International Journal of Disaster Risk Reduction 13 (2015) 61–65

Contents lists available at ScienceDirect

International Journal of Disaster Risk Reduction

journal homepage: www.elsevier.com/locate/ijdrr

Comparing the direct human impact of natural disasters for two cases in 2011: The Christchurch earthquake and the Bangkok flood

Ilan Noy

EQC-MPI Chair in the Economics of Disasters, School of Economics and Finance, Victoria University of Wellington, PO Box 600, Wellington, New Zealand

ARTICLE INFO

Article history:
Received 5 February 2015
Received in revised form
30 March 2015
Accepted 30 March 2015
Available online 7 April 2015

Keywords:
Christchurch
Earthquake
DALY
Bangkok
Flood
Disaster impact

ABSTRACT

The standard way in which disaster damages are measured involves examining separately the number of fatalities, of injuries, of people otherwise affected, and the financial damage that natural disasters cause. Here, we implement a novel way to aggregate these separate measures of disaster impact and apply it to two catastrophic events from 2011: the Christchurch (New Zealand) earthquakes and the Greater Bangkok (Thailand) flood. This new measure, which is similar to the World Health Organization's calculation of Disability Adjusted Life Years (DALYs) lost due to the burden of diseases and injuries, is described in detail in Noy [7]. It allows us to conclude that New Zealand lost 180 thousand lifeyears as a result of the 2011 events, and Thailand lost 2644 thousand lifeyears. In per capita terms, the loss is similar, with both countries losing about 15 days per person due to the 2011 catastrophic events in these two countries.

1. Introduction

The standard way in which disaster damages are measured involves examining separately the number of fatalities, of injuries, of people otherwise affected, and the financial damage that natural disasters, such as earthquakes or floods, cause. This classification dates back to a 1970s UN-sponsored project, at the Economic Commission for Latin America and the Caribbean. It was further developed and refined, and is now referred to as the Damage and Loss Assessment Methodology (see [4]).

As the UN notes: "Part of the reason why disaster losses have not created the same political or economic imperative to address the risks of disease or financial risks may be the way in which they are measured. In reality, disasters affect households, communities and countries due to the combined impact of mortality, morbidity and damaged or destroyed housing, infrastructure and agriculture. Separate measurements of mortality and economic loss fail to capture the full dimensions of disaster." [11].

Noy [7] proposes a way to aggregate measures of disaster impact that overcomes some of the methodological difficulties inherent in any attempt to generalize from the separate measures. This measure is similar to the calculation of Disability Adjusted Life Years (DALYs) that is frequently used when comparing the efficacy of health interventions. The World Health Organization (WHO) uses this methodology to calculate the DALYs that are lost from the burden of diseases and injuries [14]. As in the WHO's calculations of DALYs, the unit of measurement in the index used here is also 'lifeyears'.

The one conceptual difference between the WHO's approach measuring the 'burden of disease' and our approach is that the DALYs measure the impact of diseases exclusively on health, while our measurement is aimed at accounting for the impact of disasters on human welfare more generally. In order to to do that, we also need to incorporate the impact of financial losses on human well-being. Put differently, the loss of capital assets implies a need to devote further human effort in order to rebuild, reconstruct, or recreate these destroyed assets. Without this need, the effort and resources needed to rebuild would have been available for use in other ways to improve human welfare. The measure used here thus includes not only an accounting of the time lost because of mortality and morbidity, but also the time communities will need to devote to rebuilding their lives and the assets that they have lost.[1]

Here, we focus on two of the most catastrophic disasters in the most catastrophic year on record for disaster risk, at least in terms of financial losses.[2] These two events, the 22/2/2011 earthquake in Christchurch, New Zealand, and the post-monsoon floods in

[1] At alternative literature converts human lives into monetary terms using value-of-statistical-life measurements (e.g., [12]).

[2] Unfortunetly, obtaining detailed data on the most catastrophic event of 2011, the Great East-Japan earthquake/tsunami/nuclear failure, proved to be beyond the scope of this project, especially as the direct effects of this event are still ongoing.

E-mail address: ilan.noy@vuw.ac.nz

http://dx.doi.org/10.1016/j.ijdrr.2015.03.009

Thailand, are also quite different both in terms of the main characteristics of the hazard (a sudden and very supervising earthquake, and a slow-moving and anticipated flood) and, as we already noted, in the countries in which they occurred. These two events were also unique in that the data required to complete the calculations presented here was available (from various sources detailed below).

2. A description of the two events

The series of earthquakes in the Canterbury region of the South Island of New Zealand began on 4/9/2010. While some damage was caused by this first event, no fatalities occurred, and no major urban centre was directly affected. Another Canterbury earthquake with a magnitude of 6.1 struck closer to the City of Christchurch on 22/2/2011, and because of its location and physical characteristics, significantly more damage was caused to infrastructure and buildings and 185 lives were lost. Widespread liquefaction also added to the damage of the earthquake. About 80,000 housing units were significantly damaged. The 2011 earthquake was largely unexpected since it occurred in a previously little-known fault [15]. For a much fuller description, see Potter et al. [10].

In the latter part of 2011, Thailand experienced its worst flooding in decades. The World Bank [16] estimated there were 800 fatalities and a total loss of THB 1.43 trillion (USD 46.5 billion) associated directly with the flooding. Flooding affected many provinces, including most importantly the commercial hub of Bangkok, and had an estimated duration of 6 months. Mean annual rainfall reached its peak in 2011 representing a 24% increase from normal. Alongside record-breaking rainfall, Poaponsakorn [9] attributes the extensive damage to Thailand's inefficient water management, unplanned urbanization and lack of reliable warning systems.[3]

3. The lifeyears index

Some of the basic assumptions used in the construction of the index were previously adopted by the WHO in their constructon of the burden of disease measures. When calculating lifeyears lost due to moratlity and morbidity, as in the Burden of Disease project, one simply aggregate the number of years lost per person by simple linear summations and the mortality and morbidity sums are also added together.[4]

In the DALY literature, the value of monetary damages is not accounted for. The lifeyears meaure, however, assumes that a dollar worth of destroyed assets lost in a high-income country such as New Zealand imposes a less adverse impact on society than a similar dollar asset lost in a lower-income country like Thailand; income per capita in 2011, in the two countries was USD 5192 and 37,192.[5] The index we use here converts all damage indicators – including mortality, morbidity, other impacts on human lives (e.g. displacement), and damage to infrastructure and housing – into an aggregate measure of lifeyears lost, not of less easily interpretable currency/monetary units.

The index proposed here, based on a modified version of Noy [7], consists of the following:

$$Lifeyears_i = L_i\left(M, A^{death}, A^{exp}\right) + I_i(N) + DAM_i(Y, INC)$$

where $L\left(M, A^{death}, A^{exp}\right)$. is the number of years lost due to event (i) mortality, calculated as the difference between the age at death and life expectancy.[6] $L\left(M, A^{death}, A^{exp}\right)$ requires not only information on the number of people who died (M), but also the vectors of their age profile (A^{death}), and the projected life expectancy for each individual (A^{exp}). For life expectancy, we follow the WHO's aroach in measuring DALYs. The WHO uses a uniform life expectancy of 92 years ($A^{exp} = 92$ for all m). This number originates from projections made by the United Nations regarding the likely average life expectancy at birth in the year 2050 [13]. The rationale for using this value for life expectancy, and one that is uniform across countries, is that the number represents a viable estimate of the possible frontier of human longevity in the foreseeable future.[7] This assumption also res another a potential difference in our measure between the Thailand and N Zealand disasters, as actual life expectancy in New Zealand is somewhat higher. Thus, our measure for the number of lifeyears lost due to disaster mortality is $L = \sum_{m=1}^{M}(92 - A_m^{death})$.

$I(N)$ s the cost function associated with the people who were injured, or otherwise affected by the disaster. In principle, this should includes serious injuries, and the cost of their care, time spent in hospital and later rehabilitation, impact on people's mental health, impact on those whose houses were destroyed or livelihoods were adversely affected, impact on those who were displaced (temporarily or permanently), and any other direct human impact, N, in this framework, is all the information available f each disaster that allows us to calculate, as closely as is possible, this component of the overall index. The complete information set is never available, however. For global measures, one can typically only find information about the number of people injured and otherwise affected, though this count includes a wide range of syndromes and impacts.

The EMDAT dataset, the most frequently used global dataset, includes only information on the number of people affected, but not on the nature of this impact. Desinventar, an alternative global dataset maintained by UNISDR, includes separately data on injuries, and people affected, but without further distinctions. In the cases we investigate here, we have additional information, which we use as well. Following the WHO methodology in calculating DALYs, we assume that the impact function is defined as $I(N) = eTN$.

The coefficient, e, is the 'welfare-reduction weight' that is associated with being exposed to a disaster. There is no precedent to determining the magnitude of this weight, and there is much debate about the appropriate methodology to determine such weights (see the discussion about the 'disability weights' in determining DALYs [13]). Since we do not have information about how each individual was affected, we adopt the WHO's weight for disability associated with "generic uncomplicated disease: anxiety

[3] Noy and Patel [8] provide more detail. Haraguchi and Lall [5] identify another unique aspect of this event; they observe that the affected region served as an important link in many global supply chains.

[4] Fox-Rushby and Hanson [3] discuss the accepted ways of calculating DALYs, including the possibility of time-discounting (whereby the future is discounted as playing a reduced role in current consideration).

[5] While in the value-of-statistical-life approach, the monetary damages are aggregated at face value, with the implied assumption that a dollar is worth the same everywhere.

[6] Henceforth, we supress the subscript i-the indicator for the event being analysed.

[7] It could be argued that a theoretically more attractive option is to use the life expectancy at the time of death. There is a practical challenge here, as the life expectancy at different ages varies significantly and information on the age profile of life expectancy is less reliable. There is also an ethical challenge, since this implies placing more weight on dasters occurring in wealthier regions, where life expectancy is higher. We note, however, that life expectancy at the median age is significantly higher than life expectancy at birth, especially for countries with lower life expectancy at birth, so that this choice of 92 does not exaggerate the impact of mortality to a very significant extent.