]	[0.035]	[0.024]
Share of workers in agriculture	0.114***	0.024	-0.179***	-0.206***	0.169***
	[0.032]	[0.051]	[0.043]	[0.039]	[0.034]
Nighttime light	0.004	0.000	0.005	0.006	0.005
	[0.006]	[0.008]	[0.006]	[0.007]	[0.006]
J-test	0.080	0.010	3.390	0.072	0.366
(p-value)	0.777	0.918	0.066	0.789	0.545
Observations	15,926	15,926	15,926	15,926	15,926
R-squared	0.052	0.233	0.151	0.168	0.159

See the note for Table 2.2 for the definition of all control variables included in the model. See the note for Table 2.4 for the construction of instrumental variables. †J-test and p-value are acquired from instrumental variable estimation in consideration of the sampling weight but not the full survey setting. The sample includes all married women.

Table 2.11: Internal Household Migration, Outmigration and Women's Employment: Instrumental variable Estimation using Migration Network and Rainfall (Full Sample)

Dependent variable	Work for family member	Work for someone else	Self-employed
	(1)	(2)	(3)
Male outmigration	0.053	-0.037	0.029
	[0.041]	[0.032]	[0.032]
Male internal migration	0.189***	-0.075	-0.077
	[0.072]	[0.047]	[0.050]
Constant	-0.032	0.254***	0.259***
	[0.228]	[0.068]	[0.086]
J-test	1.908	0.068	1.896
(p-value)	0.17	0.79	0.17
Observations	15,926	15,926	15,926
R-squared	0.266	0.137	0.265

See the note for Table 2.2 for the definition of all control variables included in the model. See the note for Table 2.4 for the construction of instrumental variables. †J-test and p-value are acquired from instrumental variable estimation in consideration of the sampling weight but not the full survey setting. The sample includes all married women.

Table 2.12: Internal Household Migration, Outmigration and Women's Empowerment: Instrumental Variable Estimation using Migration Network and Rainfall (Full Sample)

Dependent variable	Polygamous	Owns a bank account	Final say in own healthcare	Final say on visits to family or relatives	Living with in-laws
	(1)	(2)	(3)	(4)	(5)
Male outmigration	-0.263***	0.016	0.092***	-0.079**	0.140***
	[0.031]	[0.045]	[0.035]	[0.037]	[0.029]
Male internal migration	-0.148***	0.034	0.088*	-0.067	0.091*
	[0.048]	[0.065]	[0.050]	[0.051]	[0.049]
Constant	0.490**	0.083	0.115	0.175	0.329
	[0.193]	[0.239]	[0.150]	[0.152]	[0.238]
J-test	0.126	0.009	3.505	0.058	0.303
(p-value)	0.72	0.93	0.06	0.81	0.58
Observations	15,926	15,926	15,926	15,926	15,926
R-squared	0.051	0.233	0.149	0.167	0.161

See the note for Table 2.2 for the definition of all control variables included in the model. See the note for Table 2.4 for the construction of instrumental variables. †J-test and p-value are acquired from instrumental variable estimation in consideration of the sampling weight but not the full survey setting. The sample includes all married women.

Table 3.1: Summary Statistics

	Partially damaged		Severely damaged	
	Mean	SD	Mean	SD
School dropout	0.0069	0.0828	0.0090	0.0947
Missed pregnancy checkup	0.0007	0.0267	0.0011	0.0330
Missed child immunization	0.0012	0.0353	0.0013	0.0362
Quit job	0.0032	0.0565	0.0071	0.0841
Displaced from house	0.1350	0.3417	0.6641	0.4723
Log of public transfer	4.16	4.74	8.32	3.75
Public transfer (Rs)	7,787	10,934	19,225	9,860
Education of household head	3.74	4.57	3.26	4.37
Age of household head	46.52	14.79	48.15	15.08
Age of house	15.46	14.28	25.15	20.17
Household size	5.04	2.41	4.86	2.47
Number of dead	377		9,027	
Number of injured	840		9,300	
Observations (households)	256,937		865,718	

Note: The sample includes all the households that reported damage to housing after the earthquake. Partially damaged refers to houses that are classified as habitable as the load carrying capacity of houses is not reduced appreciably. Severely damaged refers to houses that either require significant structural repair or are totally collapsed.

School dropout is an indicator variable equal to one if the household reported anyone dropped out of school (level 10 and below) due to the earthquake. Quit pregnancy checkup is an indicator variable equal to one if household reported that a pregnant women quit regular checkup due to the earthquake. Missed child immunization is an indicator variable equal to one if household reported that a child missed regular immunization due to the earthquake. Quit or change job is an indicator variable equal to one if household reported that any member had to quit job or change job due to the earthquake. Displaced from house is an indicator variable equal to one if the household reported being displaced from the house due to the earthquake. Public transfer is the total transfer received by the household from the government after the earthquake.

Table 3.2: Private and Public Response to the 2015 Earthquake (OLS Estimation)

Dependent variable	School dropout	Quit regular pregnancy checkup	Children miss regular immunization	Quit or change job	Log of public transfer	Displaced from house	Displaced from ward or district
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Severely damaged house	0.004**	0.000***	-0.000	0.002***	1.913***	0.293***	0.017***
	[0.002]	[0.000]	[0.000]	[0.000]	[0.089]	[0.009]	[0.001]
Constant	0.001	0.000	0.001	0.006***	-0.496	0.123**	0.017***
	[0.003]	[0.001]	[0.001]	[0.001]	[0.491]	[0.048]	[0.005]
Observations	1,032,950	1,032,950	1,032,950	1,032,950	967,388	1,032,950	1,032,950
R-squared	0.007	0.001	0.002	0.005	0.392	0.377	0.071

Note: The sample includes all the households that reported damage to housing after the earthquake. The set of control variables include education of head of household, age of head of household, household size, age of house, and ward level population before the earthquake. Foundation structure of house, ethnicity of head of household and district fixed effects are also controlled in all regressions. Standard errors are clustered at the ward level.

Standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

Table 3.3: Private and Public Response to the 2015 Earthquake (IV Estimation)

Dependent variable	Severely damaged house	School dropout	Quit regular pregnancy checkup	Children miss regular immunization	Quit or change job	Log of public transfer	Displaced from house	Displaced from ward or district
	First stage	IV						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ward distance from epicenter	-0.216***							
	[0.036]							
Severely damaged house		-0.055	0.004	-0.005	-0.013	16.344***	1.051***	0.070
		[0.038]	[0.005]	[0.010]	[0.021]	[3.247]	[0.177]	[0.057]
Constant	1.212***	0.036	-0.002	0.003	0.015	-9.261***	-0.331***	-0.015
	[0.109]	[0.024]	[0.004]	[0.006]	[0.013]	[2.065]	[0.122]	[0.034]
Observations	1,023,656	1,023,656	1,023,656	1,023,656	1,023,656	958,659	1,023,656	1,023,656
R-squared	0.302	0.001	0.000	0.001	0.001	0.001	0.099	0.066

Note: See Table 3.2. First-stage *F-statistic* for significance of ward's distance from epicenter is 36.89. Standard errors are clustered at the ward level.

Standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

Table 3.4: Impact of Earthquake on Other Social Security Allowances (OLS and IV Estimation)

Dependent variable	Child protection assistance	Elderly allowance	Child protection assistance	Elderly allowance
	OLS	OLS	IV	IV
	(1)	(2)	(3)	(4)
Severely damaged house	-0.000	-0.004***	0.003	-0.013
	[0.000]	[0.001]	[0.008]	[0.031]
Constant	0.001	-0.315***	-0.001	-0.309***
	[0.002]	[0.010]	[0.005]	[0.021]
Observations	1,032,949	1,032,949	1,023,655	1,023,655
R-squared	0.073	0.142	0.073	0.142

See note in Table 3.1 and Table 3.2. Standard errors are clustered at the ward level.

Standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

Table 3.5: Impact of Transfer and Dead in Household (House Fixed Effects Estimation)

Dependent variable	School dropout	Quit regular pregnancy checkup	Children miss regular immunization	Quit or change job
	(1)	(2)	(3)	(4)
Dead in household	0.013**	-0.001	0.000	0.012**
	[0.006]	[0.001]	[0.002]	[0.005]
Public transfer	0.000*	-0.000	0.000	0.000
	[0.000]	[0.000]	[0.000]	[0.000]
Constant	0.006***	0.001**	0.002***	0.010***
	[0.002]	[0.001]	[0.001]	[0.002]
Observations	107,533	107,533	107,533	107,533
R-squared	0.715	0.546	0.575	0.661

See note in Table 3.1 and Table 3.2. Dead in household indicates household that reported earthquake-related death. In addition to foundation structure of house, ethnicity of head of household and district fixed effects, the regression estimation also control for house fixed effect. Standard errors are clustered at the ward level.

Standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

Table 3.6: Impact of Transfer and Dead or Injured in Household (House Fixed Effects Estimation)

Dependent variable	School dropout	Quit regular pregnancy checkup	Children miss regular immunization	Quit or change job
	(1)	(2)	(3)	(4)
Dead or injured in household	0.010**	0.002	-0.002	0.012***
	[0.004]	[0.001]	[0.001]	[0.004]
Public transfer	0.000*	-0.000	0.000	0.000
	[0.000]	[0.000]	[0.000]	[0.000]
Constant	0.006***	0.001**	0.002***	0.010***
	[0.002]	[0.001]	[0.001]	[0.002]
Observations	107,533	107,533	107,533	107,533
R-squared	0.715	0.546	0.575	0.661

See note in Table 3.1 and Table 3.2. Dead or injury in household indicates household that reported earthquake-related either death or injury. In addition to foundation structure of house, ethnicity of head of household and district fixed effects, the regression estimation also control for house fixed effect. Standard errors are clustered at the ward level.

Standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

Table 4.1: Summary Statistics

	2011				2016			
	Control		Treatment		Control		Treatment	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Adult sample								
Thin	0.21	0.42	0.10	0.29	0.11	0.32	0.05	0.20
Urban	0.11	0.32	0.17	0.36	0.55	0.52	0.68	0.43
Education	4.11	4.32	5.07	3.99	4.17	4.53	5.17	4.15
Age	36.80	17.40	38.35	17.37	39.09	18.30	40.16	16.62
Household size	5.77	2.86	5.35	2.50	5.74	3.20	4.75	2.40
Observations	19,867		11,756		19,831		10,232	
Children sample								
Underweight	0.19	0.40	0.12	0.31	0.26	0.47	0.11	0.28
Low birthweight	0.11	0.33	0.12	0.31	0.13	0.36	0.10	0.28
BMI	21	3.25	22	3.07	21	3.88	23	3.49
Thin	0.18	0.39	0.13	0.32	0.19	0.42	0.06	0.22
Urban	0.14	0.35	0.24	0.41	0.55	0.53	0.73	0.41
Age	2.00	1.42	1.97	1.37	2.02	1.47	1.98	1.31
Household size	6.02	2.98	5.39	2.16	6.19	3.23	5.10	2.31
Observations	3,797		1,647		3,517		1,309	

Note: The sample is restricted to those continuously living in the household even after the earthquake. Children sample includes 5 years and younger. Low birthweight is for children born within the last 12 months of the survey. Adult sample includes those between 15-49 years.

Control and treatment indicate areas not affected and affected, respectively, by the 2015 earthquake. Thin refers to body mass index (BMI) less than 18.50. Body mass index is calculated as weight in kilograms divided by the square of height in meters. Underweight among children is defined as weight-for-age z-score less than minus 2 standard deviation below the mean of the WHO Child Growth Standards (Croft, Marshall and Allen 2018). A newborn weighing less than 2500 grams is considered to have low birthweight.

Table 4.2: Short-term Impact of 2015 Earthquake (DID Estimation)

Dependent variable	Thin adults	Under weight	Low birthweight	BMI children	Thin children
Sample	Adult	Children			
	(1)	(2)	(3)	(4)	(5)
Post*treat	0.064***	-0.002	-0.044	0.190	0.026
	[0.015]	[0.028]	[0.033]	[0.251]	[0.028]
Post (=2016)	-0.081***	-0.009	0.010	0.660***	-0.031
	[0.011]	[0.026]	[0.018]	[0.155]	[0.021]
Treat	0.040	0.098	-0.021	-0.924	0.051
	[0.047]	[0.071]	[0.146]	[0.727]	[0.051]
Urban indicator	0.009	-0.005	0.001	0.187	-0.012
	[0.008]	[0.021]	[0.018]	[0.158]	[0.020]
Education	-0.006***				
	[0.001]				
Age	-0.019***	0.092***	0.001	-0.122	0.014
	[0.002]	[0.018]	[0.018]	[0.112]	[0.015]
Mother's education		-0.028***	0.005	0.051	-0.002
		[0.009]	[0.010]	[0.074]	[0.010]
Constant	0.539***	0.258***	0.259**	20.512***	0.155***
	[0.044]	[0.060]	[0.125]	[0.606]	[0.041]
Observations	15,390	4,553	2,294	4,614	4,614
R-squared	0.082	0.102	0.076	0.226	0.107

See note in Table 4.1. Sample is restricted to adults. Post equals one if survey year is 2016. The set of control variables include urban indicator, education (mother's education for children sample), age, age squared, and household size. Ethnicity, district, and wealth fixed effects are controlled in all regressions. Standard errors are clustered at the ward level.

Standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

Table 4.3: Heterogeneous Short-term Impact of 2015 Earthquake (DID Estimation)

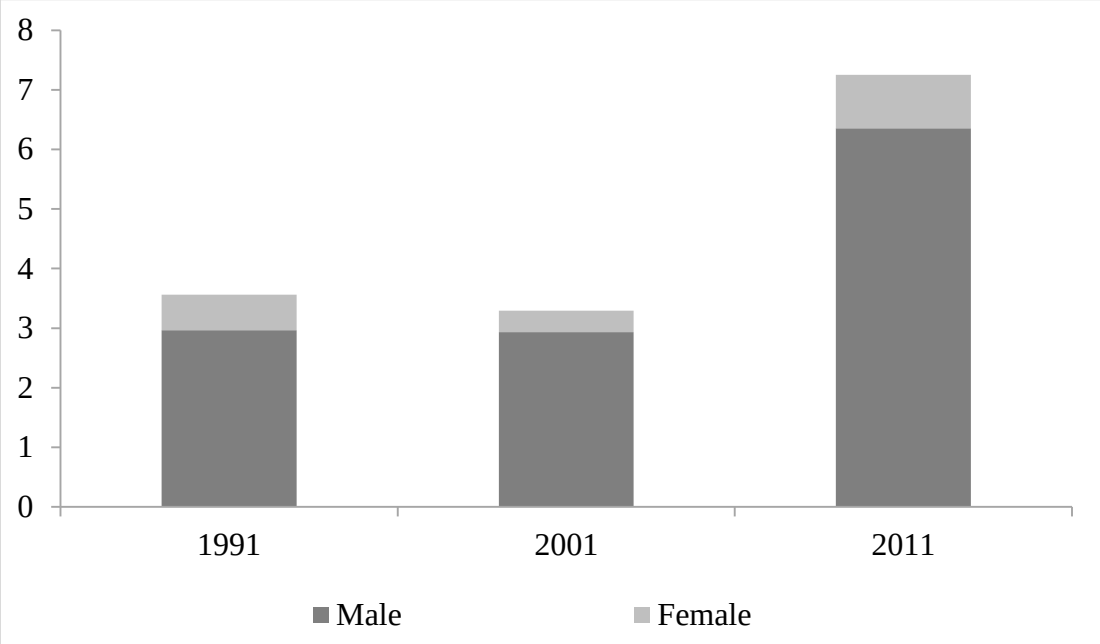
Dependent variable	Under weight	Low birthweight	BMI children	Thin children	Under weight	Low birthweight	BMI children	Thin children
Sample	Male children				Female children			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post*treat	-0.009	-0.119***	-0.091	0.066*	-0.012	0.037	0.353	-0.004
	[0.038]	[0.044]	[0.317]	[0.038]	[0.037]	[0.046]	[0.322]	[0.033]
Post (=2016)	-0.007	0.042*	0.828***	-0.049*	-0.015	-0.025	0.559***	-0.021
	[0.029]	[0.023]	[0.190]	[0.028]	[0.034]	[0.030]	[0.191]	[0.025]
Treat	0.159	0.022	-0.315	0.018	-0.139	0.358	-1.068	0.085
	[0.116]	[0.043]	[0.695]	[0.069]	[0.152]	[0.233]	[1.364]	[0.153]
Urban indicator	-0.005	0.002	0.337*	-0.022	0.001	0.008	0.074	-0.004
	[0.025]	[0.023]	[0.200]	[0.026]	[0.031]	[0.028]	[0.195]	[0.024]
Age	-0.032**	0.011	-0.024	0.000	-0.018	0.001	0.092	-0.007
	[0.014]	[0.012]	[0.093]	[0.012]	[0.012]	[0.016]	[0.103]	[0.013]
Mother's education	0.057**	-0.035	-0.089	0.025	0.122***	0.035	-0.185	0.005
	[0.028]	[0.025]	[0.169]	[0.023]	[0.026]	[0.028]	[0.148]	[0.021]
Constant	0.275***	0.103*	19.491***	0.191***	0.242***	0.344*	21.615***	0.130**
	[0.104]	[0.061]	[0.611]	[0.051]	[0.081]	[0.185]	[0.741]	[0.058]
Observations	2,381	1,227	2,411	2,411	2,172	1,067	2,203	2,203
R-squared	0.122	0.134	0.260	0.135	0.131	0.120	0.235	0.115

See note in Table 4.1 and Table 4.2. Children sample includes 5 years and younger. Low birthweight is for children born within the last 12 months of the survey. Post equals one if survey year is 2016. The set of control variables include urban indicator, mother's education, age, age squared, and household size. Ethnicity, district, and wealth fixed effects are controlled in all regressions. Standard errors are clustered at the ward level.

Standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

Figures

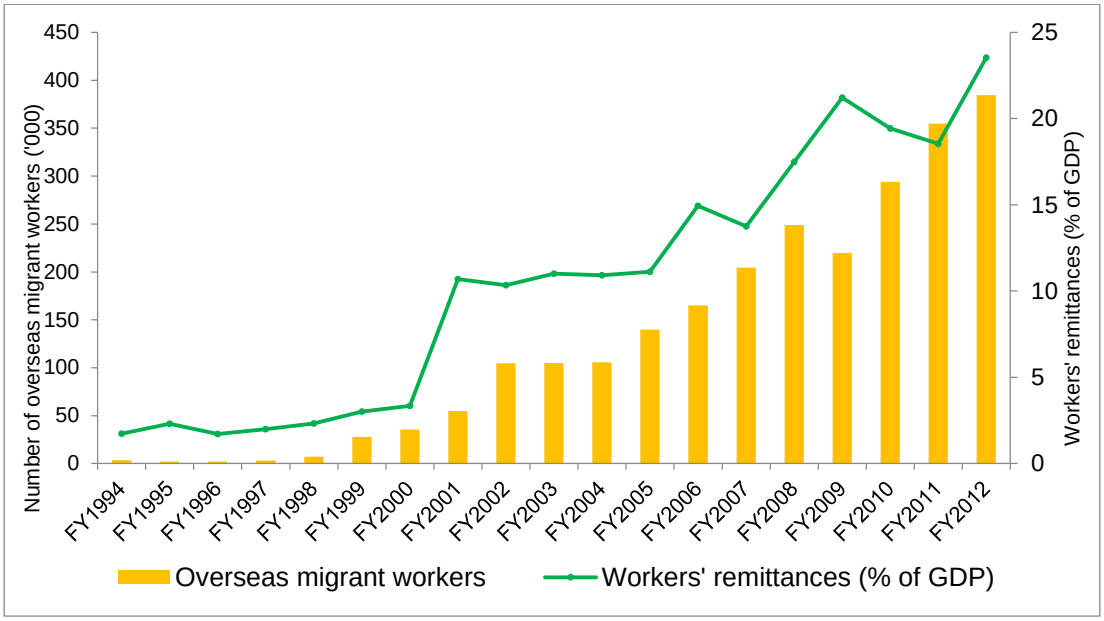
Figure 2.1: Absentee Population (% of total population)



Note: Anyone away or absent from the place of birth or usual place of residence and gone abroad for at least six months before the census date is considered to be absent and is not counted as part of the present population.

Source: CBS (2012)

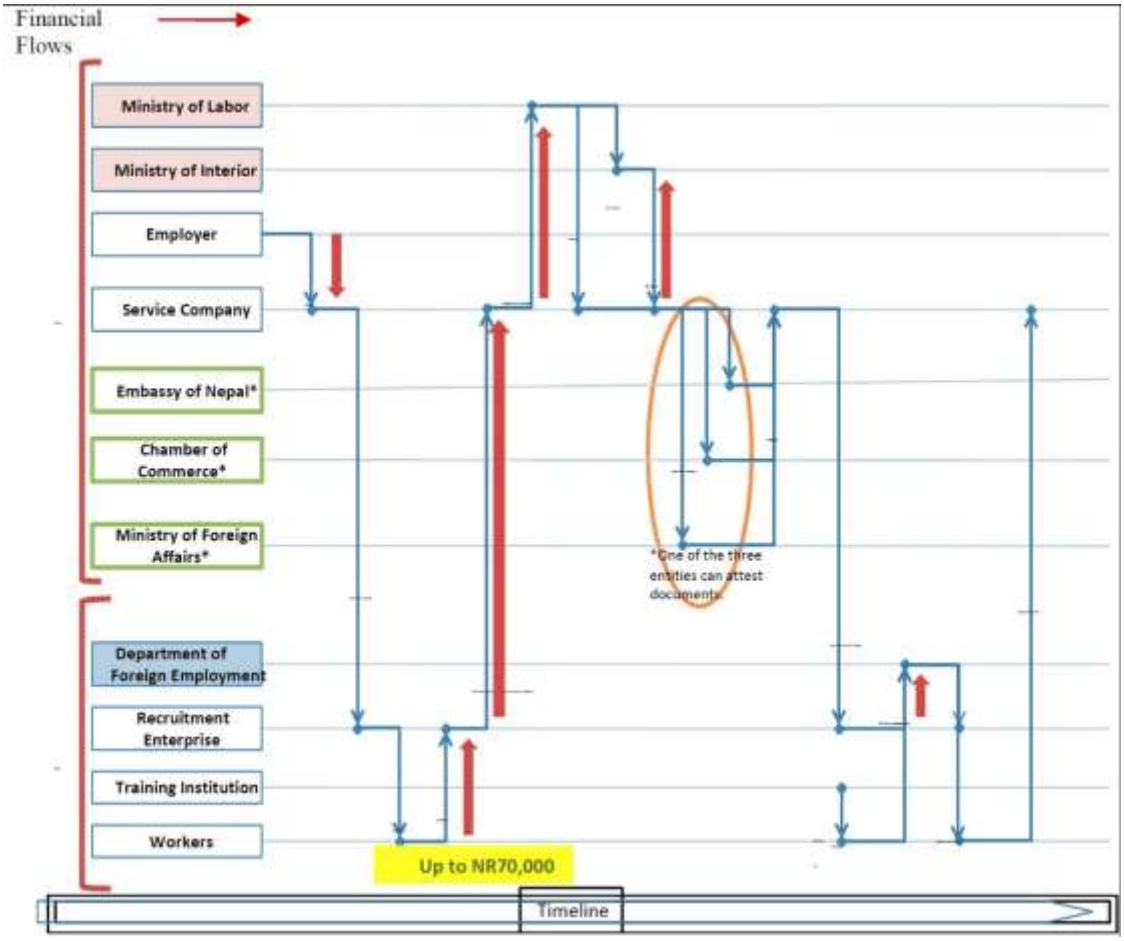
Figure 2.2: Overseas Migration and Workers' Remittances



Note: The number of overseas migrants (in thousands) excluding migrants to India. Workers' remittances are expressed as a percentage of GDP.

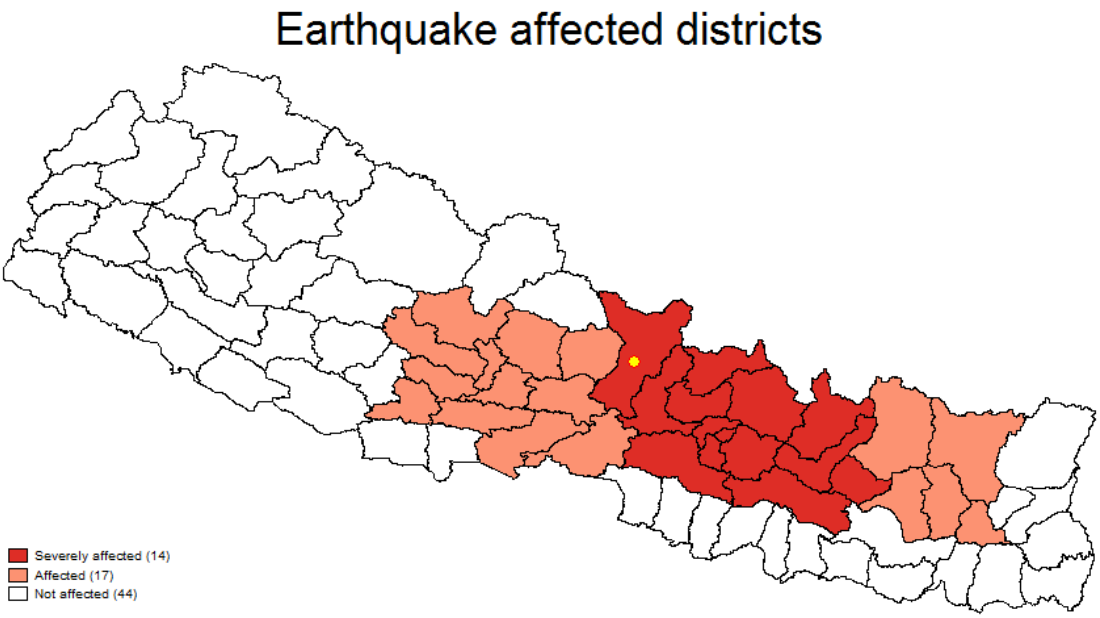
Source: DoFE (2014) and NRB (2018)

Figure 2.3: Nepal-Qatar Migration Process



Source: Shishido (2011)

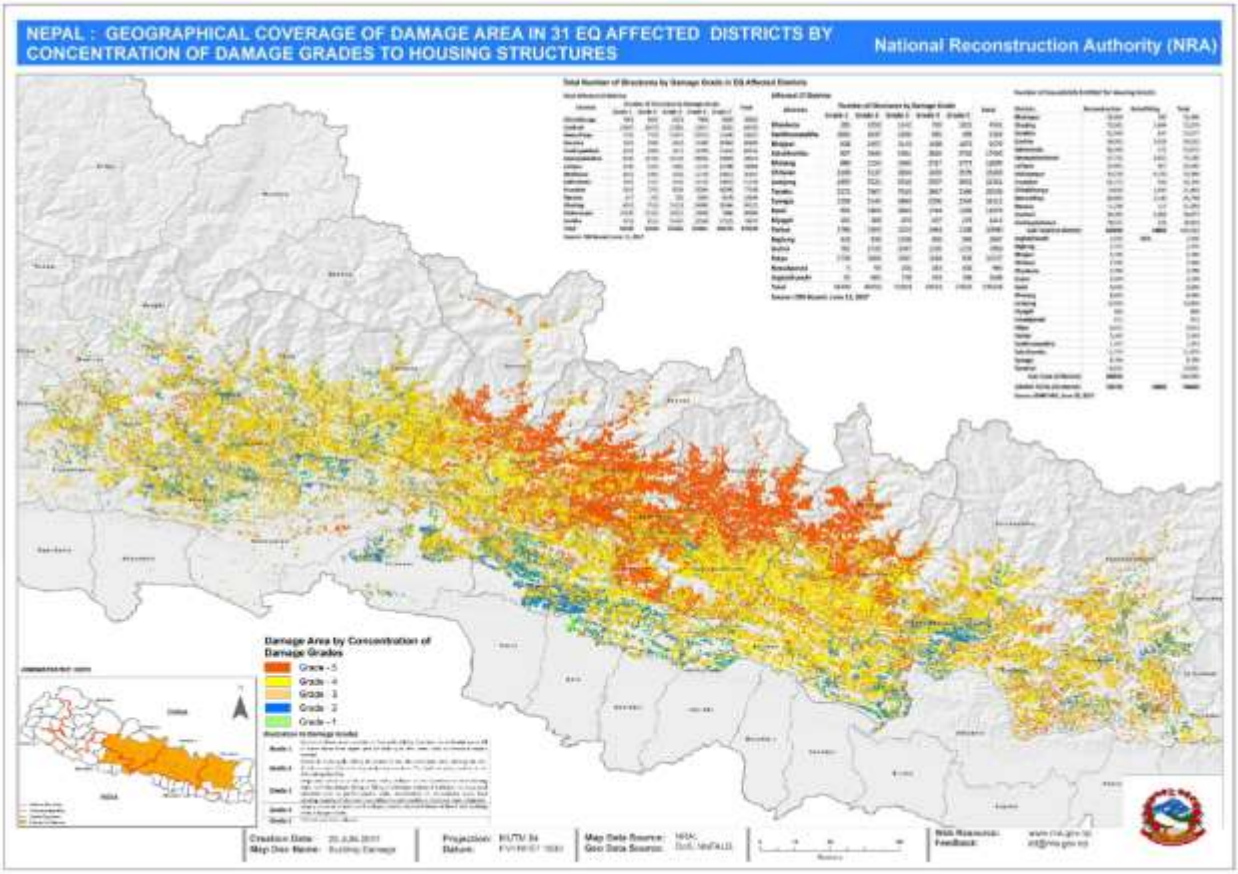
Figure 3.1: Earthquake Affected Districts



Note: The yellow circle depicts the epicenter at Barpark in Gorkha district.

Source: Author's illustration

Figure 3.2: Severity of Housing Damage



Note: The figure shows the housing damage based on the severity of damage. Grades 1 and 2 are considered as habitable as the load carrying capacity of houses is not reduced appreciably and are categorized as partially damaged. Grades 3, 4 and 5 are categorized as severely damaged, which either would require significant structural repair or are totally collapsed.

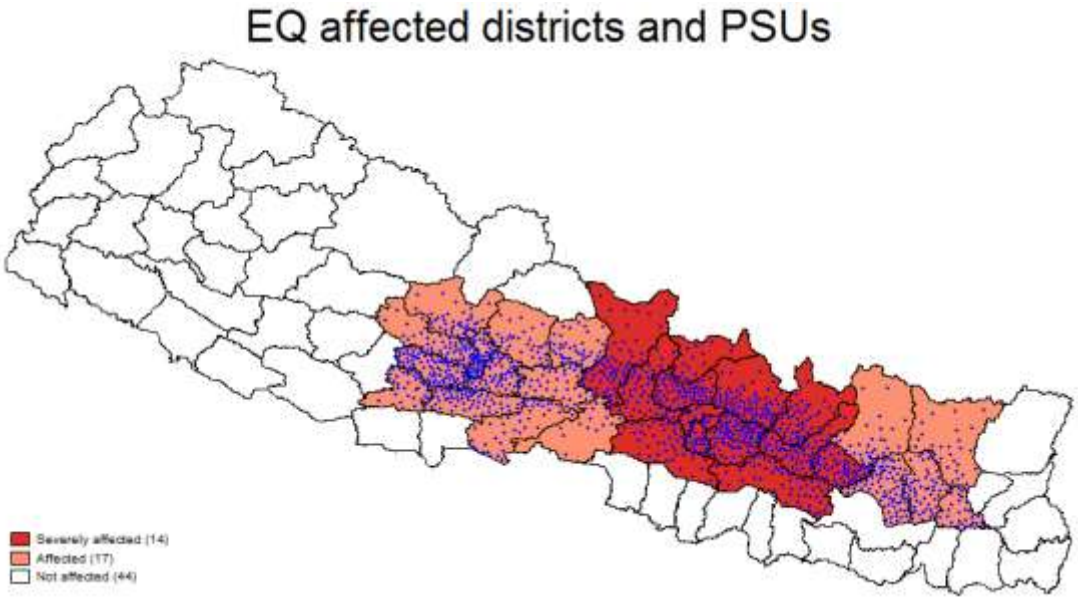
Source: National Reconstruction Authority

Table 3.2.1: Grading Criteria for Severity of Housing Damage

Grade category	Description
Grade 1	House requires only architectural repairs. Specifically, the house has hairline to thin cracks in plaster on few walls, falling of plaster bits in limited parts, and fall of loose stone from upper part of building in few cases.
Grade 2	Load carrying capacity of the house is not reduced appreciably. Specifically, the house has cracks in many walls, falling of plaster in bits over large area, damage to non-structural parts like chimney and projecting cornices.
Grade 3	Load carrying capacity of structure is partially reduced and the house requires significant structural repair. Specifically, the house has large and extensive cracks in most walls, collapse of small portion of non-load bearing walls, roof tiles detach, tilting or falling of chimneys, failure of individual non-structural elements such a partition/gable walls, and delamination of stone/abode walls.
Grade 4	Large gaps occur in walls, walls collapse, partial structural failure of floor or roof, and building is in danger of collapse.
Grade 5	House is in total or near total collapse.

Source: CBS (2017)

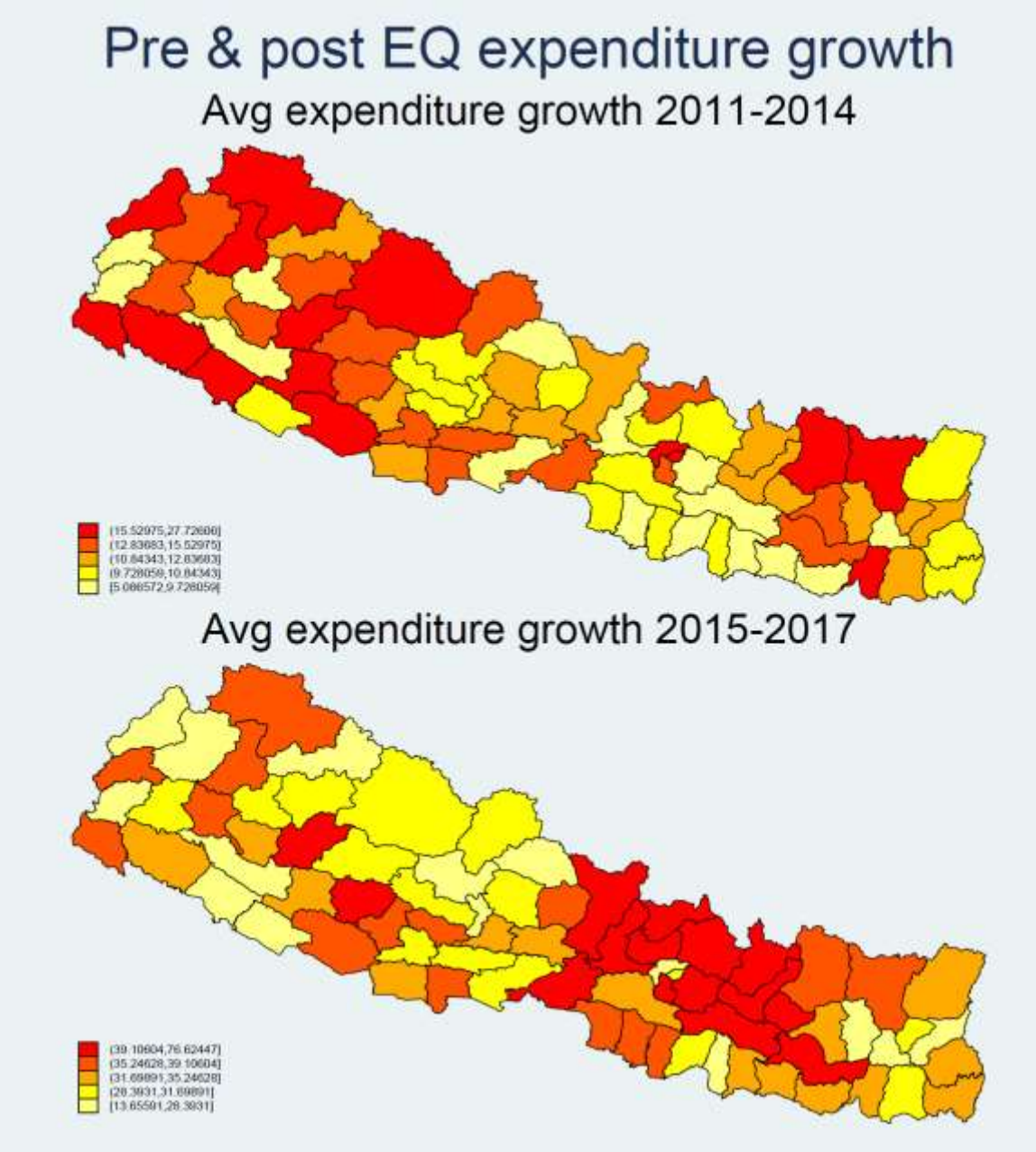
Figure 3.3: Centroid of Ward



Note: The figure shows the earthquake-affected districts and centroid of wards, which are matched to local wards or municipalities in Household Registration for Housing Reconstruction Program survey (CBS, 2017). The instrument refers to the distance from these wards (PSUs) to the epicenter of the 2015 earthquake.

Source: Author's illustration

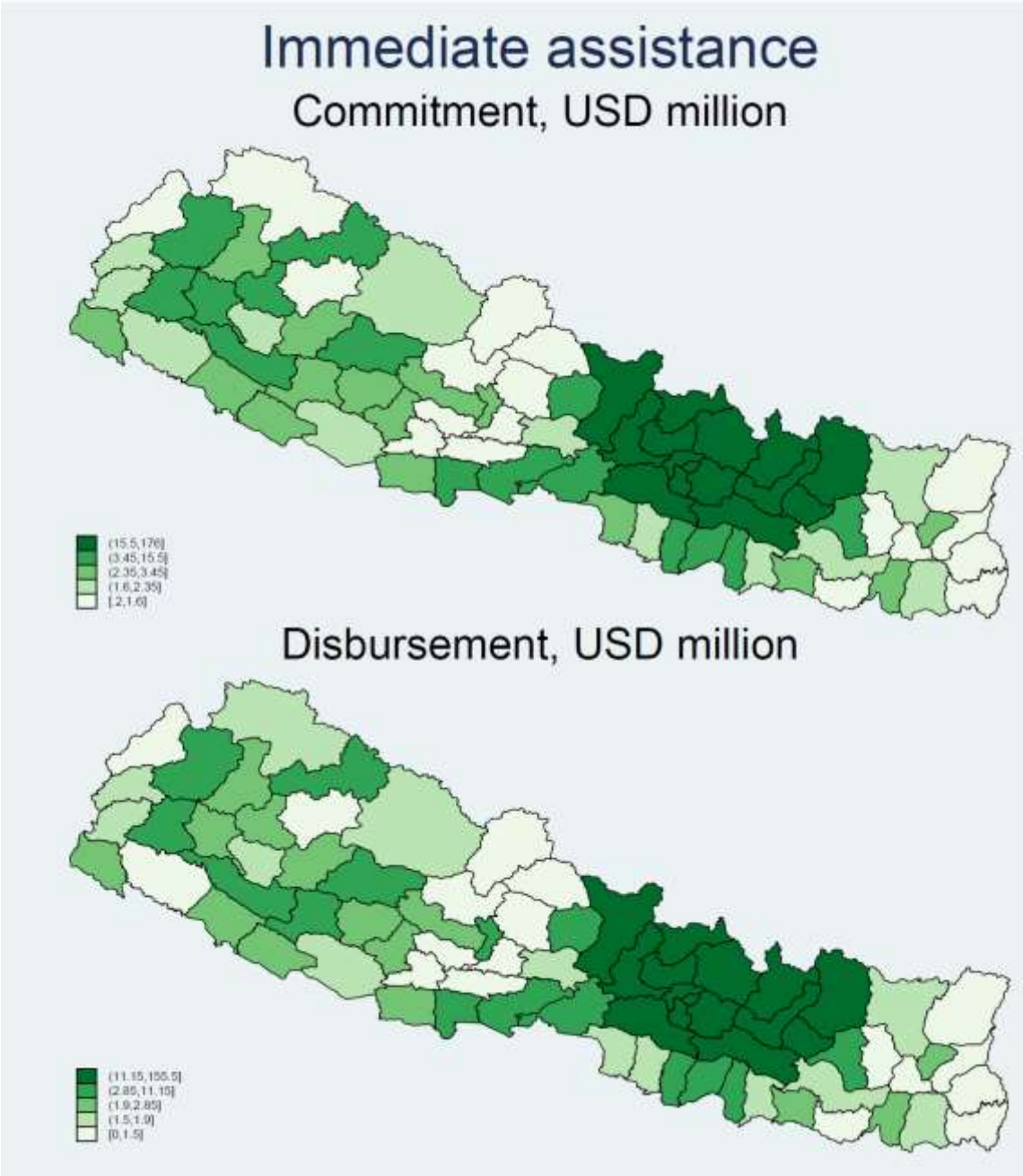
Figure 4.1: Pre and Post Earthquake Expenditure Growth



Note: The figure shows the average annual growth rates of public expenditure in the districts.

Source: Author's illustration based on data from Ministry of Finance

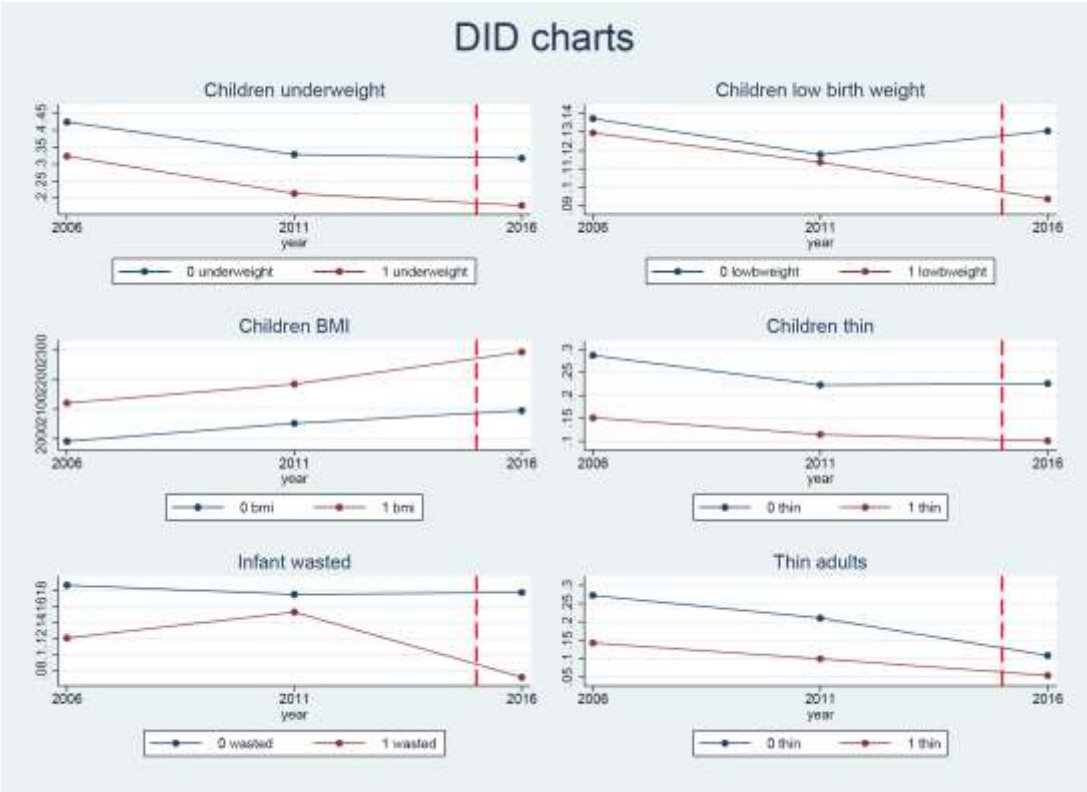
Figure 4.2: Immediate Non-governmental Assistance



Note: The figure shows non-government sector's commitment and disbursement immediately after the earthquake.

Source: Authors' illustration using data from Ministry of Finance.

Figure 4.3: DID charts



Note: The figure shows common pre-treatment trend with mean of the outcome variables for three years (2006, 2011 and 2016). The parallel trend assumption is satisfied in the case of underweight, low birthweight and body mass index for children, and thin for adults.