



Small quakes, big impact:
lessons learned from
Christchurch



Could a small aftershock in a city not considered an earthquake hotspot trigger one of the largest insurance losses ever? Absolutely, because this is exactly what happened when a 6.3 magnitude earthquake hit Christchurch, New Zealand, on 22 February 2011. The massive – and unexpected – insurance costs exposed blind spots in current views of financial earthquake risk. And, in the aftermath of the event, both the claims and rebuilding process proved challenging. Given that a similar sized earthquake can occur virtually anywhere, it is vital that we learn from the Christchurch experience.

Foreword

During 2010 to 2011, the world suffered a string of serious earthquakes. These events were devastating both in terms of the number of lives lost and the destruction of property and infrastructure. I only need mention what happened in Haiti and Chile or later in northeastern Japan and in Turkey. During this period, several damaging earthquakes also struck Christchurch, New Zealand. Seismic events caused economic losses of over USD 308 billion in these two years and earthquake-insured claims for 2011 are likely to surpass USD 58 billion, a world record.

Two noteworthy features of the Christchurch events – compared to the others – were the high contribution of the insurance industry towards reconstruction costs and the fact that the earthquakes affected a city which was not known as a seismic hot spot.

These features prompted our experts to identify reasons why insurers were caught off guard by the scope and complexity of the claims process and the spiralling claims costs as well as to suggest ways of learning for the future. After all, other cities around the world could face similar issues, especially if they are not usually identified as earthquake hot spots.

This publication is a summary of their conclusions and generally seeks to raise awareness of the possible consequences of earthquakes in city centres on insurance.

I wish you an enlightening read.

Matthias Weber, Group Chief Underwriting Officer, Swiss Re

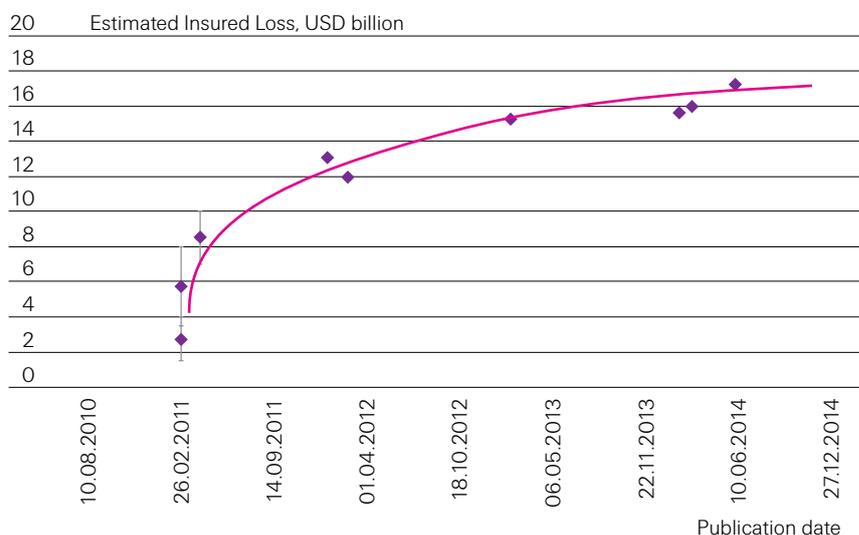
A small quake in the wrong place can have a hefty price tag

Before 2011, Christchurch was not a place one readily associated with a high earthquake risk. Unlike the capital Wellington, Christchurch does not sit near New Zealand's main fault lines. It is located on New Zealand's South Island, has a population of 380 000 (total country population is 4.2 million) and consists of 99 500 houses, 30 000 flats and 38 000 businesses.

Why then was the impact of a 6.3 magnitude (M) earthquake so devastating? Estimates for the total economic cost continue to rise. Current estimates stand at USD 21.5 billion for the February 2011 event, or USD 31.6 billion if the 7.0 M September 2010 and 6.0 M June 2011 earthquakes are also factored in.

For the insurance sector, the cost from the Christchurch earthquake is currently put at USD 17.2 billion for the February 2011 event and close to USD 25 billion for all three events combined (Swiss Re Economic Research & Consulting). This cost far exceeded the initial, model-based forecasts and took the insurance industry by surprise. Over the last 50 years, the only higher earthquake-related insurance losses globally have been those from the 9.0 M event in Japan in 2011 (USD 37.7 billion indexed to 2013) and the 6.7 M event in Northridge (California) in 1994 (USD 22.9 billion indexed to 2013).

The chart below shows the rise of the total insurance loss estimates made by various vendors, brokers and reinsurers over time for the February 2011 event. It shows that the current insurance loss estimate of USD 17.2 billion is more than twice the upper end of the initial loss estimates provided by model vendor companies, which ranged between USD 1.5 and 8 billion. Part of this increase is due to the strengthening of the New Zealand Dollar (NZD) against the USD since February 2011. However, this only accounts for a 14% increase in the USD-based insurance loss estimate.



Sources:

- AIR news alert, Feb. 23, 2011
- EQECAT CatWatch, Feb. 23, 2011
- Marsh. Comparing claims from catastrophic earthquakes, Feb. 2014
- RMS Cat Update, April 5, 2011
- Swiss Re *sigma*

How come initial estimates were so far out?

Why did initial estimates, which were based largely on earthquake model outputs, so significantly underestimate the actual loss? Although New Zealand has one of the highest levels of residential and commercial property insurance penetration, the insurance sector was taken by surprise in several areas.

Firstly, there was the sheer number of claims: As Christchurch was not considered an earthquake hotspot, claims processing procedures were not set up to deal with the well over 400 000 claims across all events with multiple claims lodged per property. For instance, the Earthquake Commission of New Zealand (EQC) had to rapidly increase staff from 22 core members and 27 assessors in reserve before the earthquakes, to over 1000 by February 2011. On certain days, 13 000 assessments were handled per day by 350 assessors (equating to 37 claims per assessor per day). As a result, detailed assessments were not possible. This left them susceptible for challenge at a later point in time which prolonged the process and made it more costly. Large numbers of claims adjustment experts, brought in internationally for a limited time, subsequently handed over claims to different parties. The resulting lack of continuity further complicated the claims process. Claims costs have also increased because of protracted negotiations due to claims advocates who worked on a contingency basis. This tendency is seen in other regions as well.

Secondly, so-called secondary loss agents contributed significantly to the overall loss resulting from the February 2011 Christchurch earthquake. These included widespread liquefaction, slope instabilities, continued aftershock activity and the effect of widespread damage in the central business district.

Such agents are to a large degree blind spots in the current earthquake models, despite their potential impact on earthquake risk assessments. They can consequently act as claims inflators that significantly increase the ultimate payout.

And finally, in the case of residential claims, the specifics of the insurance policy wordings and the interactions of multiple policies on one claim further impacted the adverse loss development.

Aftershocks

The 22 February 2011 Christchurch earthquake was, from a seismological point of view, an aftershock of the earlier earthquake of 4 September 2010. Although weaker, the aftershock had a far more devastating impact on Christchurch than the earlier main seismological event, mainly because it struck so close to the central business district. It also created higher losses for the insurance industry. Although it was well known that large earthquakes are followed by multiple aftershocks and that this activity often persists for a few years, the New Zealand events are testing the industry's assumption about the scale of consecutive disasters in the same region.

As aftershock sequences can easily trigger second event or stop-loss covers, they are important to consider when assessing earthquake risk. This is especially true for second event covers, which only pay out if the policy is affected by two or more loss events. If aftershocks are neglected in the underwriting process, the risk for claims can be significantly underestimated. The same is true for stop-loss covers, which trigger when the aggregate of all losses to a portfolio during the policy contract period exceed a certain deductible. For these covers as well, the presence of aftershocks strongly increases the chance of a payout to the policyholder.

Liquefaction

The costs due to liquefaction are substantial and all models by far underestimated the impact of this phenomenon in Christchurch – both the 2010 and the February 2011 events resulted in widespread soil liquefaction. Liquefaction risk significantly increases reconstruction costs and often causes total losses to property. It occurs when soil substantially loses strength in response to earthquake tremors, causing it to behave like a liquid. Severe structural damage usually results if liquefaction occurs underneath a building or a highway. Additionally, it also tends to damage underground infrastructure such as water and sewage pipes.

In the February 2011 Christchurch event, entire neighborhoods were exposed to liquefaction. Many property owners were not only faced with having to repair or rebuild their homes, but also with restoring the land itself. Liquefaction often also results in property flooding because groundwater is squeezed out of the soil. Another outcome, especially for large buildings, is a phenomenon called differential settlement. This is where certain parts of a building settle more than others during an earthquake, often resulting in total loss because the building structure was compromised.

Liquefaction: not just an issue in Christchurch

Soil liquefaction is not just an issue in Christchurch. In fact, many past earthquakes such as the 1989 Loma Prieta earthquake affecting the San Francisco Bay Area have resulted in significant property damage due to soil liquefaction. Many, if not most, large cities around the world would be exposed to significant liquefaction in the event of an earthquake near the city center. The regional liquefaction maps shown here illustrate this risk for four sample cities across the world.

(Source: Swiss Re)

Soil liquefaction can wreak awful damage

Liquefaction potential in Tianjin



Liquefaction potential in Jakarta



Liquefaction potential in Vancouver



Liquefaction potential in Singapore



■ Nil ■ Low ■ Moderate ■ High

Business interruption

Business interruption claims from commercial policyholders increased due to the fact that large portions of the Christchurch central business district (CBD) were cordoned off. Hence, even businesses not directly affected by the impact of the February 2011 earthquake were unable to continue operations. That said, the large scale demolition of the CBD did somewhat reduce the business interruption issue. Furthermore, the general impact the earthquake had on the entire region – with many residents temporarily relocating, key infrastructure hampered and the worry of subsequent aftershocks – activity in the central business district was significantly reduced. Additionally, reconstruction has taken several years to get underway as authorities work to rebuild the city in a more resilient way. This has resulted in business interruption claims often in excess of the full limit.

Government involvement

Despite New Zealand having among the highest take-up rate for earthquake coverage in the world for both private and commercial insurance covers, the government became very involved due to the size and impact of the loss. In Christchurch the government limited access to the central business district, issued demolition orders, appointed a minister of recovery, strengthened building codes and designated red zone areas (where rebuilding is not allowed).

While all these actions were designed to support citizens and the rebuilding process, they also increased insurance claim costs. For instance, as mentioned further below, the strengthening of building codes resulted in larger insurance claims. Also, the increased number of stakeholders in the settlement process posed extra challenges for claims assessors. So open communication and good relations with government officials are key.

Insurance industry preparedness

Primary insurers and their staff may themselves be impacted by earthquakes. So it is important to have effective crisis response and earthquake preparedness plans. In Christchurch, staffing was too lean to handle the sheer number of claims and training of claims adjusters on the job to deal with such an event. The lack of adjusters was compounded by the fact that Australian adjusters were still occupied with settling claims from the Brisbane floods and Typhoon Yasi.

More experts needed

Engineers were also in short supply and facilities were needed for on-site claims staff. This situation highlighted the importance of cooperation within the industry to avoid inconsistencies in claims adjustment and to consequently process claims more effectively. Under such pressure, record-keeping practices may suffer.

Policy conditions

The high claims costs are partly due to the specific nature of residential building insurance policies in Christchurch. The policies were issued on an uncapped full replacement value basis meaning that any damaged property is restated to an “as new state”. As a result, the cost of repairing heavily damaged properties could significantly exceed the reported value of those buildings. For claims on commercial policies, costs were higher due to the absence of a co-insurance clause compounded with the level of underinsurance. Again this resulted in claims often far exceeding the insured values.

Loss modelling okay?

This is a crucial observation in the context of earthquake loss modeling, as loss models assume that a loss on a policy does not exceed the sums insured, meaning that the models judge risks too optimistically. Also, the albeit sensible requirement of the authorities that properties be rebuilt according to stricter building codes, e.g. with stronger foundations, meant that claims on only moderately damaged properties could become substantial. This was because insurance also had to cover the work of strengthening the foundations.

Multiple policies

Another issue was that many residential properties were covered by two policies: Firstly, there is the policy issued by the EQC, which covers almost all homes in New Zealand. This policy covers up to NZD 100 000 for building damage and NZD 20 000 for content. Then there are the additional private policies which were bought to cover the damage not covered by the EQC policy. The fact that the two policy wordings were not congruent – e.g. the EQC covers land damage while most private policies do not – created much debate between the involved insurance companies during claims settlements. This ultimately delayed the process and again drove up the total bill for the insurance business.

Government intervention had far-reaching consequences for insurers

“Neighboritis”

Another reason for the rise in claims as time went on had to do with so-called “neighboritis”. Policyholders who may have accepted a settlement at the beginning witnessed how some of their neighbors who initially rejected to settle were receiving more generous payouts. This may have prompted them to reconsider and also demand higher payouts.

Lessons learned

There are many lessons to be learned from the Christchurch experience, but the most profound one is that a small magnitude earthquake could hit virtually anywhere and trigger unexpectedly large losses. Another basic lesson is that earthquake models, which are built to predict losses due to well-established loss patterns, must be updated to ensure accuracy by addressing key model blind spots. These should include the cascading effect of earthquake aftershock sequences, the significant impact of the claims handling process on the ultimate payout, the potentially widespread effect of liquefaction in urban areas, and the paralyzing effect that slow reconstruction efforts in a city center can have. Witness the fact that

rebuilding of downtown Christchurch is far from complete more than four years after the earthquakes. Furthermore, as an industry, we have to take a serious look at the way earthquake risk is assessed for city scenarios. Is the potential for business interruption, including wide area damage fully understood and taken into account? Are there policy wordings that leave liability uncapped or open to interpretation with regard to reinstatement values? If so, is the impact on the claims process properly reflected in the way earthquake models predict financial losses? The Christchurch experience suggests that this is not the case. It is possible that Christchurch is not an exception but that similar loss developments beyond current risk perceptions could also happen in other cities.



Impact of soil liquefaction beneath a highway

Case studies

Small earthquakes, such as the 22 February 2011 event in Christchurch, can strike virtually anywhere. The consequences to society, the local economy and the insurance industry could be as severe as in Christchurch. What can other cities around the world learn from the Christchurch event, including those which are typically not on the radar of earthquake risk studies? We have selected three cities to serve as templates for many others around the world to illustrate how a Christchurch-like earthquake would impact other locations. Needless to say, each city is unique. However, the effects which resulted in very high insurance payouts in Christchurch, could also play out in other cities such as Sydney or Singapore.

The likelihood is low that a magnitude 6.3 earthquake would occur beneath any of the cities listed below. Nonetheless, as the Christchurch event showed, because such an earthquake can happen even in places not considered a high seismic risk, it is worthwhile considering the associated loss scenarios.

Sydney

Sydney is a city not deemed an earthquake quake hotspot. However, as the 25th anniversary of the Newcastle earthquake reminds us, it is located in a geographical area that has experienced damaging earthquakes in the past. Approximately 120 kms from the Sydney central business district, Newcastle was hit by a 5.6 magnitude earthquake in 1989. According to the Australian Insurance Council at the time, this triggered an insurance loss of AUD 862 million (USD 805 million) despite its small magnitude. It should be borne in mind that if it happened today, insurance costs would be in the range of AUD 4.3 billion (Risk Frontiers, Australian and New Zealand Institute of Insurance and Finance Journal in 2007) to AUD 6.2 billion (AIR, Flyer on Earthquake Model for Australia in 2012) or USD 3.8 to 5.4 billion.

If such costs could arise from an earthquake in Newcastle, what would be the impact of a small earthquake in the much larger and more built-up city of Sydney? It should be noted that the likelihood of such an event is low with a return period of several thousand years. That said, a Christchurch-like event could result in total damages of USD 120 billion (Swiss Re estimate), even without accounting for the effect of potential aftershocks. The bulk of this loss would be covered by insurance.

There are a number of reasons why Sydney is prone to extremely high insurance payouts in the case of a Christchurch-like earthquake. The city has a higher population density than Christchurch and the economic value per square meter can be as much as five times higher. The risk of building damage is higher in Sydney than Christchurch as many of Sydney's older buildings have unreinforced masonry walls. The latter is a type of construction that most of the over 35 500 buildings damaged in Newcastle had.

Like Christchurch, the majority of Sydney property owners (an estimated 80% of residential property and 90% of commercial property) buy earthquake insurance written on a full replacement value basis, albeit in most cases with a policy limit. Challenges in the claims process and the ensuing delays and inflation of cost would almost be inevitable. This would be due to the sheer number of claims and also to the policy wordings which are similar in many ways to those in Christchurch. In addition, claims handlers in Sydney are not experienced in settling earthquake claims. Such lack of knowledge would pose additional challenges. A further complicating factor could be the increasing practice of offshoring claims adjustment, meaning that the claims handlers are often unaware of local practices. The only Christchurch factor which Sydney would likely be spared is soil liquefaction. With only few exceptions, such as certain areas around Botany Bay, Sydney is largely built on strong sub soil and is expected to have little to fear from soil liquefaction.

Only Christchurch factor
Sydney would be spared is
soil liquefaction

Singapore

The probability of the Singapore area being directly exposed to a devastating earthquake is low. However, a number of relatively close tectonic features such as the Sumatra Subduction zone and the Sumatra Fault could create losses in Singapore if they generated substantial events in proximity to Singapore. Earthquakes on these tectonic features have been repeatedly felt in Singapore (e.g. M 7.2 in 1909 at a distance of 470 km, M 7.5 in 1914 at a distance of 650 km, M 7.1 in 1971 at a distance of 550 km among others). Distant but large earthquakes produce “slow shaking” that travels relatively large distances and can impact tall buildings in Singapore.

As in Christchurch, many parts of Singapore, such as Changi airport or Jurong petrochemical complex, are located on potentially liquefiable soils. At close to 100%, the earthquake insurance take-up rate is also very high and insurance would carry the bulk of the financial burden, except for the impact on infrastructure. Being a relatively aseismic country, Singapore’s building codes are less focused on earthquake resilience, although some seismic code provisions exist for tall new buildings, which are built on weak soil. At the same time, many of the newer buildings are characterised by special architectural features, which introduce irregularities in the buildings’ shapes. While architecturally interesting, such buildings are inherently weaker in earthquakes than simpler and more conventional shapes.

Singapore therefore is exposed to the same factors which contributed to a large insurance loss in Christchurch. These include the potential for liquefaction in many newly-built up areas, a very high earthquake insurance take-up rate, and an insurance industry that is relatively unaware of these risks. Additionally, Singapore’s older buildings were not built with earthquake safety as a primary objective. And, as in Sydney, Singapore has a much higher economic value per square meter than Christchurch. Consequently, an earthquake similar in magnitude and area affected might trigger a total economic loss of USD 65 billion (Swiss Re estimate). Insurance would be liable for a large portion of this economic loss.

Vancouver

We chose Vancouver as the final case study to highlight that Christchurch-like effects are also relevant for cities outside of the Asia-Pacific region. Vancouver has not experienced a substantial earthquake in recorded history. However, Vancouver is located close to the so called Cascadia subduction zone, which runs along the US-Canadian coast roughly 75 km off the coast of Vancouver Island and 300 km from the Vancouver City Centre. Paleoseismic studies indicate that the Cascadia subduction zone has generated very large earthquakes on average every 500 years. The last event happened roughly 300 years ago.

Compared to Christchurch, the population density and economic value per square meter are significantly higher in Vancouver, especially in the downtown area. By simply comparing Vancouver’s economic exposure in the downtown area to that of Christchurch, it is clear that should a Christchurch-like M 6.3 earthquake happen beneath Vancouver, it would result in substantially larger economic losses estimated at USD 40 billion (Swiss Re estimate). For a large earthquake on the Cascadia subduction zone, the total economic loss is estimated by an AIR study in 2013 at CAD 75 billion (USD 66 billion) with an insurance loss of CAD 20 billion (USD 18 billion). This estimate is higher since such an earthquake would create more widespread damage in the larger Vancouver area and would also include Victoria on Vancouver Island.

Vancouver has several areas which are prone to widespread liquefaction as the liquefaction map shows. The areas around the Fraser River, especially in Richmond, Delta and around Vancouver International Airport are located on liquefiable soils. The impact of wide-area damage and business interruption on the economy in Vancouver would likely be substantial as well. This is accentuated by the reliance of the transport network on the numerous bridges crossing the Fraser River. Many of the bridges are located on poor subsoil and would likely have to be closed for some time following an earthquake.

The earthquake insurance take-up rate in Vancouver is smaller than in Christchurch, so insurance would only be liable for a fraction of the economic damage. Nonetheless, due to the larger value accumulation, the insurance loss would be on a similar scale to the Christchurch loss. The burden on claims adjustors, most not being experienced in settling earthquake claims, would be significant. Like in Christchurch, residential policies are issued on a full replacement value basis and are often uncapped, which would make these policies prone to inflated claims. Therefore, delays and complications in the claims process, as experienced in Christchurch, would likely also occur.

Another complicating factor in Vancouver are the so called “loss assessment covers”, which are sold to condominium owners. The loss assessment covers are intended to pay for the part of the building damage which is not covered by the condominium association’s building insurance, or which falls within the deductible of that cover. With the substantial deductibles on the building insurance sold to the condominium associations, the loss assessment covers are susceptible to substantial payouts. However, this loss assessment cover exposure is often not systematically tracked and the corresponding claims might offer a further surprise.

Conclusion

As the Christchurch events and the case studies of Sydney, Singapore and Vancouver highlight, the impact of a Christchurch-like earthquake on a city center can be immense. There are many such cities around the world which are not usually associated with high earthquake risk. But when such an event does occur, losses can nonetheless be substantial. The consequences seen in Christchurch are most probably the norm as opposed to the exception. It is true that the probability of a Christchurch-type event in any specific city is very low. Nevertheless, there is a substantial probability that one or other city somewhere in the world will be affected in the coming years and will show similar claims-inflating effects.

Relying on potentially outdated models which may not fully reflect the factors described in this publication, could potentially lead to the situation where the insurance industry is not taking the risk of potential earthquakes in city centres fully into account. We have focused on three cities as examples. However, many other cities around the globe meet similar criteria and would be equally prone to devastating earthquake damage.

Furthermore, we recommend that insurers conduct "what-if" scenarios based on the Christchurch experience. These exercises need to address questions such as: Do the policy wordings offer the necessary clarity? What potential exposures could be covered which are not currently taken into account? Would sufficient claims adjusters be available? Is a process in place to deploy and coordinate claims adjusters? How will the settlement of claims work? Could damage to key infrastructure hamper reconstruction efforts? During the process of reconstruction how will the communication and coordination between insurers, authorities, and the public be handled? Addressing these questions will help us benefit from the costly lessons from the Christchurch experience.

Seismic risk in city centres underestimated by insurance industry

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The front cover image shows the devastation caused by the 2011 Christchurch earthquake and the subsequent rebuilding process.

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