

The impact of the 2015 earthquake on internal and international migration in Nepal

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Abstract

Migration for work is a defining feature of the Nepali labor market. This study examines the impact of the 2015 earthquake on internal and international migration in Nepal. Using ground shaking intensity and damage severity as measures of earthquake impact, I employ a series of difference-in-difference equations to estimate the impact using two different datasets. The results across both measures and datasets show a decline in emigration among men, particularly to countries other than India post-earthquake in the affected districts. For women, the mostly insignificant results suggest little to no effect on their migration, and the impact of the earthquake on internal migration is minimal as well.

1 Introduction

Nepal has been experiencing a rise in migration in recent years. Until the late 1990s, migration out of Nepal was limited mostly to India because of physical proximity and cultural and historical ties. With the Nepal government's policy to promote institutions that facilitate foreign employment in countries other than

India, migration for work, particularly to Malaysia and Gulf countries, has been increasing. This rise in migration has been accompanied by the government's efforts to regulate the foreign employment market such as the formulation of Nepal's Foreign Employment Policy 2012 and National Strategic Action Plan 2015-22 for the migrating workers' welfare [Bossavie and Denisova, 2018]. There have been cases of Nepali workers being stranded and facing challenges in foreign countries, with some falling victim to deceitful manpower agencies that issue fake documents. As a response, the Department of Foreign Employment has advised all Nepali workers to acquire valid work permits, as working without one is against the law [RSS, 2022]. The recent foreign employment policies ensure the safety of Nepali migrants working abroad. Over the course of 2008 to 2018, the Department of Foreign Employment issued more than 4 million work permits [Migration Report, 2020] for Nepali migrant workers to work outside the country excluding India.

In this paper, I examine the effect of the devastating 7.6 magnitude earthquake on April 25, 2015, on migration in Nepal. The earthquake hit north-central Nepal at 11:56 a.m. damaging buildings and infrastructures and leaving around 8,790 dead and 22,300 injured [NPC, 2015]. On May 12, 2015, a 6.8 magnitude aftershock hit the same region again, with the epicenter further east than the epicenter of the first earthquake. The damage from the earthquake and aftershocks was estimated to be up to USD 7 billion [Maharjan et al., 2016]. Central Nepal, the crisis hit zone as seen in Figure A.1, is the third-largest region in terms of work permit issuances [Migration Report, 2020]. I examine whether the earthquake led to an increase or decrease in

migration in the earthquake-affected regions.

Shakya et al. [2022] address this question using district-level data on work permits for international migrants issued by the Department of Foreign Employment. They find that there is a 37.8% decrease in work permits issued per 100,000 population post-earthquake in the severely affected districts. However, due to the use of administrative data, they fail to factor in illegal migrants, internal migrants, and migrants to India since Nepal-India migration is not regulated due to an open border shared between the two countries.

This paper extends the study by Shakya et al. [2022] by examining internal migration and tries to overcome its shortcomings in analyzing international migration. To do so, I use the Nepal Labor Force Survey (NLFS) 2007/08 and 2017/18, which contains information on household members who have migrated from their district of origin, including migrants to India and internal migrants. These labor force surveys include individual characteristics such as sex, age, education, and caste that can be used as individual controls, setting it apart from Shakya et al. [2022]. Using two definitions for classification of districts into treatment and control groups (following Shakya et al. [2022]), one by NPC [2015] based on damage severity (two categories: severely affected and not severely affected) and the other by the United States Geological Survey based on Peak Ground Acceleration that quantifies the ground shaking intensity (five categories: severe, very strong, strong, moderate, and light), and the data from NLFS 2007/08 as pre-treatment and NLFS 2017/18 as post-treatment period, this paper employs a difference-in-difference method to estimate

the changes in migration caused by the earthquake. Since the classification criteria are not specified by NPC [2015], my primary focus is on the outcomes based on the ground shaking intensity classification.

My results based on ground shaking classification indicate the likelihood of moving, internally or internationally, is reduced in the affected districts. The impact of internal migration is minimal. Notably, emigration, particularly to India, is considerably lower for men. Likewise, the probability of migration to countries other than India is also negative for men in strongly affected districts. Conversely, the results for women are small and statistically insignificant, showing little to no effect. The results obtained from the damage classification indicate minimal to no effects on both internal and international migration including emigration to India, the Gulf, and migration to countries other than India. However, the only exception is for women, as the results indicate a statistically significant increase in their likelihood to migrate to Gulf countries.

The different outcomes for migration using two measures of the earthquake impact, damage and shake intensity, are puzzling. It could be that the two classifications capture two different aspects of the earthquake's effect, with one detecting an early migration response while the other reflecting later migration patterns, though it cannot be pinned down which is which. I use the district-level work permit panel data from 2008 to 2018 as a second way of measuring moving internationally to countries other than India, which allows for checking pre-trends. The results indicate a decline in the total (22%) and male (28%) work permits issued in the severely impacted

districts using the damage classification. This trend aligns with the observations made by Shakya et al. [2022]. However, in contrast to their findings, which report insignificant results for women, my results show a statistically significant impact in the case of female work permits. When applying the ground shaking classification, the treatment effect exhibits a negative trend but is statistically insignificant for the moderately and strongly affected districts. Shakya et al. [2022] also employed the ground shake classification in their robustness check and their baseline findings are robust across various levels of ground shaking. However, it is important to note that Shakya et al. [2022] employed four sets of treatment and control groups based on ground shaking intensity, while I use a categorical variable for this purpose.

There are several opposing theories that offer explanations for how migration would change in response to natural disasters. Migration could increase the search for better opportunities elsewhere since natural disasters often lead to the destruction of properties and loss of income and because remittances from a family member abroad can help the family in rebuilding or relocating. Or it could decrease due to increasing job opportunities in the recovery phase, particularly in the reconstruction sector, or because of a lack of access to transportation or financial instruments for migration costs. My results suggest that the earthquake had a negative impact on the emigration of men with no significant impact on women. This result is consistent with Spitzer et al. [2020], who find that the earthquake of 1906 in the Messina-Reggio Calabria region of Italy, at the height of the Age of Mass Migration, had an insignificant 7% relative decrease in emigration from affected areas. Gröschl and

Steinwachs [2017] also find a non-significant impact on international migration of natural hazards. The effect of earthquakes on the permanent migration of households is also not significant as presented in Bohra-Mishra et al. [2014]; a 1% increase in houses destroyed during earthquake decreases the probability of migrating by 0.00000016. Conversely, Mahajan and Yang [2020] show that migration from other countries to the US increases when a hurricane affects the origin countries.

Unlike Ager et al. [2020]’s study of the 1906 San Francisco earthquake on migration where they find that the earthquake led to fewer migrants and damaged the role of chain migration in the area by a third, my results show no significant effect on internal migration in Nepal. Gröger and Zylberberg [2016] study on the impact of typhoon Ketsana in Vietnam in 2009 on household income and how households react to the income shock. Their results show that long-distance migration from rural to urban areas increases as a coping strategy for income loss. While damage and loss are factors in deciding to move, financial constraints to cover migration costs can deter migration. Yang [2008] find strong evidence for difficulties in accessing the credit market after the earthquake, leading to a decline in migration in areas closest to the earthquake in El Salvador.

2 Data

The main data used in this paper is the Nepal Labor Force Survey 2007/08 and 2017/18 obtained from the Central Bureau of Statistics, Nepal. These nationwide

surveys were conducted to gain insight into various labor market indicators in the country such as employment, unemployment, underemployment, and labor force participation. These household-based surveys collect data on the economic activities of household members along with demographic and housing information. The survey also includes data on absentee members of the household; those who have been away from the house for at least six months and are expected to return in the future, thus capturing any illegal migration as well. As with any survey data, they are self-reported and the information on absentee members of the household is not completely reliable, and migration, both internal and international, may be undercounted. Additionally, if the entire household moves away permanently, this survey has no way of recognizing such families. These surveys are conducted every ten years, so data on intermediate years between 2008 and 2018 are not available.

Households with a migrant member report how long that member has been away from the household. People who moved more than three years before the 2017/18 labor force survey moved before the earthquake. Therefore, their migration decision was unaffected by the earthquake, hence they are part of the non-migrants¹; I adjusted the outcomes of those who migrated three years before the survey to that of non-migrants. Since I am adjusting for the post-earthquake migrants, I also adjust for pre-earthquake absent people in the same way. Pre-earthquake migrants who moved three years before the 2007/08 survey are counted as non-migrants. After this adjustment, 4840 individuals listed as migrants changed to non-migrants. With this adjustment,

¹If the respondents answer that the migrant member has been away for more than three years, permanent migration or potential return migration can also be studied. I will examine this in a future iteration.

the people who migrated right after the earthquake and returned within three years will not be observed in this data.

I use the National Planning Commission’s (NPC) definition of severely affected and not severely affected districts [NPC, 2015]. Shakya et al. [2022] also use this definition for their main analysis. NPC classifies 14 out of the then 75 districts as severely affected districts (Nepal currently has 77 districts as the government split two districts each into two in the 2015 Constitution). The NPC does not provide the reasoning for how they have determined which districts are categorized as severely affected and not severely affected, although the Post Disaster Needs Assessment Report suggests the classification was based on damage percent in those districts.

In addition to the damage classification of severely affected districts, I follow Shakya et al. [2022], which uses the Peak Ground Acceleration (PGA) Data from the United States Geological Survey as their robustness check. The effect of the earthquake is “Severe” if $PGA > 0.3$, “Very Strong” if $0.2 < PGA \leq 0.3$, “Strong” if $0.1 < PGA \leq 0.2$, “Moderate” if $0.02 < PGA \leq 0.1$, and “Light” if $PGA \leq 0.02$. Shakya et al. [2022] conduct a series of difference-in-difference regression where they assign “Light” as their control group and the treatment group is one of the other three categories for each regression (the data from the two unused categories are not included in the regression). Instead, I use “Light” as my control group and assign the degrees of severity as categories to the treatment variable. The district classification based on ground shaking data and damage data is presented in Table A1 in the appendix.

In order for Nepali citizens to work outside the country legally (aside from India),

they have to obtain work permits from the Department of Foreign Employment. The work permit application process requires submitting an employment letter, a valid passport, and a valid work visa along with other documents. This paper also uses the same data as Shakya et al. [2022]² on the number of work permits issued in each district from 2008 to 2018, split by gender. I obtained this data from the appendix tables of the Nepal Labour Migration Report 2020 and Labour Migration for Employment: A Status Report for 2015/16-2016/17 issued by the Ministry of Labour, Employment, and Social Security³. I do not include the workers who renewed their work permits. Various worker characteristics such as age, caste, etc are not available for this data. As Nepal shares an open border with India, people are free to move between borders without any logistical process. Due to this, the Department of Foreign Employment does not mandate people working in India to get work permits. Hence, this data does not include Nepali labor workers in India, a popular destination for Nepali migrant workers.

Table 1 shows the internal and international migration destination by year, further broken down into development regions ⁴ for internal and countries for international. In 2008, 44.8% of the migration was internal whereas 54% was international. In 2018, internal migration decreased to 38.9% and international migration increased to 60.9%. In both years, the internal destination attracting the most migrants was the Central Development Region, probably because the capital city, Kathmandu, is

²Shakya et al. [2022] use the permit data from 2010/11-2015/16.

³Since the Department of Foreign Employment's database is online and is updated real-time, data gathered at one point may not match in the future [Migration Report, 2018].

⁴The development regions were replaced with seven provinces after the promulgation of a new constitution in 2015. I use the development regions to group districts for 2018 data as well.

located there. Likewise, India is the major international destination, followed by the Gulf and Malaysia. Central Development Region and India are the top internal and international destinations for long-term migrants (those who moved more than three years before the survey) as well.

Figure 1 illustrates the labor permits issued over the years 2008-2018 for men and women. There is a general upward trend for both from 2008 to 2013. Subsequently, the permits issued for men saw a decline from 2013 to 2016, while permits for women experienced a similar trend from 2013 to 2015, before rising in 2017 for men and 2-16 for women, followed by a dip in 2018. The number of permits issued to men is higher than women. It could be because males are mostly the breadwinners of the family in Nepal, so they are more likely to go abroad for work. Or it could be due to the enforcement of additional safety measures by the Nepal government for females to prevent trafficking and abuse.

3 Model/Methodology

The paper employs a simple two-period difference-in-difference (DD) to estimate the impact of the earthquake on migration. The DD is estimated using the following model:

$$Y_{idt} = \beta_0 + \beta_1 post + \delta (treat \times post) + \gamma_d + X_{idt} + \epsilon_{idt} \quad (1)$$

Y_{idt} represents a binary outcome variable, taking the value 1 if an individual has migrated (listed as an absentee in the survey) and 0 if the individual is a non-migrant in district d at time t . The outcome variable changes across regressions. Table 2 presents the six sets of dependent variables used in the regressions below. When the dependent variable is migrate, internally or internationally, it takes outcome 1 for migrating internally or internationally and outcome 0 for not migrating. Out of the sample used for this study, 14.5% migrate and 85.5% do not migrate. Similarly, when the dependent variable is migrate internally, it takes outcome 1 for migrating internally and outcome 0 for not migrating or migrating internationally. Out of the sample used for this study, 5.8% migrate internally, and 85.5% either do not migrate or migrate internationally. $Post$ is the post-earthquake dummy for the 2017/18 survey. $treat \times post$ is the DD variable. γ_d is district fixed effects. X_{idt} represents controls for sex, age, education level, and caste. All the variables except for age are categorical variables. The categories for the education levels and castes are presented in Table A2 in the appendix. The reference group for education is kindergarten (Nursery/KG/Shishu) and for castes is Brahmin. The main coefficient of interest is δ , which captures the treatment effect. ϵ_{idt} is the error term. The standard errors are clustered at the district level (origin districts).

I use two definitions of treatment and control district classification. Under the damage classification, treatment districts are the 14 severely affected districts. So, the variable $treat$ is a binary indicator where 0 is the control group, in this case, not severely affected districts, and 1 is the treatment group, which is severely affected

districts. Control districts are the remaining 61 districts. Under the ground shaking classification, I group “Severe” and “Very Strong” into the “Strong” category as there are only 3 districts combined in both of those groups. So, the variable *treat*, in this case, is a categorical variable, where 0 includes the “Light” districts, 1 includes the “Moderate” districts, and 2 represents the “Strong” category.

Since the surveys are available for only two time periods, one before and one after the earthquake, the parallel trend assumption cannot be tested with this data. So as a second way of measuring emigration to countries aside from India, I use the following DD equation for the administrative data on work permits:

$$Y_{dt} = \beta_0 + \beta_1 (treat \times post) + \gamma_d + \lambda_t + \epsilon_{dt} \quad (2)$$

Y_{dt} is the logarithm of the work permits⁵ issued in district d in year t . *treat* is a dummy or a categorical variable depending on the district classification used. *post* is a dummy that takes value 1 for years after 2014. The work permit data are recorded under fiscal years. The fiscal year in Nepal runs from July 17 of the current year to July 16 of the next year. Since the earthquake happened in April 2015, it falls under fiscal year 2014/15, or 2014 for convenience. γ_d is district fixed effects and λ_t is year fixed effects. β_1 is the main coefficient of interest that captures the treatment effect.

⁵Some districts issued 0 labor permits to females in some years. Taking the logarithm of 0 generates missing values, so I replaced 35 of those missing values with 0.

4 Results

4.1 NLFS Data

Panel A of Tables 3 to 8 present the DD results for various outcomes using the earthquake damage district classification with one treatment and one control group. Panel B of these tables presents the results for the DD equation using the ground-shaking classification. Panel A of Table 3 presents the DD results for migrating internally or internationally and not migrating as the outcome variable. Columns (1) and (2) comprise the total sample in the survey with and without controls respectively. Columns (3) and (4) are for males and the remaining columns (5) and (6) are for females. The treatment effect is positive but statistically non-significant for everyone. The likelihood of migrating after the earthquake in the most affected districts is higher than in the less affected districts. The treatment effect is particularly small for males. For the total and female population, the probability is higher by 1% and 1.3% respectively. The controls for education and caste change the post coefficient for males; males with higher than third-grade education are more likely to migrate and men belonging to all castes except Brahmin (the reference group) migrate more. In the case of females, education level affects the post coefficient the most; the women who migrate have at least a tenth-grade education. In Panel B of Table 3, the results use ground-shaking district classification. Opposite to Panel A, the treatment effect is negative and significant for the total and male population in strongly and moderately affected districts. The likelihood

that males in the moderate districts migrate post-earthquake is lower by 4.1% than in light districts. For females in the moderate districts, the likelihood of migrating is positive but small. In the strong districts, the probability of migrating is lower for the total and male population as compared to the light districts by 3.9% and 6.4% respectively. In the case of females in strong districts, the treatment effect is negative and insignificant. Like the damage classification, adding education levels (and caste) as control(s) influences the post variable for females (males).

Table 4 presents DD results with outcome 1 as migrating internally and outcome 0 as not migrating or migrating internationally. For the damage classification, the treatment effect is positive and statistically non-significant for everyone. Age has a negative effect on migrating internally for males and influences the post coefficient. The likelihood of migrating internally goes down as males grow old. Education control is the main factor for the change in the post coefficient for females. Females with higher education levels, tenth grade and above, migrate more. The treatment effect is insignificant for everyone under the ground shake classification as well; negative for total with controls and males in strong districts, negative for males with controls in moderate districts, and positive for the rest. In both categories, the magnitude of impact on women is similar to men.

Table 5 shows the results for the DD equation with outcome 1 as migrating internationally and outcome 0 as not migrating or migrating internally. Panel A presents the damage classification results. The treatment effect is positive and statistically non-significant for the total and female population. Men in severely affected districts are less likely

to move internationally post-earthquake, although statistically insignificant. The controls for education and caste change the coefficient for post for men. The results under the ground shake classification are presented in Panel B. Unlike the damage classification, in districts that are strongly affected, the probability of migrating outside the country is significantly lower for everyone. Similarly, the treatment effect is negative (and significant) for everyone (total and male) in moderately affected districts. The likelihood that males in those districts migrate outside the country post-earthquake is lower by 4.2% than in light districts. Similar to the damage measure, adding controls for education and caste influences the post coefficient for males. Both classifications show that men are less likely to migrate internationally, suggesting the presence of more opportunities inside the country.

Table 6 shows the results for DD equation with outcome 1 as migrating to India and outcome 0 as not migrating or migrating internally or migrating to countries other than India. Nepal and India share an open border, so migration between the two countries is not on official record, which is why Shakya et al. [2022] were not able to analyze Nepal-India migration. The treatment effect is positive and statistically non-significant for the total, male (except Column 3), and female population. The likelihood of migrating to India after the earthquake in the most affected districts is higher by a very small percentage than in the less affected districts. Panel B shows different results. In both categories, the probability of migrating to India is significantly lower for the total and male population as compared to light districts by 2.6% and 4% for strong and 2.1% and 3.4% respectively. For females in both

categories, the treatment effect is negative and insignificant.

Table 7 presents the results for the DD equation with outcome 1 as migrating to the Gulf and outcome 0 as not migrating or migrating internally or migrating to countries other than the Gulf. Using damage classification in Panel A, the treatment effect is positive for the total, male (except Column 3), and female population. The probability that females in affected districts move to Gulf countries post-earthquake is higher by 0.4% and is statistically significant. In Panel B for ground shake, everyone is less likely to migrate to the Gulf in the strong districts. In moderate districts, the treatment effect is negative and insignificant for total and males. For females, the treatment effect is small but positive.

Table 8 shows the results for the DD equation with outcome 1 as migrating to not India and outcome 0 as not migrating or migrating internally or migrating to countries other than India. In Panel A, the treatment effect is negative and insignificant for the total and male population. The probability of moving to countries other than India is higher for females by 0.2% in severely affected districts than in non-affected districts. The results are mostly similar for ground shake classification. The total and male population in strong districts have a significantly lower probability of migrating to countries other than India by 1.4% and 2.2% respectively than the light districts. For females in those districts, the treatment effect is negative and insignificant. The treatment effect is negative and insignificant for total and males in moderate districts whereas for females, the treatment effect is positive and insignificant.

4.2 Administrative work permits data

Figures 2, 3, and 4 show the average trends for the permits issued in each district over the years 2008-2018 for the total, male, and female population, grouped according to the damage and ground shake classification. Pre-earthquake, the trends are parallel for the treatment and control groups. After the earthquake, the permits issued decreased for total and males under both classifications, but the permits issued to females do not seem to change very much. In both definitions, the treatment and control districts follow the same pattern before the earthquake. Right after the earthquake, the number of work permits issued decreased and went further down until it increased again in 2017 and dropped again in 2018.

Table 9 shows the results for the DD equation where the outcome variable is the logarithm of work permits issued in each district. In Panel A, the treatment and control districts are classified according to damage. The treatment effect is negative and significant at 1% for the total and male population. The number of permits issued to work abroad decreased by 22% and 28% for the total and male population in severely affected districts after the earthquake. For females, the number of work permits issued increased by 13% at 10% significance level. Shakya et al. [2022] also find similar effects for the total and male population. However, their effect on females is insignificant. Using the ground shake classification in Panel B, the effect on the work permits issued is insignificant, opposite from Panel A, except for females in moderately affected districts where the work permit issued to them increased by 27% post-earthquake.

I also conducted an event study on this data to examine the year-by-year breakdown of the impact of the earthquake. For this, I use damage classification to form the treatment and control districts and follow the panel event study design by Clarke and Tapia-Schythe [2021]. Figure 5, shows the event study plot for the total permits issued, permits issued to males, and permits issued to females in panels a, b, and c. Figure 5a shows evidence of a significant decrease in work permits issued right after the earthquake. However, there are significant differences in the pre-earthquake period as well, particularly 5 and 6 years before the earthquake. Similar to the total permits issued, the permits issued for males also decreased significantly following the earthquake and rose gradually. There is only one significant difference in the pre-earthquake period. In the case of females, there are a number of significant differences before the earthquake and no significant change in the work permits issued post-earthquake. Since there were significant pre-trends before the earthquake, I used the synthetic difference in difference (sDiD) method to consistently estimate the treatment effect by constructing control districts that are comparable to the treatment districts. I implement the sDiD estimator based on Arkhangelsky et al. [2021] with clustered bootstrap variance coded by Clarke et al. [2023] in Stata.

Table 10 presents the sDiD results where the outcome variable is the logarithm of work permits issued in each district. In Panel A, the treatment and control districts are classified according to damage. The results are similar to Panel A of Table 9; the treatment effect is negative and significant at 1% for the total and male population except for the insignificant effect on females. Panel B shows the results for ground

shaking classification. The sDiD command in Stata only allows for one treatment and one control group, so I grouped Moderate and Strong districts to make the treatment group. Light is the control group. The treatment effect is insignificant for total and females. The impact on permits issued to males is negative and significant at 10%. The results from both panels suggest that men stopped migrating internationally to countries other than India. Figures 6, 7, and 8 echo the results in the table. Post-earthquake, the labor permits issued for the total and male population declined sharply in Panel A as compared to the control group. In Panel B, the permit trends declined, although not as sharply as in Panel A. In contrast, the outcome trends stayed parallel for females even after the earthquake, suggesting that the impact of the earthquake on female outmigration was not significant.

Overall, the results from the survey data suggest that men are less likely to migrate internationally using the ground shaking specification. The damage classification does not have a strong impact on the emigration of men. With the permit data DD results for damage classification, it is evident that the emigration of men to countries other than India declined. In contrast, ground shake intensity does not significantly impact male emigration in the same way. This effect is positive and statistically significant for males in the sDiD results. Therefore, across both classifications and datasets, the emigration of men decreased, particularly to destinations other than India. The results for women are mostly insignificant, indicating that the earthquake had little to no effect on their migration behavior.

5 Discussion

In theory, the districts that have been severely damaged should correspond to the districts that experienced the intense ground-shaking, and the results should also reflect this. However, the results in the previous section show otherwise, which is puzzling. Since the NPC [2015] does not specify how they categorized the districts into severely hit and not severely hit by the earthquake, though it largely seems to be based on most damage, it may not align entirely with the ground tremor classification. The ground shake classification is an established method of measuring earthquake intensity, so I focus more on the results from this measurement. From the ground shake results of the survey data, men are less likely to migrate internationally. The permit data results from sDiD analysis also show that men stopped going to countries other than India for work; male emigration decreased as a result of the earthquake. Women represent a smaller percentage of people who migrate, so the standard errors cannot get small enough to capture possibly significant changes in migration. Hence the earthquake has little to no effect on women. There is also minimal impact on internal migration. However, it is interesting to observe that women move internally as much as men. A likely explanation could be that since the costs of internal migration are not as high as international, married women move with their spouses.

Drawing from the results, it could be that the two measurements for how the earthquake affected the districts have different effects on migration. The effect of the damage, as classified by the NPC, is that people in the affected regions

move immediately and temporarily or with the entire household in response to the earthquake. Since I defined migrants as people who moved three years before 2018 in the survey data, people who moved right after the earthquake and returned within three years would not be counted in the survey. But they would be seen in the work permits if they migrated to another country. The effect of the ground shaking, defined according to PGA, could be that people emigrated later or for longer or without their families, so they are observed in the survey data along with the permit data. Overall, this explanation for the puzzling results is not comprehensive; it is rather suggestive and might not be entirely plausible.

The earthquake's impact was devastating, resulting in the widespread destruction of historical sites and traditional mud-brick houses within the affected region. In response, the government established the National Reconstruction Authority, collaborating with the Nepal Earthquake Housing Reconstruction Project supported by the World Bank [Nepali, 2021], to provide financial assistance to individuals facing such losses. With a focus on reconstruction efforts, it could be that the control districts may not entirely be control districts. It is possible that individuals move from control to treatment districts, residing in temporary housing. This shift could potentially divert individuals from seeking opportunities to migrate abroad, explaining the observed decline in emigration in the results.

6 Conclusion

There are many accounts of villages in Nepal where the youths have migrated and the people remaining are the elderly and children. This paper studies the impact of the 2015 earthquake on the migration pattern in Nepal. Using the Nepal Labor Force Survey 2007/08 and 2017/18 as the main data source, I employ a simple two-period difference-in-difference to estimate the change in migration. I use two measures of treatment and control group classification: damage and ground shake. Since the criteria for categorizing the districts into severely damaged and not severely damaged is not specified clearly and the two ways of measuring earthquake impact show different results, I focus more on the ground tremor classification results. The results indicate that males are less likely to migrate internationally after the earthquake. The effect on women is small and statistically insignificant. There is no big impact on internal migration. As an additional approach, I use the district-level work permit data to estimate the effect of the earthquake on international migration excluding India. The results show an insignificant effect on the work under the ground shake classification of districts. Using the damage district classification, the results show significant decreases in the number of work permits issued for the total (22%) and male (27.9%) population in the severely affected districts post-earthquake. For females, the number of work permits issued increased significantly by 13%. Since the labor permits issued to females show no pre or post-trends from an event study, I ran a synthetic difference-in-difference to find that the earthquake did not have a significant impact on the number of labor permits issued to females. This result also

shows that men stopped migrating abroad for work. The results from this paper, though puzzling, provide some insight into how the earthquake altered the migration pattern and how it varied across genders. Most of the migration was driven by males. A likely explanation for the results could be that the two ways of measuring the earthquake impact have different effects on migration, with one capturing migrating early and the other capturing migrating later, though it is not easy to distinguish which is which.

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Table 1: Migration destination by year, broken down into regions in percent terms

	Year		>3 years migrants
	2008	2018	
Internal (%)	44.7	38.9	48.5
Eastern	6.2	3.9	6.6
Central	25.4	18.8	29.4
Western	6.6	8.2	6.3
Mid-Western	3.8	4.3	3.9
Far-Western	2.7	3.7	2.3
International (%)	54.1	60.9	50.3
India	25.0	26.0	20.8
South Asia minus India	0.1	0.01	0.2
East Asia	1.4	1.6	1.9
Gulf	13.6	18.6	12.7
Malaysia	5.7	8.1	6.0
US	2.0	0.8	2.1
UK	0.9	0.3	1.1
Australia	0.9	0.8	0.8
Other countries	4.5	4.7	4.7
Don't know (%)	1.2	0.2	1.2

Notes: Internal, International, and Don't know add up to 100%. The destinations within Internal sum to the total Internal. The destinations listed under International sum to the total International. > 3 years migrants are people who have been absent from the household for more than three years when the survey was conducted. I adjust them as non-migrants since I am looking at the impact on earthquake-induced migration.

Table 2: Mean of dependent variables used across regressions

Dependent variable	Total	Male	Female
Migrate	0.145	0.203	0.065
Migrate internally	0.057	0.068	0.043
Migrate internationally	0.080	0.125	0.018
Migrate to India	0.039	0.059	0.010
Migrate to the Gulf	0.025	0.041	0.002
Migrate internationally minus India	0.041	0.065	0.007

Notes: The dependent variable names are outcome 1.

Table 3: Probability of migrating internally or internationally, using damage and ground shake classification

	(1)	(2)	(3)	(4)	(5)	(6)
	Total	Total	Male	Male	Female	Female
Panel A: Damage						
Treat x Post	0.008 (0.010)	0.010 (0.011)	0.000 (0.014)	0.005 (0.015)	0.013 (0.008)	0.013 (0.008)
Post	0.009 (0.008)	-0.011 (0.008)	0.027** (0.011)	-0.002 (0.011)	-0.008 (0.005)	-0.020*** (0.005)
Observations	118,750	118,750	69,369	69,369	49,381	49,381
R squared	0.03	0.13	0.04	0.12	0.02	0.09
Controls	No	Yes	No	Yes	No	Yes
Panel B: Ground shake						
Strong x Post	-0.038* (0.020)	-0.039* (0.021)	-0.062** (0.026)	-0.064** (0.028)	-0.005 (0.014)	-0.007 (0.014)
Moderate x Post	-0.024* (0.013)	-0.022 (0.013)	-0.043** (0.018)	-0.041** (0.019)	0.003 (0.009)	0.002 (0.009)
Post	0.028*** (0.010)	0.008 (0.011)	0.057*** (0.015)	0.028* (0.015)	-0.006 (0.006)	-0.017*** (0.006)
Observations	118,750	118,750	69,369	69,369	49,381	49,381
R squared	0.03	0.13	0.04	0.12	0.02	0.09
Controls	No	Yes	No	Yes	No	Yes

Notes: Linear probability model. Dependent variable takes the value 1 for migrating and 0 for not migrating. All regressions include (origin) district fixed effects. Controls include age, sex, education level, and caste. The controls for columns 4 and 6 do not include sex.

The standard errors in parentheses are clustered at the district level.

*** p<0.01, ** p<0.05, * p<0.10

Table 4: Probability of migrating internally, using damage and ground shake classification

	(1)	(2)	(3)	(4)	(5)	(6)
	Total	Total	Male	Male	Female	Female
<hr/> Panel A: Damage <hr/>						
Treat x Post	0.010 (0.006)	0.010 (0.006)	0.011 (0.008)	0.012 (0.008)	0.007 (0.007)	0.008 (0.007)
Post	-0.003 (0.004)	-0.011*** (0.004)	-0.001 (0.005)	-0.010** (0.005)	-0.005 (0.004)	-0.013*** (0.004)
Observations	118,750	118,750	69,369	69,369	49,381	49,381
R squared	0.02	0.05	0.02	0.05	0.02	0.07
Controls	No	Yes	No	Yes	No	Yes
<hr/> Panel B: Ground shake <hr/>						
Strong x Post	0.001 (0.013)	-0.000 (0.013)	-0.003 (0.015)	-0.005 (0.015)	0.006 (0.011)	0.006 (0.011)
Moderate x Post	0.003 (0.007)	0.002 (0.007)	0.000 (0.008)	-0.000 (0.008)	0.006 (0.007)	0.005 (0.007)
Post	-0.002 (0.005)	-0.010** (0.004)	0.002 (0.006)	-0.006 (0.006)	-0.007** (0.003)	-0.015*** (0.003)
Observations	118,750	118,750	69,369	69,369	49,381	49,381
R squared	0.02	0.05	0.02	0.05	0.02	0.07
Controls	No	Yes	No	Yes	No	Yes

Notes: Linear probability model. The dependent variable takes the value 1 for migrating internally and 0 for not migrating or migrating internationally. All regressions include (origin) district fixed effects. Controls include age, sex, education level, and caste. The controls for columns 4 and 6 do not include sex. The standard errors in parentheses are clustered at the district level.

*** p<0.01, ** p<0.05, * p<0.10

Table 5: Probability of migrating internationally, using damage and ground shake classification

	(1)	(2)	(3)	(4)	(5)	(6)
	Total	Total	Male	Male	Female	Female
Panel A: Damage						
Treat x Post	0.000 (0.006)	0.002 (0.007)	-0.007 (0.010)	-0.002 (0.010)	0.005 (0.003)	0.004 (0.003)
Post	0.011** (0.005)	0.001 (0.005)	0.024*** (0.008)	0.007 (0.008)	-0.002 (0.003)	-0.005* (0.003)
Observations	118,750	118,750	69,369	69,369	49,381	49,381
R squared	0.02	0.11	0.04	0.10	0.01	0.05
Controls	No	Yes	No	Yes	No	Yes
Panel B: Ground shake						
Strong x Post	-0.041*** (0.009)	-0.040*** (0.010)	-0.062*** (0.013)	-0.062*** (0.014)	-0.011* (0.006)	-0.012* (0.006)
Moderate x Post	-0.028*** (0.009)	-0.025*** (0.009)	-0.046*** (0.013)	-0.042*** (0.013)	-0.002 (0.005)	-0.003 (0.005)
Post	0.031*** (0.007)	0.020*** (0.008)	0.054*** (0.011)	0.036*** (0.011)	0.002 (0.004)	-0.001 (0.005)
Observations	118,750	118,750	69,369	69,369	49,381	49,381
R squared	0.02	0.11	0.04	0.10	0.01	0.05
Controls	No	Yes	No	Yes	No	Yes

Notes: Linear probability model. The dependent variable takes the value 1 for migrating internationally and 0 for not migrating or migrating internally. All regressions include (origin) district fixed effects. Controls include age, sex, education level, and caste. The controls for columns 4 and 6 do not include sex. The standard errors in parentheses are clustered at the district level.

*** p<0.01, ** p<0.05, * p<0.10

Table 6: Probability of migrating to India, using damage and ground shake classification

	(1)	(2)	(3)	(4)	(5)	(6)
	Total	Total	Male	Male	Female	Female
<hr/> Panel A: Damage <hr/>						
Treat x Post	0.001 (0.006)	0.003 (0.006)	-0.001 (0.008)	0.002 (0.008)	0.001 (0.003)	0.002 (0.003)
Post	-0.003 (0.005)	-0.007 (0.005)	-0.001 (0.008)	-0.008 (0.007)	-0.003 (0.003)	-0.003 (0.003)
Observations	118,750	118,750	69,369	69,369	49,381	49,381
R squared	0.05	0.10	0.07	0.12	0.02	0.06
Controls	No	Yes	No	Yes	No	Yes
<hr/> Panel B: Ground shake <hr/>						
Strong x Post	-0.026** (0.010)	-0.026** (0.011)	-0.040** (0.016)	-0.040** (0.016)	-0.009 (0.005)	-0.009 (0.005)
Moderate x Post	-0.022** (0.010)	-0.021** (0.010)	-0.036** (0.015)	-0.034** (0.015)	-0.004 (0.005)	-0.004 (0.005)
Post	0.011 (0.009)	0.008 (0.009)	0.021 (0.014)	0.015 (0.013)	0.001 (0.005)	0.000 (0.005)
Observations	118,750	118,750	69,369	69,369	49,381	49,381
R squared	0.05	0.10	0.07	0.12	0.02	0.06
Controls	No	Yes	No	Yes	No	Yes

Notes: Linear probability model. Dependent variable takes the value 1 for migrating to India and 0 for not migrating or migrating internally or migrating to countries other than India. All regressions include (origin) district fixed effects. Controls include age, sex, education level, and caste. The controls for columns 4 and 6 do not include sex. The standard errors in parentheses are clustered at the district level.

*** p<0.01, ** p<0.05, * p<0.10

Table 7: Probability of migrating to the Gulf, using damage and ground shake classification

	(1)	(2)	(3)	(4)	(5)	(6)
	Total	Total	Male	Male	Female	Female
<hr/> Panel A: Damage <hr/>						
Treat x Post	0.001 (0.003)	0.002 (0.003)	-0.001 (0.005)	0.001 (0.005)	0.004*** (0.001)	0.004** (0.001)
Post	0.009*** (0.002)	0.005*** (0.002)	0.017*** (0.003)	0.010*** (0.003)	-0.001 (0.001)	-0.001* (0.001)
Observations	118,750	118,750	69,369	69,369	49,381	49,381
R squared	0.01	0.04	0.02	0.04	0.003	0.01
Controls	No	Yes	No	Yes	No	Yes
<hr/> Panel B: Ground shake <hr/>						
Strong x Post	-0.008** (0.003)	-0.007* (0.004)	-0.010* (0.005)	-0.009 (0.006)	-0.003 (0.002)	-0.004 (0.002)
Moderate x Post	-0.003 (0.003)	-0.002 (0.003)	-0.004 (0.006)	-0.003 (0.006)	0.000 (0.001)	0.000 (0.001)
Post	0.012*** (0.002)	0.008*** (0.002)	0.021*** (0.003)	0.013*** (0.003)	0.001 (0.001)	0.000 (0.001)
Observations	118,750	118,750	69,369	69,369	49,381	49,381
R squared	0.01	0.04	0.02	0.04	0.003	0.01
Controls	No	Yes	No	Yes	No	Yes

Notes: Linear probability model. The dependent variable takes the value 1 for migrating to the Gulf and 0 for not migrating or migrating internally or migrating to countries other than the Gulf. All regressions include (origin) district fixed effects. Controls include age, sex, education level, and caste. The controls for columns 4 and 6 do not include sex. The standard errors in parentheses are clustered at the district level.

*** p<0.01, ** p<0.05, * p<0.10

Table 8: Probability of migrating internationally to countries other than India, using damage and ground shake classification

	(1)	(2)	(3)	(4)	(5)	(6)
	Total	Total	Male	Male	Female	Female
<hr/> Panel A: Damage <hr/>						
Treat x Post	-0.001 (0.004)	-0.001 (0.004)	-0.006 (0.007)	-0.004 (0.007)	0.004** (0.002)	0.002 (0.002)
Post	0.014*** (0.003)	0.008** (0.003)	0.026*** (0.005)	0.015*** (0.005)	0.001 (0.001)	-0.002 (0.001)
Observations	118,750	118,750	69,369	69,369	49,381	49,381
R squared	0.01	0.05	0.02	0.05	0.01	0.02
Controls	No	Yes	No	Yes	No	Yes
<hr/> Panel B: Ground shake <hr/>						
Strong x Post	-0.014*** (0.005)	-0.014** (0.006)	-0.022*** (0.008)	-0.022** (0.009)	-0.002 (0.003)	-0.003 (0.003)
Moderate x Post	-0.006 (0.005)	-0.005 (0.005)	-0.010 (0.008)	-0.008 (0.008)	0.002 (0.002)	0.001 (0.002)
Post	0.019*** (0.003)	0.012*** (0.003)	0.033*** (0.005)	0.021*** (0.005)	0.001 (0.001)	-0.001 (0.001)
Observations	118,750	118,750	69,369	69,369	49,381	49,381
R squared	0.01	0.05	0.02	0.05	0.01	0.02
Controls	No	Yes	No	Yes	No	Yes

Notes: Linear probability model. The dependent variable takes the value 1 for migrating internationally to countries other than India and 0 for not migrating or migrating internally or migrating to India. All regressions include (origin) district fixed effects. Controls include age, sex, education level, and caste. The controls for columns 4 and 6 do not include sex. The standard errors in parentheses are clustered at the district level.

*** p<0.01, ** p<0.05, * p<0.10

Table 9: Impact of the earthquake on work permits issued

	(1)	(2)	(3)
	Total	Male	Female
<hr/> <hr/> Panel A: Damage <hr/>			
Treat x Post	-0.249*** (0.057)	-0.327*** (0.058)	0.123* (0.073)
Observations	825	825	825
R squared	0.97	0.97	0.97
<hr/> <hr/> Panel B: Ground shaking <hr/>			
Strong x Post	-0.082 (0.087)	-0.106 (0.096)	0.106 (0.092)
Moderate x Post	-0.017 (0.081)	-0.053 (0.083)	0.239*** (0.086)
Observations	825	825	825
R squared	0.97	0.97	0.97

Notes: Differences-in-Differences model. Dependent variable is the logarithm of the work permits issued. All regressions include (origin) district and year fixed effects. The standard errors in parentheses are clustered at the district level. Missing values generated as a result of taking the logarithm are replaced as 0 for the female work permits.

*** p<0.01, ** p<0.05, * p<0.10

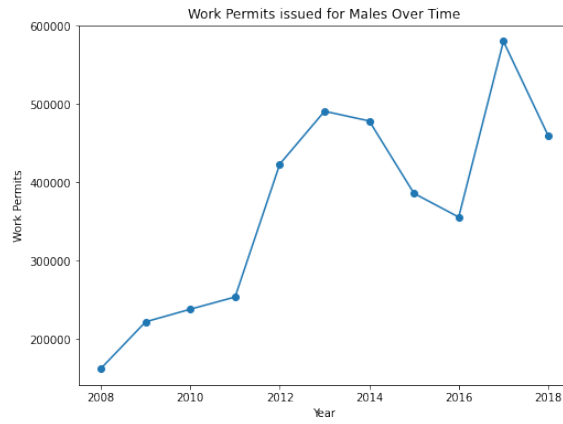
Table 10: Impact of the earthquake on work permits issued-sDiD

	(1)	(2)	(3)
	Total	Male	Female
<hr/> <hr/> Panel A: Damage			
Treat x Post	-0.234*** (0.031)	-0.276*** (0.036)	0.120 (0.074)
Observations	825	825	825
<hr/> <hr/> Panel B: Ground shaking			
Treat x Post	-0.046 (0.042)	-0.078* (0.044)	0.084 (0.060)
Observations	825	825	825

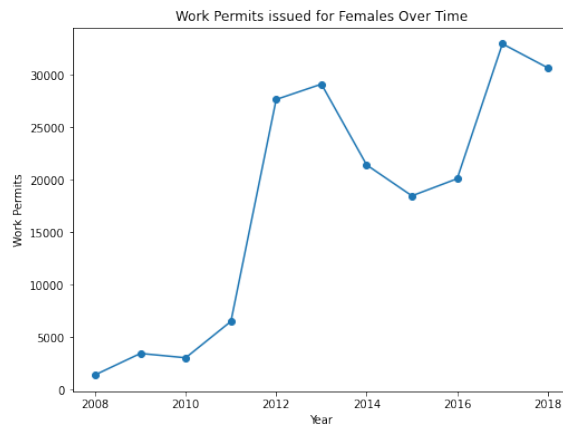
Notes: Synthetic Differences-in-Differences model. Dependent variable is the logarithm of the work permits issued. The standard errors in parentheses are generated using clustered bootstrap. Missing values generated as a result of taking the logarithm are replaced with 0 for the female work permits. The treatment group for ground shaking combines

Moderate and Strong districts.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

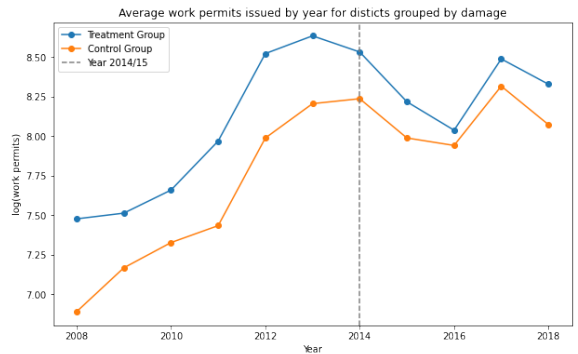


(a) Males

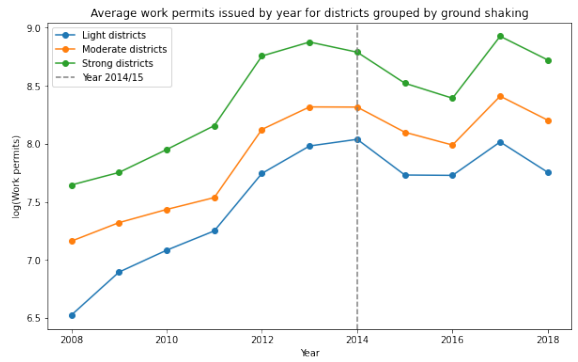


(b) Females

Figure 1: Work permits issued by year for males and females

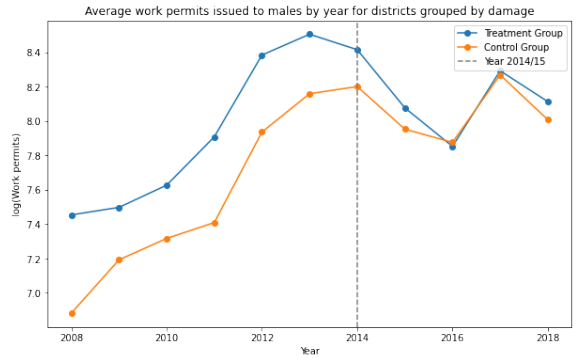


(a) Damage classification

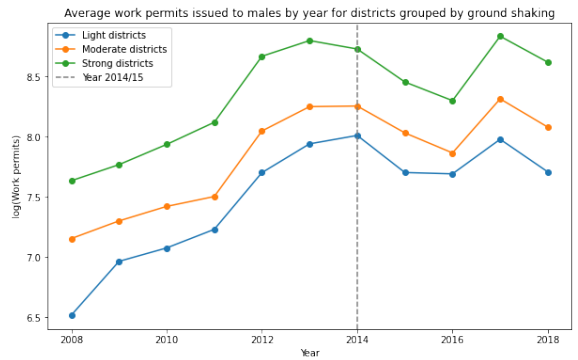


(b) Ground shake classification

Figure 2: Average log permits issued over time

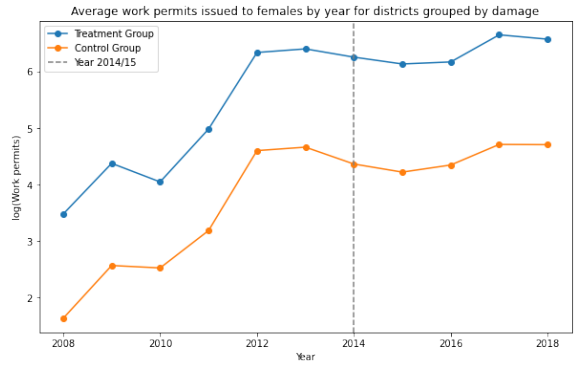


(a) Damage classification

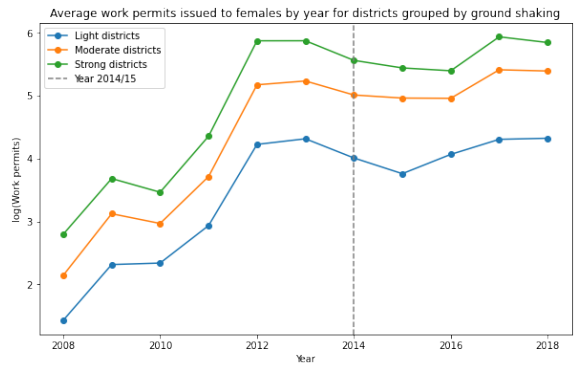


(b) Ground shake classification

Figure 3: Average log permits issued over time to males



(a) Damage classification



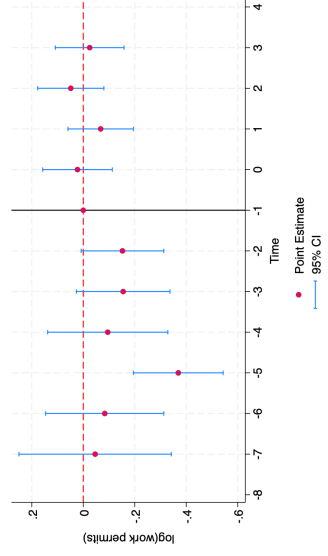
(b) Ground shake classification

Figure 4: Average log permits issued over time to females



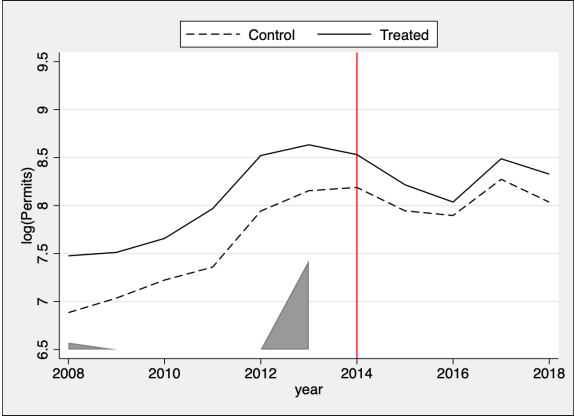
(a) Total work permits issued

(b) Work permits issued to males

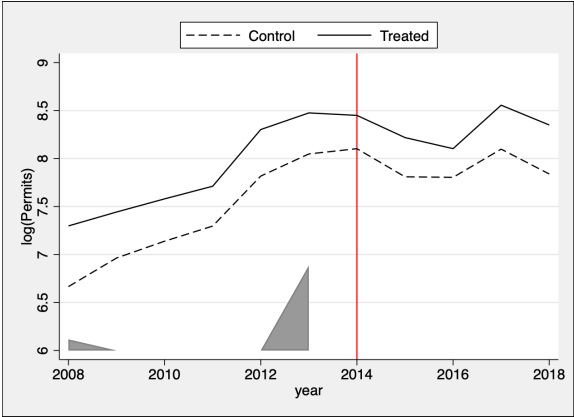


(c) Work permits issued to females

Figure 5: Event study plots using damage classification. The reference period is the year of the treatment.

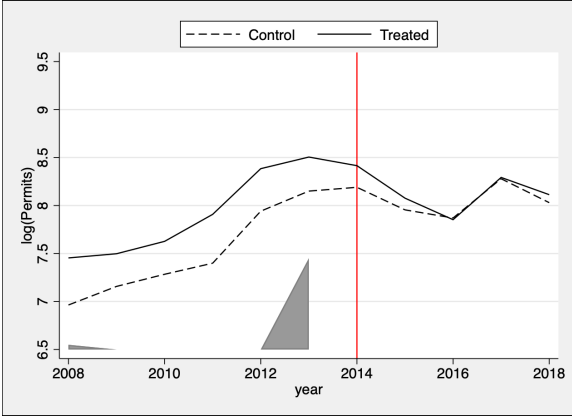


(a) Damage classification

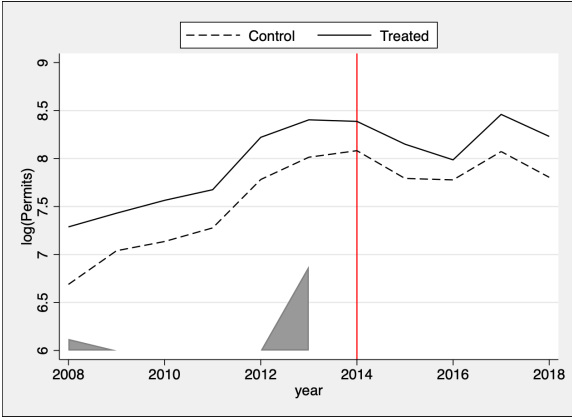


(b) Ground shake classification

Figure 6: sDiD outcome trends for work permits. The treatment group for ground shaking combines Moderate and Strong districts.

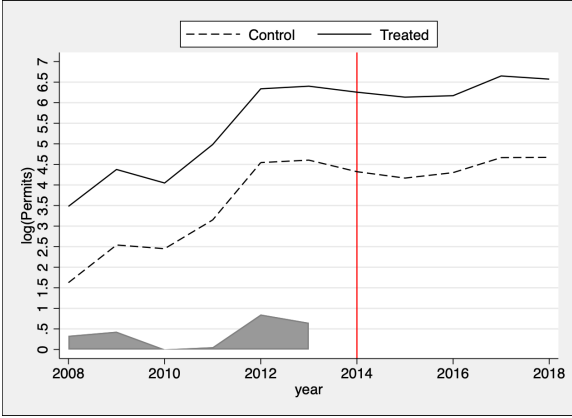


(a) Damage classification

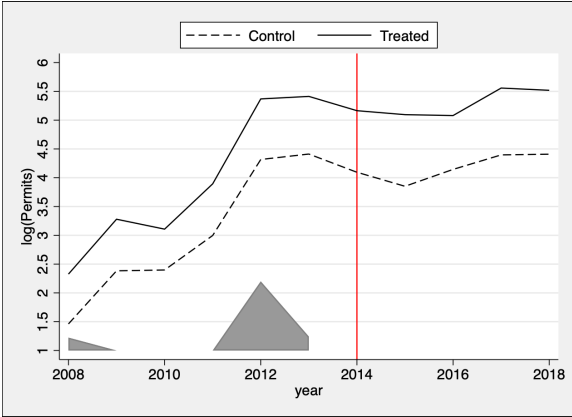


(b) Ground shake classification

Figure 7: sDiD outcome trends for work permits issued to males. The treatment group for ground shaking combines Moderate and Strong districts.



(a) Damage classification



(b) Ground shake classification

Figure 8: sDiD outcome trends for work permits issued to females. The treatment group for ground shaking combines Moderate and Strong districts.

Appendices

A Results for appendix

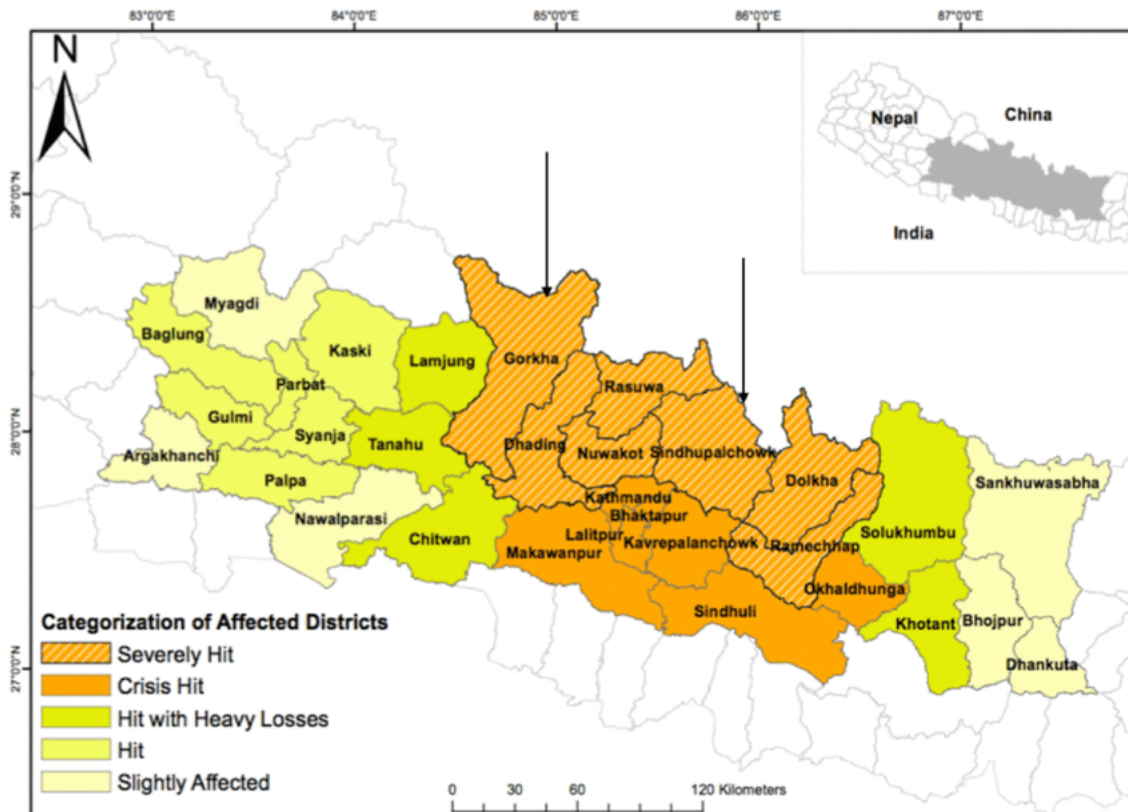


Figure A.1: Severely affected districts according to NPC [2015]
Source: NPC [2015]

Table A1: District classification

Damage classification	Ground shaking classification
<p>Not severely affected</p> <p>Arghakhanchi, Baglung, Baitadi, Bajhang, Bajura, Banke, Bara, Bardiya, Bhojpur, Chitwan, Dadelhura, Dailekh, Dang, Darchula, Dhankuta, Dhanusa, Dolpa, Doti, Gulmi, Humla, Ilam, Jajarkot, Jhapa, Jumla, Kailali, Kalikot, Kanchanpur, Kapilbastu, Kaski, Khotang, Lamjung, Mahottari, Manang, Morang, Mugu, Mustang, Myagdi, Nawalparasi, Palpa, Panchthar, Parbat, Parsa, Pyuthan, Rautahat, Rolpa, Rukum, Rupandehi, Salyan, Sankhuwasabha, Saptari, Sarlahi, Siraha, Solukhumbu, Sunsari, Surkhet, Syangja, Tanahu, Taplejung, Tehrathum, Udayapur</p>	<p>Taplejung, Panchthar, Ilam, Jhapa, Morang, Dhankuta, Tehrathum, Bhojpur, Khotang, Udayapur, Saptari, Dhanusa, Dang, Banke, Bardiya, Dailekh, Jajarkot, Kalikot, Mugu, Humla, Bajura, Bajhang, Achham, Doti, Kailali, Kanchanpur, Dadelhura, Baitadi, Darchula</p>
<p>Severely affected</p> <p>Gorkha, Dhading, Rasuwa, Nuwakot, Sindhupalchowk, Dolakha, Ramechhap, Okhaldhunga, Sindhuli, Kavrepalanchowk, Kathmandu, Lalitpur, Bhaktapur, Makwanpur</p>	<p>Moderate</p> <p>Bara, Bhaktapur, Chitwan, Kavrepalanchowk, Kaski, Kathmandu, Lalitpur, Makwanpur, Manang, Nawalparasi, Arghakhanchi, Baglung, Dolakha, Dolpa, Gulmi, Jumla, Kapilvastu, Mahottari, Mustang, Myagdi, Okhaldhunga, Pyuthan, Ramechhap, Rolpa, Rukum, Salyan, Sankhuwasabha, Sarlahi, Sindhuli, Siraha, Solukhumbu, Sunsari, Surkhet Lamjung, Palpa, Parsa, Dhading, Gorkha, Parbat, Rautahat, Rupandehi, Syangja, Sindhupalchowk, (not in severely affected districts except the last one)</p>
	<p>Very strong Nuwakot, Rasuwa</p>
	<p>Severe Tanahu</p>

Table A2: Education levels and caste categories

Education levels	Caste
Nursery/KG/Shishu	Brahmin
Class 1	Chhetri
Class 2	Magar
Class 3	Tharu
Class 4	Tamang
Class 5	Newar
Class 6	Rai/Gurung/Limbu
Class 7	Muslim
Class 8	Kami
Class 9	Sherpa/Bhote
Class 10	Others
SLC	
Class 12/Intermediate level	
Bachelor level	
Master level	
Professional degree	
Literate (Non-formal education)	
Illiterate	

Note: The education levels are presented just as it is used in the survey. Nursery/KG/Shishu is the reference group. Brahmin the reference group for caste.