IDB WORKING PAPER SERIES No. IDB-WP-535

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September 2014

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2014

Cataloging-in-Publication data provided by the
Inter-American Development Bank
Felipe Herrera Library

Caruso, Germán.
Quake'n and shake'n... forever! long-run effects of natural disasters: a case study on the 1970 Ancash earthquake / Germán Daniel Caruso, Sebastián Miller.
p. cm. — (IDB Working Paper Series ; 535)
Includes bibliographic references.
1. Children—Social aspects—Peru. 2. Fathers and sons—Social aspects—Peru. 3. Children—Earthquake effects—Peru. 4. Fathers and sons—Earthquake effects—Peru. 5. Earthquakes—Social aspects—Peru. 6. Natural disasters— Social aspects—Peru. I. Miller, Sebastián. II. Inter-American Development Bank. Department of Research and Chief Economist. III. Title. IV. Series.
IDB-WP-535

http://www.iadb.org

Abstract[1]

This study estimates the effects of the 1970 Ancash earthquake on human capital accumulation on the affected and subsequent generation, 37 years after the shock, using the Peruvian censuses of 1993 and 2007. The main finding is that males affected by the earthquake in utero completed on average 0.5 years less schooling while females affected by the earthquake completed 0.8 years less schooling. Surprisingly, those whose mothers were affected at birth by the earthquake have 0.4 less years of education, while those whose fathers were affected by the earthquake at birth have no effects on their education. The evaluation of other outcomes also suggests that the level of welfare of the affected individuals has been negatively impacted in the long run. The present investigation supports previous literature on shocks in early childhood, providing evidence of the existence of intergenerational transmission of shocks.

JEL classifications: D31, I32, C49

Keywords: Long-term effects, Intergenerational transmission, Natural disasters

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1. Introduction

Individuals in developing countries are exposed to different types of exogenous shocks including famines, armed conflicts and natural disasters. Among those shocks, the least studied and most likely to keep affecting people's life are natural disasters. These are deeply traumatic events that affected about 217 million people every year since 1990, causing damages of US$ 143 billion per year from 2001 to 2010 (Guha-Sapir et al., 2012). The literature in general only analyzes the macroeconomic impact of natural disasters affecting growth (Cavallo et al., 2013). However, those costs do not include other welfare consequences such as negative health effects, impacts on labor markets and losses of human capital accumulation.

Recent research suggests that shocks in early childhood may have long-term effects not only on health status but also educational and marriage market performance (Almond, 2006). Furthermore, these effects tend to be greater for individuals who are exposed while in utero or during the first two years of life compared to individuals exposed later in life (Neelsen and Stratmann, 2011). From the standpoint of health and economic outcomes for adults, the occurrence of these shocks in early childhood is considered to be especially harmful. Several studies using longitudinal data coupled with information on early-life or in utero shocks have shown persistent and long-term effects on health, education, and socioeconomic outcomes (see recent papers by Maccini and Yang, 2009, and Maluccio et al., 2009).

In this context, this paper seeks to estimate the long-run effects of shocks in early childhood and to determine whether the effect is persistent in its intergenerational transmission mechanism. The study in particular estimates the effects of a natural disaster on human capital accumulation of the affected and subsequent generation. To this end the paper uses the 1970 Ancash earthquake in Peru and looks at the effects in 1993 and 2007, 23 and 37 years, respectively, after the shock.

This paper contributes to the literature of early childhood and natural disasters in several dimensions. First, we provide evidence of the long-term effects of natural disasters on education, health and other socioeconomic outcomes. Second, we present evidence that suggests that shocks of this type can affect the descendants of the affected individuals. Finally, we show evidence of the existence of a gender bias where females are more affected than males, in concordance with the literature (Neumayer and Plümper, 2007).

The main finding of the present research is that males affected by the earthquake in utero complete on average 0.5 years less of schooling, while females affected by the earthquake complete 0.8 years less of schooling. Surprisingly, those whose mothers were affected at birth by the earthquake have 0.4 less years of education while those whose fathers were affected by the earthquake at birth have no effects on their education. The evaluation of other outcomes also suggests that the level of welfare of the affected individuals have been negatively impacted in the long run. The present investigation supports previous literature of shocks in early childhood, providing evidence of the existence of intergenerational transmission of the shocks.

The remainder of the paper is organized as follows. In the next section, an overview of the Ancash earthquake is presented. Section 3 describes the data used in the analysis. Section 4 describes the identification strategy, and Section 5 presents the main results as well as a discussion of the mechanisms, followed by robustness tests. Finally, Section 6 concludes.

2. The 1970 Ancash Earthquake

On May 31, 1970 at approximately 15:23 local time a 7.9 degree on the Richter scale earthquake struck a large area of Peru. According to USGS (2014) the epicenter was located about 22 miles west of Chimbote in the Pacific Ocean. The earthquake was felt from Chiclayo in the north to Lima in the south of the country, with coastal cities near the epicenter suffering the most damage (USGS, 2014). Figure 1 shows the intensity by department using the Mercalli scale, which gives an idea of how the earthquake was felt in different parts of the country.[2,3]

One of the direct consequences of the earthquake was a huge landslide of ice and rocks from the Huascaran Mountain that buried the whole town of Yungay, where

[2] Peru is administratively divided into six regions which are subdivided into 24 departments and 196 provinces.

[3] The Mercalli scale measures intensity of the earthquake as perceived by people, while the Richter scale measures the magnitude of the movement at its epicenter. For example, an intensity of less than VI on the Mercalli scale would not produce damage to building structures, while an intensity of XII would mean total devastation.

presumably more than 20,000 perished. The landslide itself would have already made it the country's deadliest natural disaster since 1900 according to EM-DAT. However the earthquake itself had already killed more than twice that number. EM-DAT's estimate is over 66,000 dead (EM-DAT, 2014). Figure 2 shows the death toll distribution by the affected departments in Peru according to DESINVENTAR (2014).[4]

In terms of affected population, EM-DAT (2014) estimated over 3 million people (close to a quarter of Peru's population at the time) affected, again the worst natural disaster recorded in Peru since 1900. Moreover, buildings and infrastructure also suffered damages estimated at around US$530 million, the third-costliest disaster for Peru according to EM-DAT. Figures 3 and 4 shows the distribution of affected homes and health centers by department.

Although the Ancash department was by far the most affected in every measure used, scores of peoples were affected and infrastructure was destroyed and/or damaged throughout the whole area affected by the earthquake. Many areas, especially rural areas, remained isolated for months after the earthquake since roads and railroads were destroyed.

3. Data

3.1 Peruvian National Censuses

The main sources of information of this paper are the Peruvian National Censuses of 1993 and 2007. These data are provided by the Integrated Public Use Micro Data Series (IPUMS), a database that contains the world's largest publicly available census samples.[5] The censuses report information on the date and place of birth at province level of each individual, as well as information at the individual level on demographics such as gender, educational attainment, disability and marital status. The censuses additionally provide information on household assets, such as access to clean water and sewage, access to electricity, quality of the house, number of rooms per capita and other durable assets. In order to capture the wealth of each household, this paper calculates a measure of

[4] Death tolls and affected population vary depending on the source used. The DESINVENTAR dataset estimates a death toll of only 31,996, while EM-DAT reports 66,000. Other sources have reported deaths and missing near 100,000.

[5] In particular, the samples supplied for Peru represent 10 percent of the census data.

multidimensional wealth. This is a binary variable calculated using a cluster analysis approach following Caruso, Sosa-Escudero and Svarc (2014) that includes information about the assets available for each household so as to identify the financial status of households.

3.2 Preliminary Observations

In Table 1 we present the summary statistics of the main variables used in this study and in Table 2 we compare the characteristics of the individuals and households in affected and non-affected states. Along some dimensions, such as disabilities, age at the first birth and some household assets, affected states appear to be better off than non-affected states while for the other characteristics, there are no significant differences across states. It is important to note that those differences would lead to an underestimation of the results of the paper. Therefore, in our identification strategy we include state fixed effects to control for those differences between states, avoiding any potential bias resulting from pre-existing differences between states.

4. Empirical Model

The identification strategy relies on a comparison of each outcome of similarly aged individuals in affected and non-affected states. The implicit assumption is that in the absence of the earthquake, the observed differences across different cohorts in each outcome would be similar across affected and non-affected states. This estimation strategy is summarized in Table 3.[6] Thus, we estimate the following equation:

$$Y_{ijt} = \beta(Born\ in\ Affected\ State_j * Affected\ Cohort_t) + \gamma_t + \delta_j + \alpha X_{ijt} + \varepsilon_{ijt} \quad (1)$$

where Y_{ijt} is the outcome of interest for the individual *i* that is part of cohort *j* in the state *j*, γ_t are cohort fixed effects; δ_j are state fixed effects; X_{ij} are individual control variables that includes regional trends and gender fixed effects; and ε_{ijt} is a random, idiosyncratic error term. β measures the effect of the earthquake on the outcome of interest for

[6] As shown in Table 3, we present two distinct control groups: i) one across space, i.e., the same cohorts but from areas not affected by the shock; and ii) one across time, i.e., cohorts born in the affected area but old enough to have completed their education at the time of the shock.

individuals who are part of cohort j during the impact of the earthquake in the affected states.

In addition, in order to identify the effects of the shocks on the next generation, this paper estimates the following regression using the exposure of the parents of each child:

$$Y_{ijt} = \beta(Parent\ born\ in\ Affected\ State_j * Parent\ Affected\ cohort_t) + \gamma_t + \delta_j + \alpha X_{ijt} + \varepsilon_{ijt} \quad (2)$$

where Y_{ijt} is the outcome of interest for individual i who is part of cohort j in state j, γ_t are cohort fixed effects; δ_j are state fixed effects; X_{ij} are individual control variables that includes regional trends, age fixed effects and gender fixed effects; and ε_{ijt} is a random, idiosyncratic error term. β measures the effect of the earthquake on the outcome of interest for the descendants of the affected individuals.

Other shocks could happen at the same time in the same region. To verify that the observed differences across states and cohorts in each outcome are due to the earthquake, this paper estimates the following equation using an intensity measure of the earthquake:

$$Y_{ijt} = \beta(Intensity\ of\ each\ disaster\ in\ the\ birth\ region_j * Affected\ Cohort_t) + \gamma_t + \delta_j + \alpha X_{ijt} + \varepsilon_{ijt} \quad (3)$$

where $Intensity\ of\ each\ disaster\ in\ the\ birth\ region_j$ measures the Mercalli intensity of the earthquake in state j. All models include state and cohort fixed effects.

5. Results

5.1 Years of Education

Table 4 presents the results of our main specification for the effect of the earthquake on educational attainment. As previously mentioned, it includes states fixed effects, cohort fixed effects and regional trends. The first three columns of the table show the regressions using data from the 1993 Census, while the last three columns show the regressions using the data from the 2007 Census. We find that exposure in utero to the earthquake reduces educational attainment by about 0.58 years, 23 years after the shock (Column 1). Moreover, the observed effect 37 years after the earthquake is similar, showing a reduction of 0.65 years of education (Column 4). This similarity between the effects in 1993 and 2007 suggests that the effect is persistent and suggests a low chance of catching up in the long run. Furthermore, in both columns the effect is slightly decreasing in age of the affected individuals, which is consistent with the literature of shocks in early childhood analyzed above.

In columns 2, 3, 5 and 6, we analyze the differential impact on males and females. Not only is the impact greater for females than for males, but also the shocks experienced after the in utero period are only statistically significant for females. Our estimates indicate that a female hit in utero by the earthquake suffers a reduction in her education of 0.80 years, this effect being 38 percent greater than the effect found for in utero affected males using 2007 data.[7] Additionally, this differential impact is also exhibited in 1993 as presented in columns 2 and 3.

5.2 Marriage Market

In recent years, a large number of studies have been showing that human capital accumulation affects marriage market outcomes (Chiappori et al., 2009 and Lafortune, 2013). Since we find significant effects on education, another welfare dimension that may be affected is the performance of the exposed individuals in marriage markets. Tables 5 and 6 present the impact of being hit by the earthquake early in life on marriage market outcomes. In particular, we study the impact on spousal education, age at first birth and the probability of being a single parent.

Our results indicate that affected women find a partner that has 0.5 fewer years of education in comparison with the partners of unaffected women. Conversely, males are not affected in this dimension. Based on the marriage markets literature, this result suggests that the reduction in education caused by the earthquake affects the matching process of women but not that of men.[8] In the remainder of Table 5, we examine the impact of the earthquake on the age of the first birth. In this case, both females and males are affected. Being hit in utero by the earthquake precipitates the age of the first birth by four-and-a-half years, moving the average age of first birth to 18 years old for women and 20 for men.

[7] This difference is statistically significant at the 1 percent level.
[8] In this regression we also control for the education of the affected individual, so this effect is in addition to any composition effect that may arise simply due to lower educational attainment of the treated individual.

The third marriage market outcome analyzed in our study is the probability of being a single parent. In Table 6, we present the results for this outcome, coding the divorced parents as non-single parent in the first three columns and as single parent in the last three columns. The coefficients on size do not statistically differ between the two coding assumptions. In particular, our results indicate that women are mainly deprived in this dimension. Column 5 shows no significant results for males, while column 6 shows that exposure to the earthquake in utero and during the first year of life increases the probability of being a single mother by approximately 3 percentage points.

5.3 Effects on the Next Generation

While overall we find large and negative impacts of exposure to the earthquake, it is important to know whether these affect only the generation exposed to the shock or may affect the next generation as well. Tables 7 and 8 examine specifically whether the impact of the natural disaster affect the offspring of affected individuals. In order to evaluate this effect, we estimate equation (2).

Table 7 shows the effect of the earthquake on the next generation's education. The first three columns present the effect of having a mother affected by the earthquake and the last three columns present the effect of having a father affected by the earthquake. Surprisingly, having a father hit by the shock does not affect children's education, while having a mother exposed clearly affects the education of the next generation. In particular, having a mother hit in utero by the earthquake reduces the education of those individuals by 0.45 years. Moreover, the effect is also significant if the mother is affected during the first two years of life.[9]

Since we find effects on the education of the next generation, a natural question that emerges is if children who are studying less than those of parents not affected are also working more; this question arises from an extensive literature studying parents' decision-making on schooling and child labor (Ravallion and Wodon, 2000). In Table 8 we examine the effect of the shock on the child labor of the next generation. We find that the exposure of fathers to the shock does not affect child labor decisions of the household. However, we found that having a mother affected in utero by the earthquake

[9] These effects are again after controlling for parental education.

increases the probability of child labor (Column 1). Moreover, this effect is mainly driven by girls. The daughters of affected mothers experience an increase in their probability of working before reaching 16 years of age.

5.4 Disabilities

The census does not contain health questions, but it does include self-reported questions on the disability status of each individual. This information, however, is only available for 1993. So, in order to test the effect of the earthquake on this outcome, we present the estimations for disabilities in Table 9. Our results show that those individuals exposed in utero to the 1970 Ancash earthquake, have an increase in the probability of being disabled of 0.002 in comparison with those that have not been exposed. Furthermore, these results are driven by females (Column 3).

5.5 Poverty

Finally, to measure effects in wealth, we calculate a measure of multidimensional poverty using a cluster analysis approach. In this analysis we followed Caruso, Sosa-Escudero and Svarc (2014), including all the questions on household characteristics such as the quality of the floor, members of the household and access to running water. With the resulting binary variable indicating the level of asset poverty, we estimate our main specification for the probability of being asset poor in terms of the head of household's exposure to the shock. These results are presented in Table 10. We find no effects for male heads of household (Column 1 and 2). However, as shown in column 3, we find that for female-headed households in which the head was affected in utero, there is a 0.026 increase in the probability of being deprived in term of assets.

5.6. Discussion of the Mechanisms

Understanding the specific mechanisms by which the earthquake impacts welfare is critical for developing appropriate policies to relieve the negative effects of natural disasters. We find many different channels that could explain our results. The first type of channel has to do with health conditions at early ages. Several studies find that being exposed to shocks such as famines or other environmental shocks (droughts, cold weather, etc.) can have a long-lasting effect on adult conditions including height and human capital accumulation, among others. How can this occur? We can think of at least two plausible non-excludable explanations. The first one is that the shock has a negative effect on child physical health status, via malnutrition, spread of disease, lack of health services or other similar channels. The second is related to mental health, specifically posttraumatic stress disorder (PTSD), where the effect of the shock affects non-cognitive abilities in way that has long-lasting effects, including mental health issues. Some studies find that large populations of children can be affected by PTSD after earthquakes (Salcioglu and Basoglu, 2008) This latter channel would seem to fit more the pattern of earlier childrearing and an increase in the probability of single parenting.

A different set of channels that could explain the education results would be lack of physical infrastructure in education. The main argument is that schools are destroyed, therefore children could not attend and learn. However our results in Table A1 of the Appendix show that the effect for older cohorts, those who arguably lost longer periods of schooling since they were already school-age children, is in fact smaller than the effects for younger children. Moreover, this effect should not necessarily affect the children of the affected, or marriage and childrearing decisions other than through the education channel.

Another important factor is to understand why women are more affected than men. We look at two possible explanations that have been presented in the literature. Some studies in the literature find that men are weaker than women at early stages of life, so in this case the argument would be that young males die more upon impact, and since those that die tend to be weaker, the effect on women is no more than a composition effect since weaker women survive. To look at this we look at the ratio of boys/girls for the affected cohorts in both treatment and control areas and only find a differential effect for infants (children less than 1 year of age at the time of the shock).[10] Thus the argument could explain part of the effect for that cohort, but not for the others. Moreover, given the decreasing effect on age, this does not seem to suggest that relatively weaker males were necessarily the ones killed by the shock.

[10] See Table A2 in the Appendix.

We then look at migration patterns to see if more males than females left the affected areas, and whether this might explain the differential gender effects. Again, we do not find support for this explanation in any of our specifications.

5.7. Robustness Checks

The results from estimating the regressions above assume that apart from the earthquake, there were not additional events that may have coincided with the earthquake and independently affected individuals. If this statement is violated, we may misidentify the effect of the earthquake. To avoid this risk and to validate that the observed differences across states and cohorts are due to the impact of the earthquake, we estimate our third sets of regressions using the Mercalli scale as a measure of the intensity of the earthquake in each state. Appendix Table A3 presents the estimation of the third equation. Using the average intensity for the affected states (7.67), the size of the impact for an individual hit in utero represents a reduction in the years of education of 0.61, statistically identical to the 0.65 size of the negative effect found in years of education with our difference-in-difference estimations. These results validate our results using the specifications for equations (1) and (2).

In addition, in order to strength our identification strategy, we also made several false experiments, simulating false locations and false times for the earthquake. To illustrate these experiments, in Table 4 in the appendix we present two examples of the estimations simulating that the earthquake appended in 1950 in the affected regions and then simulating that the earthquake happened in 1970 but in Apurimac department. The results of our false experiments show no impact on the variables studied in this study.

Finally, we tried many impact evaluation specifications modifying our control group including different age ranges and also modifying our treatment group including different age ranges. All the results consistently confirm that the most deprived individuals are those affected in utero and in the first years of life, in concordance with the preexisting literature.

6. Conclusion

This paper estimates the long-term impact of the 1970 Ancash earthquake on early childhood and the intergenerational transmission of effects. As shown in Table 11, we find that the earthquake negatively affected many welfare dimensions including education, marriage markets outcomes and health. Moreover, we find that those effects can be propagated to the descendants of the affected individuals, expanding the cost of the earthquake to the next generation. In addition, we find a gender bias in all the outcomes analyzed, with worse long-run outcomes for affected women.

The motivation to study the long-term effects of natural disasters is that in later years these shocks will continue to affect individuals and countries without clear prevention and alleviation policies. Based on our estimates, the individuals who should be targeted in a potential alleviation policy include pregnant women and children in the first two years of life, with a special focus on girls. Linking the fact that the return of an extra year of education in an middle income country like Peru is in the range of 7.8-11 percent (Psacharopoulos, 1994) with our estimations that an individual hit in early life loses 0.5 years of education, policymakers might consider in planning a cost-effective policy that being affected in early childhood by this kind of shock implies a loss in the range of 3.9-5.5 percent of future wages in adulthood.

The results in this paper contribute to a growing literature that estimates the welfare impacts of natural disasters. The findings suggest that the impacts are relevant and long lasting and can carry over into the next generation. Understanding the exact mechanisms that produce such an outcome remains a challenge, but at this point some alternatives can perhaps be ruled out. The findings in this paper also help improve our understanding of the long-term effects of shocks in early childhood. Since conditions in early life are known to be determinant of adult outcomes, the long-term legacy of natural disasters is an issue that should be addressed with various policy interventions in the future.

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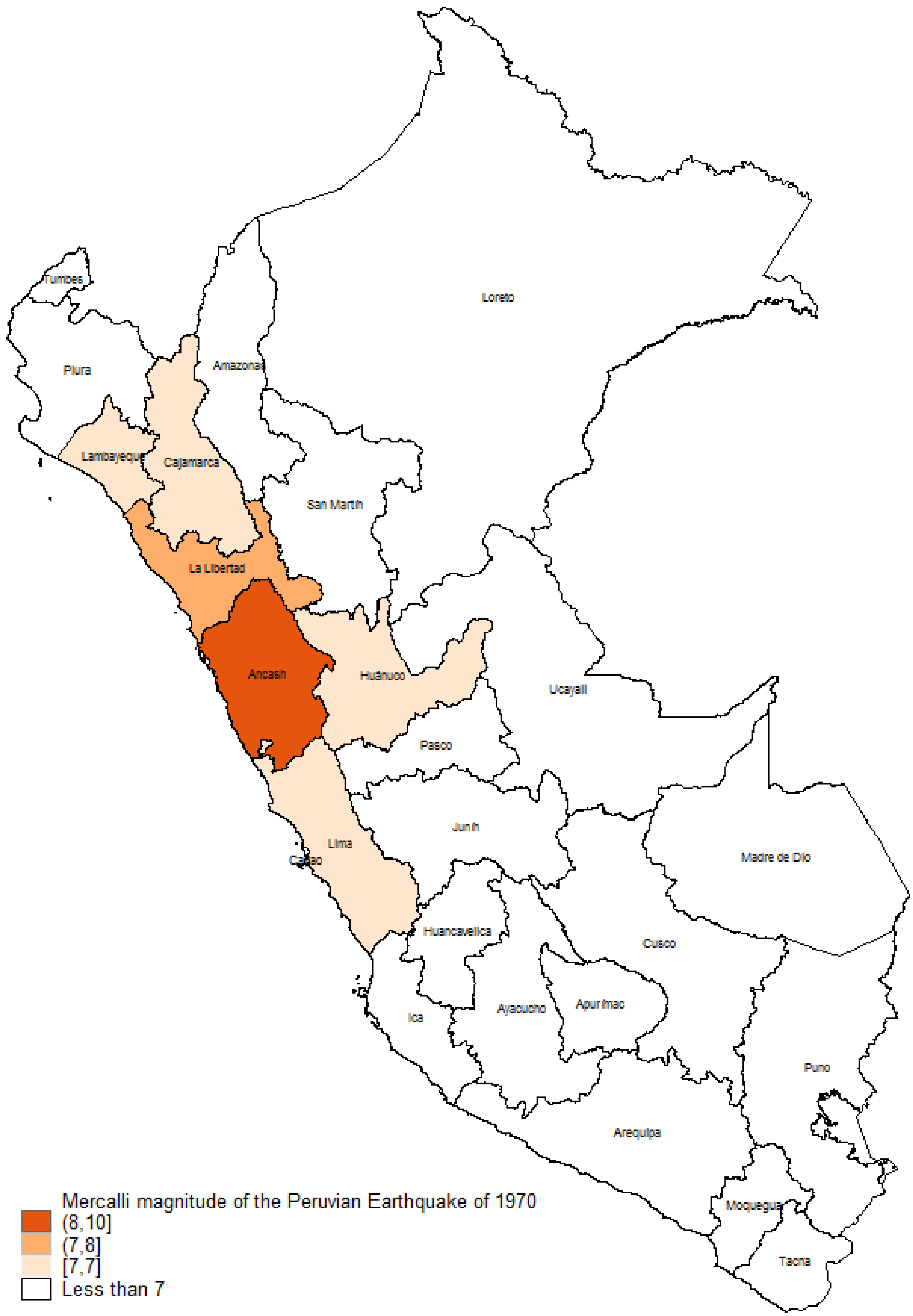
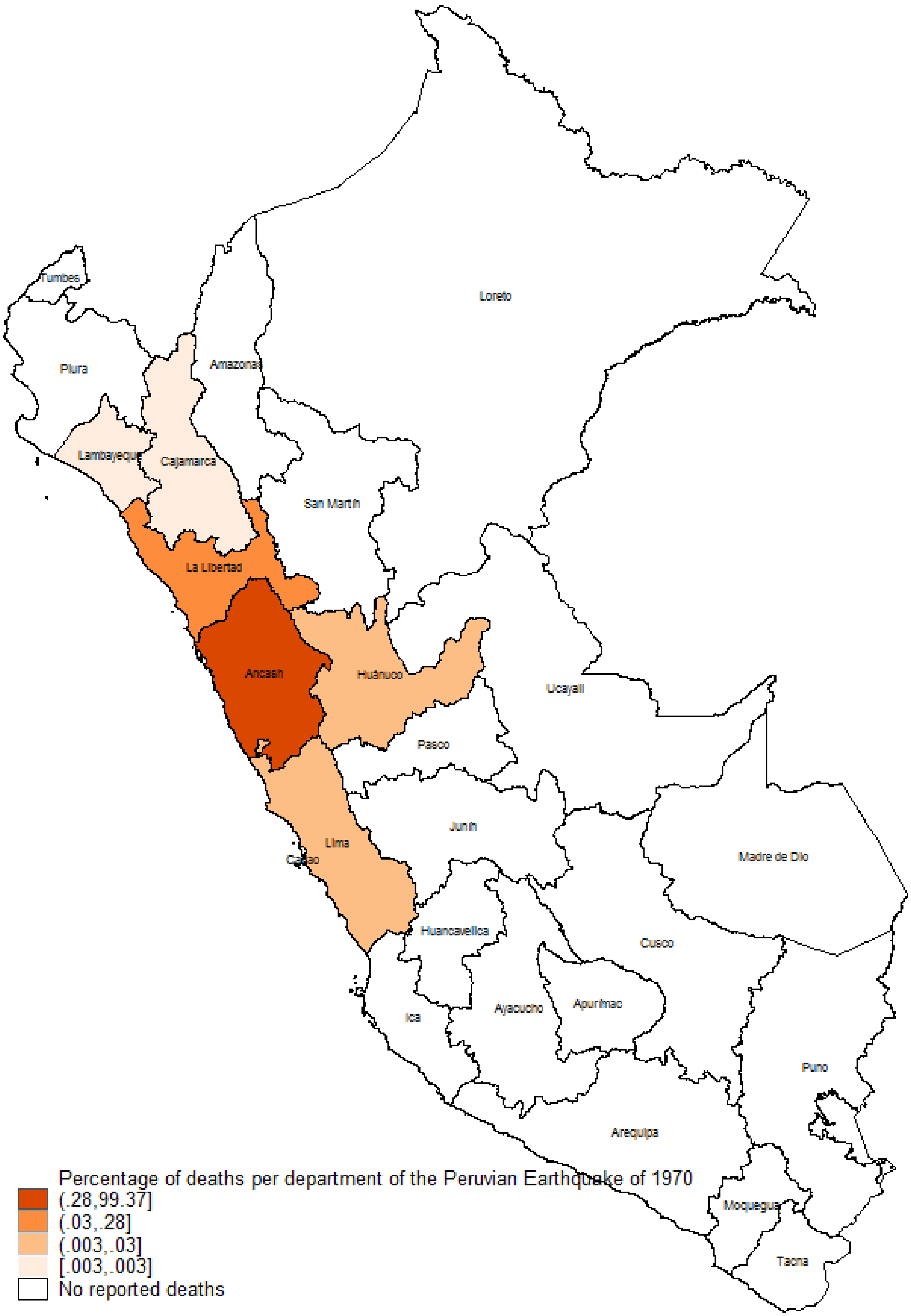
Figure 1. Mercalli Magnitude per Department of the 1970 Ancash Earthquake



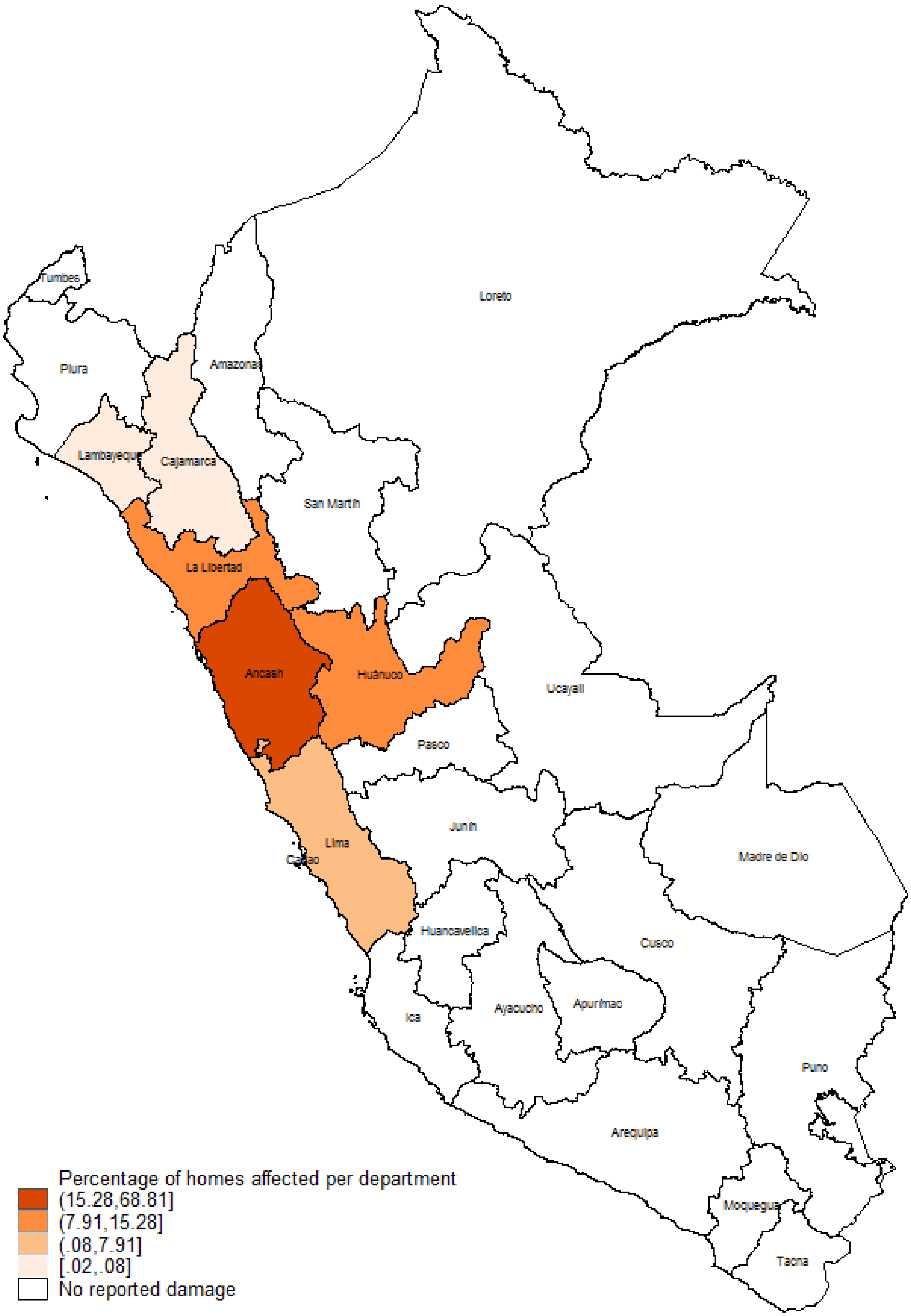
Data source: DESINVENTAR (2014).

Figure 2. Percentage of Deaths per Department Caused by the 1970 Ancash Earthquake



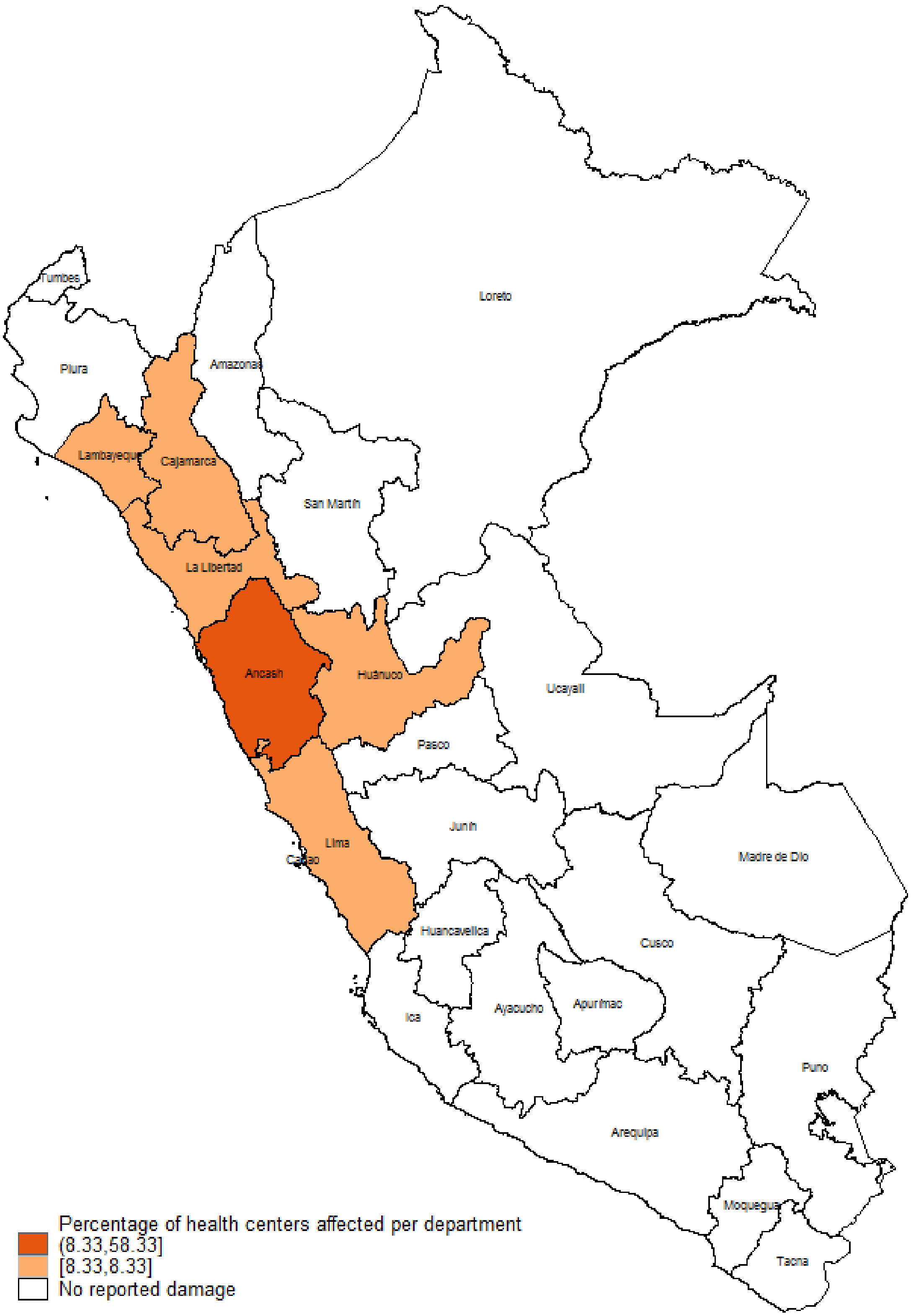
Data source: DESINVENTAR (2014).

Figure 3. Percentage of Homes Affected per Department by the 1970 Ancash Earthquake



Data source: DESINVENTAR (2014).

Figure 4. Percentage of Health Centers Affected per Department by the 1970 Ancash Earthquake



Data source: DESINVENTAR (2014).

Table 1. Summary Statistics

Variable	Mean	Standard deviation
Individuals Characteristics		
Age at first birth	23.612	5.905
Child Labor (under 16)	0.038	0.192
Probability of being a single parent	0.302	0.459
Probability of being disabled	0.013	0.113
Probability of finishing high school for individuals older than 20	0.705	0.456
Probability of finishing primary school for individuals older than 20	0.537	0.499
Probability of having kids younger than 16	0.014	0.116
Years of Education for individuals older than 20	8.407	4.147
Years of Education for individuals younger than 20	4.786	3.931
Household Characteristics		
Electricity access	0.752	0.432
Number of Bathrooms	0.833	0.373
Number of rooms	3.064	2.012
Number of rooms per capita	1.013	0.992
Phone Access	0.276	0.447
Probability of being asset poor	0.432	0.495
Probability of having a good quality floor	0.577	0.494
Probability of having a refrigerator	0.324	0.468
Number of individuals	387,930	
Number of Households	216,083	

Data source: 2007 Peruvian National Census.

Table 2. Balance between Affected and Non-Affected States

Variable	Affected states	Non-Affected states	Difference
Individuals Characteristics			
Age at first birth	23.798***	23.455***	0.343*
	(0.161)	(0.088)	(0.184)
Child Labor	0.055***	0.070***	-0.015
	(0.010)	(0.004)	(0.010)
Probability of being a single parent	0.326***	0.282***	0.044
	(0.027)	(0.007)	(0.028)
Probability of being disabled	0.011***	0.015***	-0.003**
	(0.001)	(0.001)	(0.002)
Probability of finishing high school for individuals older than 20	0.582***	0.498***	0.084
	(0.083)	(0.024)	(0.087)
Probability of finishing primary school for individuals older than 20	0.739***	0.675***	0.064
	(0.069)	(0.019)	(0.071)
Probability of having kids younger than 16	0.013***	0.014***	-0.001
	(0.000)	(0.001)	(0.001)
Years of Education for individuals older than 20	8.735***	8.116***	0.619
	(0.727)	(0.208)	(0.756)
Years of Education for individuals younger than 20	4.784***	4.787***	-0.002
	(0.112)	(0.047)	(0.122)
Household Characteristics			
Electricity access	0.778***	0.731***	0.046
	(0.055)	(0.017)	(0.057)
Number of Bathrooms	0.879***	0.797***	0.081***
	(0.028)	(0.013)	(0.031)
Number of rooms	3.221***	2.943***	0.278**
	(0.104)	(0.045)	(0.113)
Number of rooms per capita	1.038***	0.993***	0.045
	(0.044)	(0.018)	(0.048)
Phone Access	0.342***	0.226***	0.116*
	(0.061)	(0.017)	(0.063)
Probability of being asset poor	0.359***	0.487***	-0.128
	(0.077)	(0.024)	(0.081)
Probability of having a good quality floor	0.629***	0.537***	0.092
	(0.077)	(0.024)	(0.080)
Probability of having a refrigerator	0.395***	0.270***	0.125*
	(0.069)	(0.020)	(0.072)

Data source: 2007 Peruvian National Census.

Table 3. Impact Evaluation design (Treatment and Control Group)

Treatment		Control	
States	Year of birth - Cohorts	States	Year of birth - Cohorts
Ancash	1968-1970	Ancash	<1949
Cajamarca	1968-1970	Cajamarca	<1949
Huánuco	1968-1970	Huánuco	<1949
La Libertad	1968-1970	La Libertad	<1949
Lambayeque	1968-1970	Lambayeque	<1949
Lima	1968-1970	Lima	<1949
		Amazonas	1968-1970 & <1949
		Apurímac	1968-1970 & <1949
		Arequipa	1968-1970 & <1949
		Ayacucho	1968-1970 & <1949
		Cuzco	1968-1970 & <1949
		Huancavelica	1968-1970 & <1949
		Ica	1968-1970 & <1949
		Junín	1968-1970 & <1949
		Loreto	1968-1970 & <1949
		Madre de Dios	1968-1970 & <1949
		Moquegua	1968-1970 & <1949
		Pasco	1968-1970 & <1949
		Piura	1968-1970 & <1949
		Puno	1968-1970 & <1949
		San Martín	1968-1970 & <1949
		Tacna	1968-1970 & <1949
		Tumbes	1968-1970 & <1949
		Ucayali	1968-1970 & <1949

Table 4. Effects of the Earthquake on Education

VARIABLES	(1) Years of Education	(2) Years of Education	(3) Years of Education	(4) Years of Education	(5) Years of Education	(6) Years of Education
Affected in utero	-0.579**	-0.451*	-0.751**	-0.646***	-0.495**	-0.796***
	(0.257)	(0.231)	(0.310)	(0.210)	(0.213)	(0.242)
Affected in the first year of life	-0.523**	-0.343	-0.732**	-0.477**	-0.337	-0.634***
	(0.257)	(0.235)	(0.306)	(0.197)	(0.208)	(0.221)
Affected in the second year of life	-0.491**	-0.298	-0.706***	-0.472**	-0.350	-0.609***
	(0.226)	(0.211)	(0.271)	(0.205)	(0.212)	(0.229)
Census Year	1993	1993	1993	2007	2007	2007
Gender FE	Yes	Male	Female	Yes	Male	Female
Observations	501,194	245,216	255,978	387,930	188,037	199,893
R-squared	0.396	0.339	0.431	0.343	0.287	0.365

Notes: Robust standard errors in brackets, clustered at department level. *Significant at 10%; ** significant at 5%; *** significant at %. All regressions include region fixed effects, cohort fixed effects, gender fixed effects and regional trends.
Data source: Peruvian National Census of 1993 and 2007.

Table 5. Effects of the Earthquake on Marriage Markets

VARIABLES	(1) Education of the spouse	(2) Education of the spouse	(3) Education of the spouse	(4) Age at first birth	(5) Age at first birth	(6) Age at first birth
Affected in utero	-0.233***	0.141	-0.552***	-4.640***	-4.440**	-4.600***
	(0.0862)	(0.131)	(0.124)	(1.618)	(1.776)	(1.593)
Affected in the first year of life	-0.263***	0.0752	-0.524***	-3.225**	-2.426*	-3.974**
	(0.0913)	(0.133)	(0.122)	(1.468)	(1.407)	(1.595)
Affected in the second year of life	-0.241***	0.172	-0.579***	-4.228***	-3.668***	-4.680***
	(0.0830)	(0.132)	(0.113)	(1.414)	(1.162)	(1.768)
Gender FE	Yes	Male	Female	Yes	Male	Female
Observations	225,380	125,615	99,765	392,174	189,971	202,203
R-squared	0.541	0.555	0.533	0.027	0.046	0.027

Notes: Robust standard errors in brackets, clustered at department level. *Significant at 10%; ** significant at 5%; *** significant at %. All regressions include region fixed effects, cohort fixed effects, gender fixed effects, regional trends and controls for the education of the affected individual.
Data source: Peruvian National Census of 2007.

Table 6. Effects of the Earthquake on Marriage Markets

	(1)	(2)	(3)	(4)	(5)	(6)
	Including divorced as non-single			Including divorced as single		
VARIABLES	Single parent	Single parent	Single parent	Single parent	Single parent	Single parent
Affected in utero	0.025*	0.027	0.020*	0.028***	0.021	0.028**
	(0.013)	(0.018)	(0.011)	(0.009)	(0.013)	(0.012)
Affected in the first year of life	0.015	0.009	0.019*	0.017**	0.002	0.027**
	(0.0112)	(0.013)	(0.011)	(0.008)	(0.010)	(0.011)
Affected in the second year of life	0.020	0.023*	0.015	0.019**	0.017	0.016
	(0.013)	(0.014)	(0.013)	(0.009)	(0.011)	(0.011)
Gender FE	Yes	Male	Female	Yes	Male	Female
Observations	392,174	189,971	202,203	392,174	189,971	202,203
R-squared	0.032	0.045	0.026	0.093	0.034	0.105

Notes: Robust standard errors in brackets, clustered at department level. *Significant at 10%; ** significant at 5%; *** significant at %. All regressions include region fixed effects, cohort fixed effects, gender fixed effects and regional trends.
Data source: Peruvian National Census of 2007.

Table 7. Effects of the Earthquake on the Education of the Next Generation

VARIABLES	(1) Years of Education	(2) Years of Education	(3) Years of Education	(4) Years of Education	(5) Years of Education	(6) Years of Education
Parent affected in utero	-0.447***	-0.422**	-0.419**	0.0843	0.0512	0.107
	(0.125)	(0.171)	(0.190)	(0.143)	(0.176)	(0.191)
Parent affected in the first year of life	-0.458***	-0.408**	-0.461**	0.0728	0.0567	0.0803
	(0.120)	(0.165)	(0.183)	(0.129)	(0.163)	(0.178)
Parent affected in the second year of life	-0.403***	-0.392**	-0.374**	0.0758	0.0568	0.0861
	(0.116)	(0.159)	(0.176)	(0.127)	(0.161)	(0.172)
Parent Affected	Mother	Mother	Mother	Father	Father	Father
Gender FE	Yes	Male	Female	Yes	Male	Female
Observations	127,962	65,863	62,099	124,516	64,618	59,898
R-squared	0.824	0.827	0.822	0.816	0.818	0.816

Notes: Robust standard errors in brackets, clustered at department level. *Significant at 10%; ** significant at 5%; *** significant at %. All regressions include region fixed effects, cohort fixed effects, gender fixed effects, regional trends and controls for the education of the parents.
Data source: Peruvian National Census of 2007.

Table 8. Effects of the Earthquake on the Child Labor of the Next Generation

VARIABLES	(1) Child Labor	(2) Child Labor	(3) Child Labor	(4) Child Labor	(5) Child Labor	(6) Child Labor
Parent affected in utero	0.057***	0.032	0.114***	-0.035	-0.039	-0.027
	(0.019)	(0.022)	(0.037)	(0.024)	(0.028)	(0.049)
Parent affected in the first year of life	0.012	-0.020	0.073**	0.014	0.038	-0.020
	(0.019)	(0.022)	(0.036)	(0.023)	(0.027)	(0.047)
Parent affected in the second year of life	0.016	0.031	-0.008	-0.016	-0.036	0.032
	(0.020)	(0.023)	(0.037)	(0.024)	(0.029)	(0.045)
Parent Affected	Mother	Mother	Mother	Father	Father	Father
Gender FE	Yes	Male	Female	Yes	Male	Female
Observations	15,828	10,522	5,306	12,636	8,570	4,066
R-squared	0.057	0.071	0.124	0.066	0.084	0.148

Notes: Robust standard errors in brackets, clustered at department level. *Significant at 10%; ** significant at 5%; *** significant at %. All regressions include region fixed effects, cohort fixed effects, gender fixed effects and regional trends.
Data source: Peruvian National Census of 2007.

Table 9. Effects of the Earthquake on Disabilities

VARIABLES	(1) Disabilities	(2) Disabilities	(3) Disabilities
Affected in utero	0.002**	0.002	0.003*
	(0.001)	(0.001)	(0.001)
Affected in the first year of life	0.000	0.000	0.000
	(0.0001)	(0.001)	(0.001)
Affected in the second year of life	0.002**	0.001	0.003**
	(0.001)	(0.002)	(0.002)
Gender FE	Yes	Male	Female
Observations	387,930	188,037	199,893
R-squared	0.024	0.021	0.029

Notes: Robust standard errors in brackets, clustered at department level. *Significant at 10%; ** significant at 5%; *** significant at %. All regressions include region fixed effects, cohort fixed effects, gender fixed effects and regional trends.
Data source: Peruvian National Census of 1993.

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Table 10. Effects of the Earthquake on Asset Poverty

VARIABLES	(1) Asset Poverty	(2) Asset Poverty	(3) Asset Poverty
Affected in utero	0.003	-0.004	0.026*
	(0.007)	(0.008)	(0.014)
Affected in the first year of life	0.000	-0.004	0.009
	(0.008)	(0.008)	(0.014)
Affected in the second year of life	0.003	-0.002	0.018
	(0.007)	(0.009)	(0.012)
Gender FE	Yes	Male	Female
Observations	216,083	148,816	67,267
R-squared	0.207	0.216	0.190

Notes: Robust standard errors in brackets, clustered at department level. *Significant at 10%; ** significant at 5%; *** significant at %. All regressions include region fixed effects, cohort fixed effects, gender fixed effects and regional trends.
Data source: Peruvian National Census of 2007.

Table 11. Summary Table

Outcomes	Negative effect of shocks in early childhood	
	Males	Females
Education First Generation	Yes	Yes
Education Second Generation	No	Yes
Child Labor Next Generation	No	Yes
Unemployment	No	No
Fertility	Yes	Yes
Marriage Market	No	Yes
House ownership	No	Yes
Access to Cellular Phone	No	Yes
Access to a TV	No	Yes
Piped Water access	No	Yes
Electricity access	No	Yes
Number of Bathrooms	No	Yes
Number of rooms	No	Yes
Number of rooms per capita	No	Yes
Phone Access	No	Yes
Probability of being asset poor	No	Yes
Probability of having a good quality floor	No	Yes
Probability of having a refrigerator	No	Yes

Appendix Table A1. Effect of the Earthquake on Different Cohorts

VARIABLES	(1) Years of Education	(2) Years of Education	(3) Years of Education
Affected in utero	-0.635***	-0.512**	-0.763***
	(0.200)	(0.201)	(0.232)
Affected during the first year of life	-0.468**	-0.351*	-0.602***
	(0.188)	(0.197)	(0.211)
Affected during the second year of life	-0.463**	-0.364*	-0.581***
	(0.195)	(0.201)	(0.220)
Affected between the 3rd and 5th year of life	-0.409***	-0.323**	-0.503***
	(0.153)	(0.159)	(0.175)
Affected between the 6th and 12th year of life	-0.314***	-0.264**	-0.370***
	(0.119)	(0.129)	(0.133)
Affected between the 13th and 15th year of life	-0.244***	-0.263**	-0.238***
	(0.082)	(0.111)	(0.088)
Gender FE	Yes	Males	Females
Observations	759,935	371,073	388,862
R-squared	0.327	0.279	0.347

Notes: Robust standard errors in brackets, clustered at department level. *Significant at 10%; ** significant at 5%; *** significant at %. All regressions include region fixed effects, cohort fixed effects, gender fixed effects and regional trends.
Data source: Peruvian National Census of 2007.

Appendix Table A2. Gender Ratio Differences across Regions

	Ratio Boy/Girl			P-
Cohort	Treatment	Control	Difference	Value
1970	0.995	0.992	-0.002	0.5216
1969	0.934	0.987	0.053	0.0943
1968	0.966	0.980	0.013	0.3725

Data source: Peruvian National Census of 2007.

Appendix Table A3. Effects of the Shock According to the Intensity of the Earthquake

VARIABLES	(1) Years of Education	(2) Years of Education	(3) Years of Education
State Mercalli Intensity in utero	-0.079***	-0.059**	-0.098***
	(0.027)	(0.027)	(0.032)
State Mercalli Intensity during the first year of life	-0.057**	-0.040	-0.076***
	(0.025)	(0.026)	(0.029)
State Mercalli Intensity during the second year of life	-0.056**	-0.039	-0.074**
	(0.026)	(0.027)	(0.029)
Gender FE	Yes	Males	Females
Observations	387,930	188,037	199,893
R-squared	0.343	0.287	0.365

Notes: Robust standard errors in brackets, clustered at department level. *Significant at 10%; ** significant at 5%; *** significant at %. All regressions include region fixed effects, cohort fixed effects, gender fixed effects and regional trends.
Data source: Peruvian National Census of 2007.

Appendix Table A4. False Experiments

	Simulating that the earthquake happened in	
	1950	Apurimac
VARIABLES	Years of Education	Years of Education
Affected in utero	-0.0474	0.314
	(0.101)	(0.236)
Affected in the first year of life	-0.160	0.172
	(0.0979)	(0.241)
Affected in the second year of life	0.120	0.228
	(0.0810)	(0.254)
Observations	276,193	387,930
R-squared	0.280	0.343

Notes: Robust standard errors in brackets, clustered at department level. *Significant at 10%; ** significant at 5%; *** significant at %. All regressions include region fixed effects, cohort fixed effects, gender fixed effects and regional trends.
Data source: Peruvian National Census of 2007.