THEMATIC SERIES

The ripple effect: economic impacts of internal displacement

This thematic series focuses on measuring the effects of internal displacement on the economic potential of IDPs, host communities and societies as a whole

LOST PRODUCTION DUE TO INTERNAL DISPLACEMENT

The 2017 earthquake in Mexico

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INTRODUCTION

A major earthquake of magnitude 7.1 hit the greater Mexico City area on 19 September 2017. It killed 370 people, injured more than 6,000 and caused the collapse of nearly 100 buildings. Between 10,000 and 20,000 houses were damaged and the Evaluación de Riesgos Naturales (ERN) estimates direct economic losses of between $4 billion and $5 billion.

Beyond the losses caused by the earthquake's destructive force, less direct consequences can also impact the economy. One is the inability of people displaced by the disaster to continue their habitual work. By disconnecting people from their productive activity for days, weeks, months or even years, internal displacement reduces economic production. In the case of the earthquake that hit Nepal in 2015, this reduction amounted to nearly two per cent of the country's GDP, or $406 million.[1] In this case study, the same methodology shows that internal displacement associated with the earthquake led to an estimated reduction in economic production of $160 million, or 0.01 per cent of Mexico's GDP.

This much lower impact is largely due to the lesser intensity of the event itself: magnitude 7.1 in Mexico, compared with 7.8 in Nepal. In Nepal, 15 times more people were displaced than in Mexico, and for approximately twice as long. Another key factor in limiting the human and economic impacts of internal displacement caused by disasters is risk reduction. In Mexico, investments in seismic safety have been made for the past 30 years, reducing the damage caused by earthquakes, as well as the number of affected people and the time needed for their homes to be repaired.

The detailed methodology below illustrates how these policies can directly reduce lost production.

METHODOLOGY AND DATA USED

The methodology applied here is presented in more detail in the case study of the April 2015 earthquake in Nepal.[2] It provides an estimate of production lost when workers are unable to pursue their economic activity while they are displaced.

The method uses levels of housing damage to assess the number of displaced people and the duration of their displacement. The number of people displaced and the duration of their displacement are then connected to an indicator of economic production per capita, in this case GDP.

The number of internally displaced people (IDPs) was estimated using information on the population's exposure, the intensity of the earthquake and the vulnerability of the residential buildings. This helped determine whether people could live in their homes immediately after the earthquake and if not, for how long they were forced to live elsewhere.

HAZARD INTENSITY

We estimated structural damage caused by the September 2017 earthquake using spectral acceleration, a measure of ground motion intensity. Figure 1 shows the peak ground acceleration (in cm/s^2) reported by the United States Geological Survey.[3] The earthquake generated moderate to high ground accelerations of around 0.2g in the epicentral area. Very few aftershocks were detected, and were only of moderate magnitude, meaning that the results of the damage assessment on the city's built infrastructure are associated solely with the main shock.

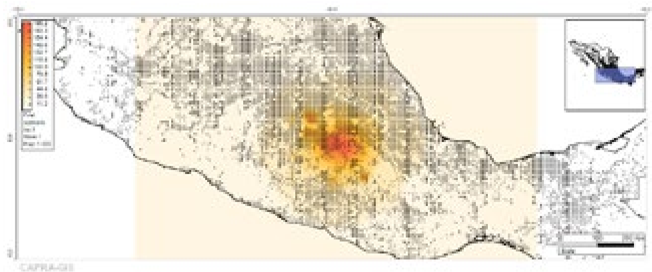


Figure 1. Peak ground acceleration for the 19 September 2017 Mexico Earthquake. Source: USGS[4]

EXPOSURE

This case study uses the UN office for disaster risk reduction (UNISDR) exposure database.[4] The database includes more than 130,000 entries for Mexico in more than 200 combinations of structural systems, number of storeys, construction materials, complexity level, building code compliance and main use. The resolution level is 5x5km (Figure 2). Each pixel contains information about the proportion of buildings within the region grouped by class (masonry, reinforced concrete, etc.), associated exposed values (based on capital stock) and occupancy levels.

Figure 2. Example of the information included in the global exposure database for Mexico City (Source: UNISDR GAR Atlas[5])

The number of inhabitants associated with each building indicate that 98,056,563 people live in Mexico. Considering that the latest World Bank data suggests that in fact the total population of the country is around 127.6 million, the exposure database appears to underestimate Mexico's population by 25 per cent. As a result, the level of economic production lost in the aftermath of the earthquake may be even higher than our study concludes.

It is important to note that no study has been undertaken to discover the exact geographical distribution of the people displaced by the earthquake, resulting in more uncertainty for our final estimates. Better data on the number of people displaced following this earthquake is necessary to make more accurate assessments.

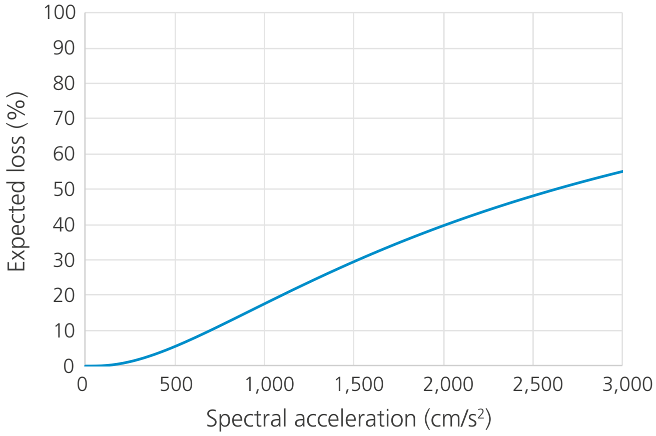
VULNERABILITY

In order to accurately assess the impact of the earthquake, we considered two different dimensions of vulnerability: physical and human.

The physical dimension is concerned with direct economic loss caused by damage to and destruction of residential buildings. This information is needed to estimate the damage levels and the duration of repair work, cleaning and recovery. For this assessment, we used the UNISDR Global Risk Model's physical vulnerability functions. They consider issues related to the building code level and enforcement for each building class identified for Mexico.

A unique vulnerability function is applied to each building class. These functions, such as the one shown in Figure 3 for wooden structures, allow estimating the duration of displacement by connecting a hazard intensity with expected direct losses.

Figure 3. Physical vulnerability function for wooden structures



The human dimension of vulnerability focuses on the number of IDPs. We assume that once a certain seismic hazard intensity is exceeded, a residential unit is no longer safe for immediate occupancy and consider all its inhabitants internally displaced. This displacement can have different durations depending on the structural damage to the buildings. An example of an extreme case would be the total collapse of a house, causing a cleaning and rebuilding process which can take more than two years. In other cases, evacuation of buildings is needed only as a safety measure and after a visual inspection, people can return to their homes.

ESTIMATING LOST PRODUCTION DUE TO INTERNAL DISPLACEMENT

The methodology, hazard, exposure and vulnerability data presented above led to an estimate of 240,000 people, at country level, prevented from immediately returning to their houses in the aftermath of the earthquake. We accounted for people who were evacuated only for a few hours as displaced for one day.

Table 1 summarises the number of IDPs and their associated displacement times. Around 140,000 IDPs were able to return home within a week. Approximately 11,000 remained displaced for more than one year.

Table 1. Number of IDPs by displacement duration

Displacement time (days)	IDPs
1	71,770
5	72,367
10	35,863
120	48,506
487	9,011
973	1,938

ESTIMATION OF THE CLEANING, RECOVERY AND REPAIR TIME

Mexico's high preparedness for earthquakes has a significant impact on the cleaning, recovery and repair time necessary for people to safely return home, and as a result, on our calculations. The country's decades-long investment in seismic safety is a key factor in reducing the length of time for which people are forced to leave their homes.

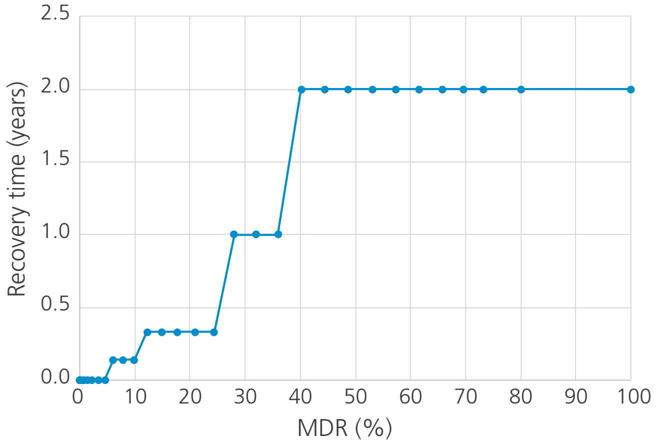
The number of days expected for the complete recovery of each residential unit from the damage done by the earthquake are shown in Table 2.

Table 2. Recovery time (in years) for single- and multi-family units by structural damage states

Building type	Recovery time (in years) by structural damage state				
	None	Slight	Moderate	Extensive	Complete
Single family unit	0.00	0.01	0.33	1.00	2.00
Multi-family unit	0.00	0.03	0.33	1.33	2.67

Figure 4 shows an example of the recovery function, which estimates the time it takes for a building to be safely habitable, in this case based on the mean damage ratio for single-family homes. Note that once the mean loss ratio exceeds 40 per cent, a total building collapse is expected and projected. This means the building needs complete reconstruction in order to be safe to live in, a process which takes two years.

Figure 4. Recovery times based on mean damage ratio for single family units



We estimated the cleaning, recovery and repair time for each building class at unit level and later aggregated them for the single and multi-family buildings. For Mexico, all reinforced concrete and steel buildings are considered multi-family. The remaining adobe, masonry and mud constructions are considered single-family.

This process indicates that the cleaning, recovery and repair of single-family units will require an estimated 494 years of aggregated man hours. The same process for multi-family units requires 1,362 aggregated years, meaning the recovery requires a total of 1,856 aggregated years.

AGGRAVATING FACTOR

An aggravating factor in estimates of recovery time is that natural disasters can destroy or obstruct roads, or make construction workers and materials unavailable to work on repair, cleaning and reconstruction. The more affected a country is by a disaster, the more difficult it will be to distribute resources to all damaged units in a timely way.

We added this aggravating factor, equal to a 5.4 per cent increase in response time based on the mean damage ratio for the whole country, to our calculations. This results in the time required for recovery being increased by a factor of 1.3, which in turn means that the necessary cleaning, recovery and repair work can be expected to require 2,412 aggregated years.

YEARS LOST BECAUSE OF INTERNAL DISPLACEMENT (YLD)

Combining mean loss ratio and displacement duration, our study suggests that Mexican people displaced following the 2017 earthquake lost the equivalent of 45,765 years of activity.

The working age defined by the OECD is between 15 and 64. To define the number of inhabitants of working age, we used the disaggregation of the Mexican population by age produced by the United Nations Population Division.[6] Interpolation between the 2015 and 2020 values was made to obtain an estimate of the situation in 2017.

Table 3 summarises the age distribution for Mexico projected for the year 2017, based on values for 2015 and 2020. The number of inhabitants of working age is around 87,054,000 which corresponds to 66.62 per cent of the total population.

Table 3. Population by age range (Mexico)

Age	# People	Share
0-4	11,368,833	8.70%
5-9	11,455,775	8.77%
10-14	11,478,656	8.78%
15-19	11,660,105	8.92%
20-24	11,510,244	8.81%
25-29	10,919,273	8.36%
30-34	10,177,238	7.79%
35-39	9,562,734	7.32%
40-44	9,175,219	7.02%
45-49	8,122,690	6.22%
50-54	6,401,673	4.90%
55-59	5,229,714	4.00%
60-64	4,294,850	3.29%
65-69	3,273,305	2.50%
70-74	2,305,215	1.76%
75-79	1,640,606	1.26%
80-84	1,067,511	0.82%
85-89	640,489	0.49%
90-94	293,163	0.22%
95-99	87,410	0.07%
100+	13,692	0.01%
TOTAL	**1,306,783,958**	**100.00%**

Mexico's working age group lost 30,488 aggregated years because of internal displacement. The country's labour force participation rate is 64.8 per cent and its unemployment rate is 3.5 per cent. Taking these factors into account, we estimate that the total time lost because of internal displacement for employed people is 19,065 aggregated years.

ECONOMIC PRODUCTION LOST BECAUSE OF INTERNAL DISPLACEMENT

In this final stage, lost economic production is estimated based on an egalitarian principle which assumes that all employed IDPs would have contributed to the economy in the same measure regardless of their age, gender and education level. GDP per capita is used as a measure of economic production and stands at $8,208 for Mexico.

Associating this measure with the number of years lost because of internal displacement in the employed population of IDPs, we estimate that Mexico lost $160 million of economic production as a result of the September 2017 earthquake. This amount assumes a complete disruption in the economic activities previously performed by the IDPs in the affected area.

FINAL REMARKS

Following the study of the April 2015 earthquake in Nepal, this second assessment of lost production linked with internal displacement in an earthquake situation confirms the usability and relevance of this methodology to measure one of internal displacement's main economic consequences. Even though data unavailability remains an obstacle, a wider and more systematic application to all displacement situations could help assess expected losses and adapt emergency and recovery plans to limit this economic impact.

Used in a prospective analysis, it can also allow governments to monitor the progress they would make if they invested in disaster risk reduction strategies aimed at limiting the scale and the duration of internal displacement. Used, as it is here, for retrospective analyses, this methodology can improve estimates of economic losses after a disaster, by including a less direct yet significant impact that is most often not accounted for.

NOTES

1. IDMC, Lost production due to internal displacement: The 2015 earthquake in Nepal, 2018.
2. Salgado-Gálvez M., Estimating the Lost Economic Production Caused by Internal Displacement Because of Disaster, International Journal of Disaster Risk Science, 2018.
3. United States Geological Survey, M 7.1 - 1km E of Ayutla, Mexico, 2017.
4. UNISDR, Global Assessment Report on Disaster Risk Reduction, 2015.
5. De Bono and Chatenoux, A global exposure model for GAR 2015. Background paper prepared for the Global Assessment Report on Disaster Risk Reduction 2015, 2015.
6. United Nations Population Division database.

Cover photo: Lidia Perez Castilla surveys her house, which was damaged by the 19 September earthquake in San Francisco Xochiteopan, Puebla State, Mexico. The pink wall (left of photo) is where Lidia's teenage daughter used to sleep.
Credit @ UNICEF/ Zehbrauskas, September 2017

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