

Statistics for Assessing Impacts on Housing from Canterbury Earthquakes, New Zealand (2009-2013)

Produced for the Asia-Pacific Expert Group on Disaster-related Statistics¹

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1. Purpose

This review of documentation provided by Statistics New Zealand aims to briefly describe experience from New Zealand following the devastating earthquakes of Canterbury Province. The analysis focusses mainly on two major sources of statistics in New Zealand: the Census of Population and Dwellings and the New Zealand national accounts. The information in this paper is drawn especially from Goodyear (2014) and Statistics New Zealand (2012), among various other online sources published by the New Zealand government, and also from discussions with experts and some typical residents of Christchurch in July, 2017.

Lessons learned from discussions with experts from Statistics New Zealand, based on their experience with the Canterbury earthquakes, are synthesized here to help facilitate further dissemination of the knowledge gained so that it may be applied in other countries. The focus for this review is statistical analysis of effects from the earthquakes on housing.

2. Background

As of December 2013, residents of Canterbury New Zealand had experienced over 60 earthquakes of magnitude 5 or higher and thousands of smaller aftershocks, over a period beginning from a surprise 7.12 magnitude earthquake on 4 September 2010. During this period, the quakes resulted in an estimated 185 deaths and damages to tens of thousands of dwellings and commercial buildings, especially in and around the city of Christchurch. As of May 2016, insurers settled 83,000 claims for residential and commercial properties.²

Among the impacts to residential areas from the Canterbury earthquakes included neighborhoods of Christchurch located in low-lying delta areas near the ocean above relatively loose and sandy soil. These structures were particularly vulnerable not just to the force of the seismic energy, but also to movements and realignments to the topsoil.

In addition, as reported by Munichre.com, large areas of already low-lying land in Christchurch sank even further, leaving it more susceptible to flood damage in adverse weather conditions. As a consequence,

¹ Prepared by Daniel Clarke of ESCAP Statistics Division; the views expressed here belong to the author, are strictly for the purpose of sharing an example relevant for disaster-related statistics development, and do not in any way represent the views or positions of the United Nations.

² <http://www.icnz.org.nz/natural-disaster/canterbury/rebuild-statistics/>

gravity-dependent infrastructure like sewage systems was no longer feasible.

The third effect was that the already thin layer of stable material overlying the liquefiable material was made even thinner. In some cases, mud pushed upwards clogging drains and, in extreme cases, overwhelming homes or yards with uprooted soil and water in a process known as liquefaction.

The consequence of these factors was that thousands of homes were now located in areas where any further seismic activity would likely bring effects to the extent that the land would no longer support buildings. The government created a new zoning classification in which areas affected by or exposed to liquefaction comprised the “red zone”. Households in red zone properties were subjected to a relocation of residency, even if the homes were still standing and relatively undamaged by the earth-shaking.

Whole neighborhoods of Christchurch were uprooted and displaced into new residential areas because of damages to the buildings or because of the new physical vulnerabilities exposed by the earthquakes and by liquefaction. These consequences have changed the landscape of Christchurch and left local officials with many challenging decisions about how to re-develop the region sustainably and with reduced vulnerability from potential future hazards.

Outside of the liquefaction “red zone” areas, the effects from the earthquakes to housing mostly took the form of destroyed buildings or reparable damages, particularly for relatively older structures. Some homes needed to be evacuated and in some cases demolished or subjected to major repairs. A common case of vulnerability were chimneys, especially older brick or stone chimneys. The greater Christchurch area of New Zealand had not, in recent historical memory, been struck by such significant earth shaking before and therefore the population was largely surprised by the disaster, which added to the psychological impacts of the disaster.

The damages created significant costs to households, insurers and to business in communities. The New Zealand Treasury estimated that the government spent around 14.9 billion New Zealand dollars³, on behalf of taxpayers, over the course of about 7 years for the reconstruction of Christchurch (including for insurance claims covered by the New Zealand Earthquake Commission). However, afterwards, structures could be gradually rebuilt for resilience against future hazards and new buildings or repairs to old dwelling and other structures in Christchurch were applying the latest standards for durability against seismic activity. Also, household disaster preparedness improved in New Zealand after the earthquakes, especially in Canterbury province.

The effort to rebuild damaged or destroyed structures is, in fact, ongoing in Christchurch. It has taken longer than expected, in part because of years of after-shocks, and in part because the extensiveness of the damages forced officials to consider many complex city planning and zoning decisions.

The Earthquake Commission of New Zealand (EQC) covered a large portion of the insurance claims for damaged and destroyed buildings and, together with the Insurance Council of New Zealand (ICNZ), they reported information and research on the progress of post-disaster insurance claims and overall costs to insurers.

³ <http://www.treasury.govt.nz/budget/2014/bps/06.htm>

3. Impacts to Population and Housing Dynamics

At Statistics New Zealand, a combination of traditional and new sources of statistics were utilized to conduct analyses and report on the impacts of the earthquakes to household dwellings. In Goodyear (2014), results from the 2013 Census of Population and Housing⁴ were used to evaluate multi-dimensional effects for the earthquakes on the population, on dwellings and on the housing status for the people of Canterbury Province.

There were clear and significant changes to housing in a variety of ways for the population of Christchurch corresponding to the period of impacts from the Canterbury earthquakes. It is difficult to make causal links, because of complexities of the hazard and because changes are affected by other factors besides the disaster. However, Statistics New Zealand developed statistics that could be used to test assumptions and develop a deeper understanding of some of the likely impacts experienced by the population in Canterbury. In particular, Goodyear (2014) investigated changes to the stocks of dwellings, numbers of occupied and unoccupied dwellings, household deprivation and crowding, and numbers of people living in ‘other private dwellings’ (e.g. mobile dwelling or motor camps).

The Canterbury Earthquake Recovery Authority (CERA) also conducted household well-being surveys in the affected communities, which revealed further information on the qualitative impacts of the earthquakes on housing. This includes the finding that living day-to-day in a damaged house as a result of the earthquakes was a moderate to major issue for around 16 percent of people in greater Christchurch in the 2013 survey, down from 22 percent of people in greater Christchurch in 2012. Also, around 15 percent of people in Christchurch city had trouble finding rental accommodation.

In Goodyear (2014), crowding of households in dwellings was assessed with information on the average number of occupants per dwelling (which increased after the earthquakes in Christchurch, in contrast to a slight reduction in occupancy rates on average, nationally) and with statistics on the annual household expenditure for housing costs as a share of total consumption expenditures. Dwellings with higher (and potentially crowded) occupancy rates corresponded with households tending to spend less on housing expenses as a share of total income. Also, living in temporary housing was shown to be a more affordable option for some Canterbury households after the earthquakes

The largest increase in private occupied dwellings after the earthquakes was in temporary dwelling types (including private dwellings in motor camps, mobile dwellings, and improvised dwellings or shelters). The largest decreases in occupied stocks of dwellings were concentrated geographically, especially in Christchurch City and in the red zone areas. “The number of unoccupied dwellings increased sharply between 2006 and 2013, with an 88.4 percent increase in Christchurch city along with a 77.7 percent increase in Waimakariri district, compared with 25.9 percent in Selwyn district.”

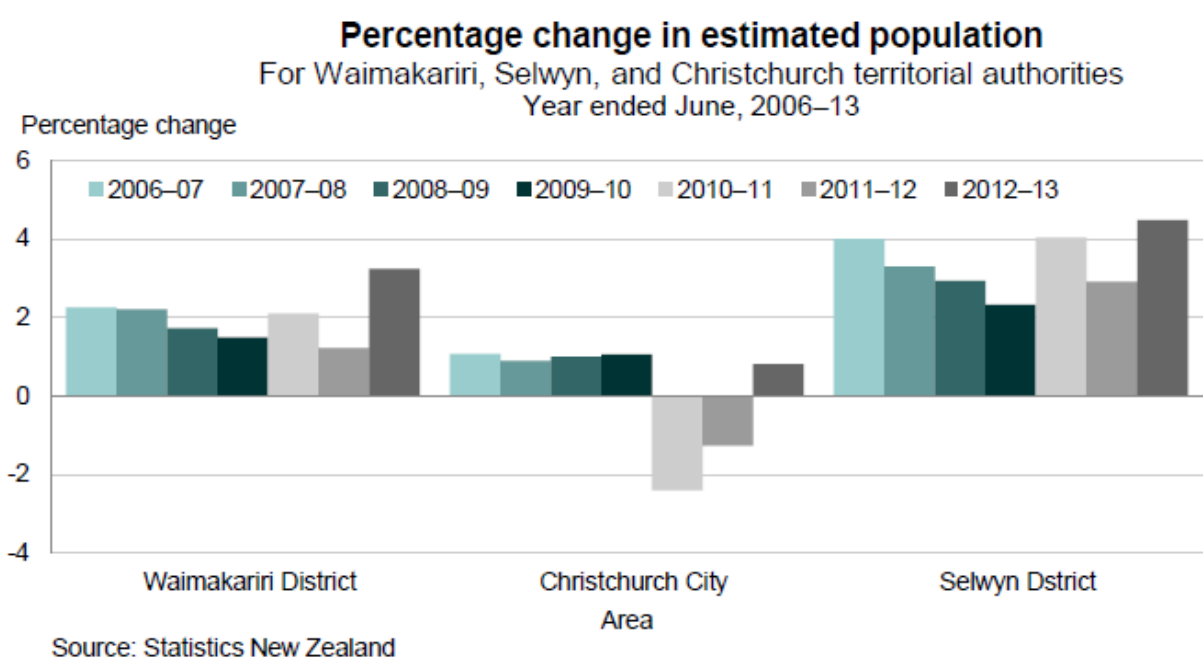
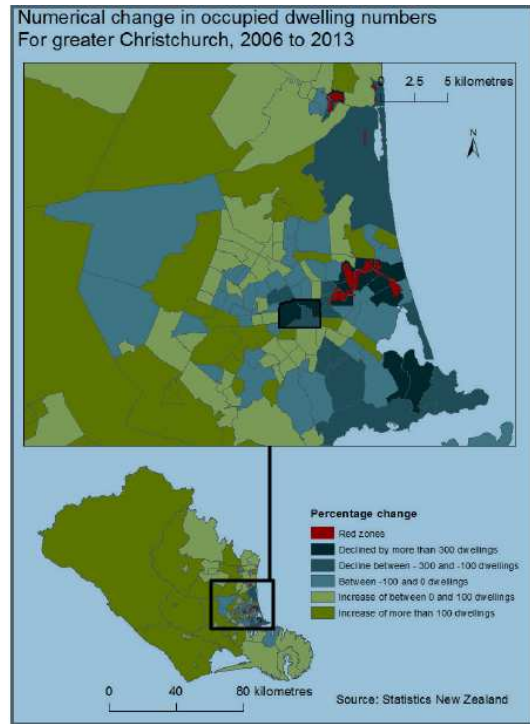
⁴ The 2013 Census of Population and Housing was postponed from 2011 due to the dramatic effects of the earthquakes

Meanwhile, “the number of occupied private dwellings has declined in Christchurch city by 3.2 percent between 2006 and 2013 compared with a 6.9 percent increase between 2006 and 2013.”

The differences in effects by geographic areas are important for the analysis. The amount and types of impacts varied greatly between districts and relocation of residence between districts was one of the common long-term impacts of the earthquakes.

Households relocated from damaged, destroyed, demolished or red zone dwellings into replacement (temporary or permanent) dwellings, usually absorbed within Canterbury and in suburban areas surrounding Christchurch city, such as Selwyn. This effect is quite clear from the census data.

There is also a broad national trend of declining ownership of dwellings, in which Christchurch city is a leading example with an 8 percent decline since 2006. For the same time period, significant increases were found for households renting in neighboring districts.



The Ministry of Business, Innovation and Employment (MBIE,2013) estimated that for Christchurch, after taking into account new houses being built, “the housing stock reduced by a net 11,500, or 6.2 percent of the previous housing stock, between the fourth quarter of 2010 when the earthquake sequence started and the fourth quarter of 2012.” The MBIE (2013) study also found increases in both house prices and rental costs in the Christchurch area after the earthquakes.

Utilizing information from the census and the CERA household surveys, an estimated 16,000 properties were severely damaged and over 9,000 were uninhabitable. In total, there were over 171,000 dwellings in greater Christchurch with an insurance claim to the Earthquake Commission – meaning that over 90 percent of dwellings received some damage.

For various reasons, the impacts varied by dwelling type. Multi-storey apartment buildings in central Christchurch city experienced the largest proportional effects in terms of the amount of damages. They also proved complex in terms of settling insurance claims. This finding is not unusual. As noted in Goodyear (2014), studies from other earthquakes internationally show that multi-unit dwellings (e.g. apartments) are often more difficult to repair or are recovered more slowly as compared to other dwelling types.

4. Assessing economic value of impacts of damaged and destroyed dwellings

Statistics New Zealand (2012) summarized the decisions and treatments adopted, in line with international standards, for measuring relevant stocks and flows associated with the disaster’s economic impacts within the New Zealand National Accounts in the years following the earthquakes.

The economic value of losses from damages or destruction to dwellings (and other assets, including roads and non-residential building) were estimated for a special adjustment (*other changes of volume from catastrophic loss*) in the stock of capital in the New Zealand national assets accounts.

For these assets, Statistics New Zealand estimated the loss of value attributable to the earthquakes at \$4.6 billion or 0.77% of the value of the country’s capital stock. This included slightly over 1% of the value of the stock of dwellings. The New Zealand GDP in the pre-earthquakes year of 2010 was about 217.5 billion.⁵ As mentioned above, estimated government expenditures for rebuilding efforts were 14.9 billion, which is around 37 percent of the total government expenditure for the year 2010.⁶

⁵ Accessed from UNSD national accounts main aggregates, GDP in current prices (unstats.un.org)

⁶ The study covered residential building, non-residential (commercial and government) buildings, roads, and other (local government) constructions and they were incurred over a 7 year period following the earthquakes. General Government Final Consumption Expenditure, 2012, accessed from UNSD (ibid).

National net capital stock losses
By asset type

Asset type	Stock losses Percent
Residential buildings	1.03
Non-residential buildings	
• Private	1.42
• Local government	2.80
Other construction (local government)	3.02
Local government roading	1.05
Total capital stock	0.77

Source: Statistics New Zealand, 2012

In estimating impacts of the earthquakes to capital stock, New Zealand made reference to Escobar C-G (2011), which estimated losses to capital stocks in a similar way for 2010 earthquakes in Chile. The 2010 earthquakes capital losses were around \$13.2 billion or around 3% of net capital stock in the Chilean economy.

These values for capital stock are based on a modified Perpetual Inventory Method (PIM) model, which closely follows best practice guidelines prepared by the OECD (see OECD, 2001). This asset valuation method requires assumptions on asset life, retirement functions, and efficiency decline for establishing value of capital stock at the relevant base time period – which in this case for New Zealand was the 2011 capital stock.

The value for the losses to capital stock was estimated for the New Zealand national accounts using information from a variety of data sources. “We went beyond our usual data sources to accurately reflect the magnitude and makeup of the earthquake adjustment.”

The value of the special adjustment for catastrophic losses represents the losses in terms of asset values, which has been defined for accounting purposes as: “a store of value representing a benefit or series of benefits accruing to the economic owner by holding or using the entity over a period of time. It is a means of transferring value from one accounting period to another.” (SNA 2008, para 3.30).

Another type of economic valuation of interest for analyzing the economic costs from disasters, including the damaged and destroyed dwellings, are insurance claims. In the national accounts, insurance claims for relatively large damages to assets from unforeseen events (like disasters) are recorded as capital transfers from the insurance company to the insured party. Capital transfers do not affect income; they are recorded as a change in the contents of asset holdings.⁷

Although the insurance claims are classified as capital transfers, the use of expenditures or transfers by households and businesses are not necessarily classified as capital accumulation. For example, repairs to buildings may not be easily identified as capital expenditures and thus would otherwise be included as

⁷ Note: in contrast with assets, insurance claims for consumer durables (e.g. a household’s automobile) damaged by a disaster are treated as a current transfer, which means they would affect the household’s disposable income directly.

part of the regular current expenditures and household consumption in the national accounts. Furthermore, there is no certainty for how households will utilize insurance payouts. Insurance claims cover a broader range of costs (e.g. costs for demolition) than the recovery of direct impacts to assets. However, since actual expenditures specifically for repairing damages to dwellings (or other assets) after a disaster are difficult to separately identify, the capitalized insurance claims could be a useful source for aggregated estimates of the costs of repairs for damages to dwellings in the case of New Zealand.

Generally, insurance claims for losses to dwellings will be higher than the value of adjustment to capital stock made in the national accounts, partly due to the effect of depreciation for the older buildings. “For example, a residential building is valued at 10 percent of its initial cost after 70 years. When a dwelling is fully replaced or even damage undone – the new asset is of higher value than the earlier version, because a depreciated asset has been replaced with a new one.” (Statistics New Zealand, 2012).

Unlike with insurance claims for earthquake damages, charitable donations are classified in the national accounts as current transfers, rather than as capital transfers, and thus the direct effect is to disposable income of recipients. The Christchurch Earthquake Appeal Trust reportedly raised over \$100 million from donors in New Zealand and abroad. Although no specific information is available on shares of donations targeted recovering housing for the population affected by damaged or destroyed dwellings, it could be safely presumed that a significant number of households in the Christchurch area received what appears in accounting terms as a one-time boost to their incomes following the earthquake from inflows of donations. Red Cross, for example, paid \$1,000 one-time grants to households affected by loss of access to power or water for two or more weeks.

As mentioned, the government instituted a new classification of land zoning after the earthquakes, with red zones representing areas deemed no longer safe for residency. The government committed to purchase red zone properties from owners. The transfers are recorded as capital transfers in the national accounts and the red zone properties removed from the dwelling stock at the time that the properties are deemed to have no remaining economic value for the purpose of dwelling (i.e. at the time of the earthquake or afterwards when the building was demolished).

Despite the significant impacts recorded to dwellings and to other infrastructure (and the general assessments by the Treasury and other sources indicating widespread economic harm caused by the earthquakes), median household incomes actually increased in greater Christchurch between 2006 and 2013 by 14.4% (compared to a 4.1% rise nationally). Similar findings have been uncovered from studies of other major disasters around the world. Growth in economic activity, but also increased inequality after a disaster, is caused by a variety of factors, including the effects of rules of accounting but also real changes to economic activity (e.g. growth in construction activities) following a disaster.

A final element to consider from the national accounts is the fact that dwellings technically provide housing services, a flow which is estimated for the production account and thus contributes to the GDP. However, only the dwellings that were destroyed or otherwise made permanently uninhabitable are removed from the housing stock used for estimated dwelling services (so excluding damaged or

impaired buildings). National stocks of dwellings, by tenure type, and numbers of households are estimated by Statistics New Zealand on a quarterly basis.⁸

The revised stock of dwellings could be combined with average rent prices, weighted by regions, to estimate the changes to the value of dwelling services. However, Statistics New Zealand elected not to make this adjustment in 2012 because “the net effects on the dwelling and household estimates are unknown”. As already mentioned, after the earthquakes there was also increases in housing stock in certain regions or types (especially temporary dwellings). Other reports also found that “not adjusting the stock of dwelling in the calculation of dwelling services does not have a significant impact on GDP.”

In summary, for calculating economic costs of the earthquakes, in particular for impacts to dwellings, several flow or stock measures from the national accounts are independently interesting (see below). These measures have distinct differences in terms of their impacts on the main national accounts aggregates (either positive or negative) and in terms of timing of the recording. This situation makes producing a single aggregate indicator for economic impacts related to dwellings (or other assets) rather elusive, but each of these types of entries to national accounting are also useful statistics for conducting broader economic assessments of the direct and indirect consequences from disasters.

- Changes to the value of the stock of dwellings in the capital account (“other changes in volume” adjustment)
- Capital transfers, e.g. from insurance companies (or government) to households for claims of damaged or destroyed dwellings
- Estimated reconstruction costs for uninsured damages absorbed by households (if available)
- Current transfers to households experiencing damaged or destroyed dwellings in the form of charitable donations
- Current transfers to households for their damaged or destroyed dwellings in the form of government purchases (e.g. red zone properties)
- Changes to the production of dwelling services in the production account based on changes to volume of housing stock (this variable not calculated for New Zealand earthquakes case)

5. Other effects of the earthquakes on housing

Reports from the New Zealand Census also revealed some impacts that could not be directly assessed via the Census, but were recorded as general observations that could be useful for follow-up studies on impacts to dwellings. For example, Goodyear (2014) noted that “while census does not collect information on housing quality, census collectors noted that a number of people were living in badly damaged housing.” Following the Census, the 2012 CERA Well-being Survey found that living day-to-day in a damaged house as a result of the earthquakes was a moderate to major issue for about 22 percent of people in the greater Christchurch area.

⁸ http://archive.stats.govt.nz/browse_for_stats/population/estimates_and_projections/dwelling-and-household-estimates-info-releases.aspx

The New Zealand 2010 General Social Survey asked households about their preparedness for a disaster. Questions were used to collect data on specific types of preparations like having a three-day supply of food and water, a household emergency plan, and the safety of dwellings and their furnishings. Compilations of statistics based on these questions can be used for assessing trends in preparedness over time (e.g. for showing effectiveness of awareness campaigns) and for developing a strengthened understanding, both within New Zealand and internationally, on how investments in household preparedness and other disaster risk reduction strategies can result in reduced casualties and reduced economic costs from disasters.

According to results of the General Social Survey from 2010, about 18 percent of households (294,000 of 1,634,000 New Zealand homes) met all three national requirements for basic preparation for a disaster, which was an improvement from 15 percent in 2008. A Media Release⁹ from Statistics New Zealand in 2012 announced that after the Canterbury earthquakes, the rate for basic preparedness in the region had doubled.

6. Conclusions

Given the central importance of housing, developing statistics on different types of impacts from disasters to secure housing, with disaggregation as much as feasible by geographic regions and by other relevant categories, is a crucial component for developing a basic range of disaster-related statistics. National statistical systems are encouraged to utilize examples from New Zealand and other countries, towards increasingly harmonized and comprehensive approaches to measurement of the impacts of disasters. These approaches should make use, where feasible, of the existing international standards for population and housing censuses, national accounts, household surveys and other sources of official statistics.

Some novel and important variables identified through this study for assessing impacts of disasters include: population movements after a disaster, rates of occupied and unoccupied dwellings, housing expenses by income category, household crowding and households living in damaged dwellings. Geographic disaggregation is critical since effects usually depend on location.

All relevant economic flows and changes in stocks of capital caused by disasters are recorded, in principle, within the System of National Accounts. This New Zealand case study provides a useful example of standard approaches for extracting economic statistics on impacts from the national accounts.

The location and timing of recording of stocks or flows in the national accounts are affected in complicated ways, depending on their incidental relationships with the standard accounting rules. These are unintended consequences of accounting rules for analysis of disasters and they simply need to be documented and understood by users of the statistics. Relevant variables can be found in a variety of accounting tables and it is important to consider the diverse range of potential economic impacts.

Statistics related to disasters are subject to uncertainties and many methodological challenges, but sharing of experiences internationally will help strengthen the understanding of, and effective responses to, disaster risk.

⁹ http://archive.stats.govt.nz/browse_for_stats/people_and_communities/Families/nzgss_MR2012.aspx

7. References

Escobar, C-G (2011, October). *Accounting for the impact of the earthquake on the Chilean national accounts*. Paper presented at Working Party of National Accounts in Paris, France. Retrieved May 21, 2012, from

OECD (2001). *Measuring capital: The OECD manual on measurement of capital stocks, consumption of fixed capital and capital services*. Organisation for Economic Cooperation and Development. Paris, France:

Goodyear, R (2014). *Housing in greater Christchurch after the earthquakes; Trends in housing from the Census from the Census of Population and Dwellings 1991-2013*. Available from www.stats.govt.nz.

Statistics New Zealand (2012). *Accounting for the economic effects of the 2010/11 Canterbury earthquakes in New Zealand's national accounts*. Available from www.stats.govt.nz.

UN (2008) *System of National Accounts 2008*. European Communities, International Monetary Fund, Organisation for Economic Co-operation and Development, United Nations and World Bank. ISBN: 978-92-1-161522-7. New York, USA