Costs and Effects: The health costs of the 22 February 2011 Earthquake

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ABSTRACT: This research considers the degree of seismic resistance of the built environment to seismic shock as a cause, and public health costs as an effect. Unfortunately, in public policy the cause and the effect are governed by different ministries with different budgets. Similarly, the costs of altering the cause are borne by building owners with possible subsidies; the costs of the effects are borne by the taxpayer-funded public health system.

This research aims to use economics to connect cause and effect, and presents an exploratory model. It explores the human cost of the Canterbury earthquakes, measured in health costs paid by ACC and District Health Boards, compared to the value of the built environment of the city in general, and to the modelled cost of preventative retrofitting to various standards of safety. But it will also explore who pays the costs, and who benefits. As such it explores both efficiency and equity of seismic building standards for new builds, and retrofitting requirements for older buildings.

In other words, it explores the cost of taking action to prevent death and injury in earthquakes, the cost of choosing not to take action, and the value of the built environment itself. In so doing, it will explore efficiency, equity, resilience, and resistance in disaster health policy.

1 INTRODUCTION

On 22 February 2011, I took a bus from my beach village to the University of Canterbury at the opposite corner of Christchurch. At 12:51pm, the bus was on the main street of town, Colombo Street, when a M6.3 earthquake struck. At first it was no different to any of the other thousands of aftershocks we'd felt since the M7.1 on 4 September 2010.It became somewhat more remarkable when an unremarkable 2-story unreinforced brick building next to the bus collapsed. The building and its concrete parapet did not collapse politely into itself, crushing the empty stores that had been vacant since being "red-stickered" by city council after earlier earthquakes. The building exploded outwards, covering the footpaths, the parking lane, the bike lane, and the northbound traffic lane with pieces of façade and parapet, big and small. The Canterbury Earthquakes Royal Commission of Enquiry (CERC) heard that his pattern of impolite explosion outwards is well known in the engineering literature, and was predicted by city council inspectors who noted on 26 Dec 2010 that the front wall and parapet were fully detached from the building and leaning out 44mm over Colombo Street.

The building had no structural reinforcement. It had no fence blocking the road or footpath in front of it. The owner of the building next door spent $200,000 on a rudimentary steel strapping job to hold his building together after September 4. His building collapsed politely into its empty self, hurting no one.

The passengers and driver of the Red Bus were not so lucky to be next to a reinforced masonry building, no matter the crudeness of the reinforcement. After the quake, our red bus was so crushed, covered, and contorted that it ceased being recognizable as a bus. It's invisible under a pile of rubble in aerial photos of Colombo Street in the immediate aftermath.

In the 59 minutes between the earthquake and my arrival at the Emergency Department at Christchurch Hospital, I heard and felt the involuntary death throes of a 14 year old boy, a 78 year old woman, and 10 others in between. Soon thereafter, an impromptu team of about two dozen men and one woman dug a meter and a half of rubble off the roof of the collapsed bus, pulled the roof off with their bare hands, prised my left leg free from under the seat that was crushing it and trapping me, lifted me out of the bus, laid me in the middle of Colombo Street, splinted my broken leg, and commandeered a passing truck to drive us to hospital. Throughout, three took it upon themselves to take turns holding my hand and telling me fishing stories.

Because the façade next to our bus was visibly leaning out and unrestrained by strapping, reinforcing, or fencing, the passers-by were forced to rely on hope that the Big One had been and gone. If that hope failed, we were forced to rely on the public health system and NZ's national accident insurance scheme, the Accident Compensation Corporation, to put the pieces back together.

Let us consider the degree of seismic resistance of the built environment to seismic shock as a cause, and public health costs as an effect. The trouble with relying on public health care if the hope for resistance to seismic shock fails, is that in public policy the cause is not related to the effect. The cause is governed by Ministry of Business Innovation and Employment (MBIE), while the effect is governed by the Ministry of Health and the Accident Compensation (ACC) Corporation. Similarly, the costs of each are borne by different parties. The costs of altering the cause are borne by building owners with possible subsidies from councils, heritage trusts, or MBIE; the costs of the effects (caused by not altering the cause) are borne by the hapless passers-by and the New Zealand taxpayers who generously pay our medical bills.

This research will aim to use economics to connect cause and effect. It will explore the human cost of the Canterbury earthquakes, measured in health costs paid by ACC and District Health Boards. We will ask questions of efficiency of seismic building standards for new builds, and retrofitting requirements for older buildings – whether the uncertain health savings in future rare events exceed, or otherwise justify, the certain costs of retrofitting now. But we will also ask questions of equity – how the costs and benefits of the built environment are distributed across society, and whether pattern of distribution is fair. More specifically, we will ask how: much it cost the public health system, compared to the value of the built environment of the city in general, and to the modelled cost of preventative retrofitting to various standards of safety; who pays the costs; and who profits from the benefits of the built environment.

In other words, it explores the cost of taking action to prevent death and injury in earthquakes, the cost of choosing not to take action, and the value of the built environment itself. In public policy, the dollar amount of the costs is often less important than how they're distributed across society. In the case of seismic retrofits and many make-safe actions, the owner pays the costs of any upgrade, while the public pays the cost of failing to upgrade. This privatises the costs of action, while socialising the risks of inaction. As such, the important question is not how much, but who pays. A traditional cost benefit analysis focuses on how much (efficiency), but this research will add who pays (equity).

2 DATA

On 22 February, the built environment of Canterbury caused 183 deaths (of 185 in total) and 3127 injuries (of 7171 in total). In other words, in most cases it wasn't the earthquake that caused most of the deaths and many injuries; it was the buildings.

We don't yet have the health costs data as we are awaiting Human Ethics approval. But we can present two case studies to approximate our questions. They are both unrepresentative and illustrative, each in its own way.

Case 1: One unfortunate and unrepresentative building, counting injuries and deaths

Table 1. One building, 3 addresses: Cost of action = $200,000, Cost of inaction = $71.4M

Address	Owner	Capital value (2007)	Land value (2007)	Cost of action[i] (CERC)	Fatalities	Opportunity cost of fatalities (VPF[ii])	Out of pocket injury costs[iii]	Cost of action or inaction
615 Colombo Street	Simon Yee	$893K	$664K	$200K strapping done	0	0	-	$200K
605-613 Colombo Street	Benson Chen Holdings	$1.44 M	$1.41M	$0K strapping not done	7 adults + 1 child	$48.2M	~$240 K	$48.4M
603 Colombo Street	Yee holdings	?	?		4 adults	$23M	-	$23M

[i] This estimate comes from the Royal Commission (CERC) hearings February 1,2 2012.
[ii] These estimates of the value of human life might seem rather callous, but they come from the economics literature on risk and are called the Value of Preventable Fatality (VPF). In NZ, an adult VPF is about $6 million. (O'Dea D. and Wren J. 2012. Page 11.)
[iii] This includes ACC expenditures for the first 12 months, and the DHB expenditures for acute care during 2 months in hospital. We have only one datapoint in health costs, due to privacy issues.

Happily this building is not representative. It over-represents the hazard in at least 4 ways:

1) Table 1 inflates the opportunity costs of fatalities. In February, there were 183 deaths related to the built environment. This presents an opportunity cost of about $1.01 billion (in value of preventable fatalities), again spread very unevenly across the city.

2) It inflates the risk. This is after the fact of a very rare, and rather unfortunate, event.

3) It inflates health costs. The total injury cost paid by ACC for the 2011 earthquake was about $21 million. We do not yet have the acute health costs (for the ~200 hospitalised), but those costs are likely to be double or treble the ACC costs. Hence the total public health cost of the February is likely a bit under $100 million, spread very unevenly across the city. This does not include the Value of Preventable Fatalities (VPF), or societal opportunity costs of the fatalities, estimated at $1.1 billion.

4) Similarly, it underestimates the cost of action. Clearly any preventative action would have lowered the toll in February, even if that action were as simple as cordoning off the entire block. (But, again, the costs of the cordon would be borne by business owners, Council, and road-users, while the beneficiaries would be the road and footpath users.) But on the scale of a city, region, or country, the costs of action on every building to mitigate a hazard of unknown time, place, and intensity far exceed the $200,000 strapping job of the neighbouring building owner interviewed by the Canterbury Earthquakes Royal Commission.

Case 2: Costs of fatalities and the value of the built environment

Table 2 presents the addresses and opportunity costs of fatal building failures, as reported by the Canterbury Earthquakes Royal Commission and the Christchurch Police, and the capital and land values as estimated by government valuers in 2007.

Table 2. Opportunity costs of fatalities vs. building values

Address	Fatalities	Societal costs of deaths (VPF)	Capital value 2007	Land value 2007	Approx. bldg value 2007	% of value in bldg
39 Bishop Street	1	$6,000,000	$243,000	$109,000	$134,000	55%
89, 91 and 93 Cashel Street	2	$12,000,000	$2,730,000	$2,380,000	$350,000	13%
32 Cathedral Square	1	$6,000,000	$6,600,000	$4,040,000	$2,560,000	39%
90 Coleridge Street	1	$6,000,000	$307,000	$229,000	$78,000	25%
382 Colombo Street	1	$6,000,000	NA		NA	NA
593 Colombo Street	1	$6,000,000	$690,000	$635,000	$55,000	8%
595 Colombo Street	1	$6,000,000	$270,000	$265,000	$5,000	2%
601 Colombo Street	1	$6,000,000	NA		NA	
603 Colombo St	4	$24,000,000	NA		NA	
605–613 Colombo Street	8	$48,000,000	$1,440,000	$1,410,000	$30,000	2%
617–625 Colombo Street	1	$6,000,000	$ 2,730,000	$975,000	$1,755,000	64%
738 Colombo Street	1	$6,000,000	$3,230,000	$3,170,000	$60,000	2%
753–759 Colombo Street	1	$6,000,000	$3,970,000	$3,890,000	$80,000	2%
309 Durham St North	3	$18,000,000	church		church	
194 Gloucester Street	1	$6,000,000	$1,680,000	$544,000	$1,136,000	68%

Table 2 continued

194 Hereford Street	1	$6,000,000	$960,000	$360,000	$600,000	63%
246 High Street	1	$6,000,000	$2,100,000	$2,040,000	$60,000	3%
43 Lichfield Street	1	$6,000,000	NA		NA	
116 Lichfield Street	4	$24,000,000	$880,000	$635,000	$245,000	28%
200–204 Manchester Street	1	$6,000,000	NA		NA	
243–245 Madras Street	115	$690,000,000	$5,750,000	$1,360,000	$4,390,000	76%
233 Cambridge Terrace	18	$108,000,000	$8,160,000	$3,820,000	$4,340,000	53%
265-271 Manchester Street	1	$6,000,000	$1,610,000	$1,210,000	$400,000	25%
7 Riccarton Road	1	$6,000,000	NA		NA	
391 Worcester Street	2	$12,000,000	$223,000	$90,000	$133,000	60%
Wainui Street	1	$6,000,000	NA		NA	

In every case in Table 2, the value of preventable fatalities far exceeds the value of the building itself. 11 of the 21 properties with available data, the value of the building proper was less than the value of the bare land; 9 of the buildings were worth less than a quarter of the capital value of the property (which includes the value of the bare land plus the improvements and buildings). The two modern buildings (CTV and PGC) were worth more than the land they were built on.

Table 2 is happily unrepresentative for the same 4 reasons as Table 1. But Table 2 fails to consider the costs of injuries; and it does not attempt to estimate the cost of preventative action.

Unrepresentative though the data available to date may be, they illustrate our questions. This research aims to contribute to that conversation by broadening MBIE's enquiry to include injuries, and quantifying many of the Royal Commission's narrative and investigative enquiries using the data described in Table 3.

Table 3. Data types and sources

Out of pocket health costs (Human ethics application now underway)
Hospital costs of seriously injured (source: DHBs)
Out-patient and Rehabilitation costs of seriously injured (source: ACC)
Hospital care costs of deceased (source: DHBs)
Out-patient costs of less seriously injured (source: ACC)
Opportunity costs of fatalities
Value of preventable fatalities calculation (VPF)
Financial details of buildings
Name(s) of owner(s)
Number of ownerships within same building (e.g. 1 bldg, 3 addresses)
Government valuation (GV)
Capital value
Land value
Date and price of last sale
Building materials: roof, walls
Age category
Condition
Detached, or shared walls
Parcel size, number of units
Property use (e.g. commercial, residential, retail, multi)
Category of business
Rent collected (if available)
City Council Buildings Surveys (1990-93): Seismic Risk, Hazardous Appendage (if useful)
Sources: Quotable Value via Quickmap, subject to laborious processing and data inconsistencies CERC Others?

3 CONCLUSIONS

Much is written about resilience to disaster. The public health system certainly contributes greatly to resilience, in part by serving as the ambulance at the bottom of the cliff. But in the case of Colombo Street and most of the deaths in the streets, there was nothing natural about the disaster that befell us. It wasn't the earthquake that crushed us, it was the buildings. Less is written about resistance to disaster, and its role in public health policy. Disaster risk reduction, by way of retrofitting in this case, would lower the height of the cliff and cushion the blow at the bottom. We wouldn't need so much resilience if the system, and the built environment, were more resistant to the initial shock.

But resistance, in the form of seismic retrofitting, is expensive. Looking at the estimated total health costs of the February 2011 earthquake presented above suggests that a conventional cost-benefit analysis of retrofitting is unlikely to conclude that it's efficient – that the uncertain health savings in future rare events exceed, or at least justify, the certain costs of retrofitting now. I must confess that in my heart of hearts, I wish that this research would show that that an ounce of prevention is worth a pound of cure. But from a pure efficiency perspective, it does not look like the numbers will support preventative retrofitting. No amount of gerry-mandering can make the numbers say what in my heart of hearts I wish they would say.

But equity is a different question. In matters of seismicity, the public pay the resilience toll, while building owners pay for resistance. Even if there is a public subsidy for resistance, it will be unrelated to the resilience costs of health expenditures. Health costs to support social resilience after a disaster are an effect of the lack of expenditure on seismic resistance before a disaster. Yet in public policy, the costs of resilience come from different ministries, different budget "Votes", and different advocacy groups, from the costs of resistance. As such, though cause and effect are graphically illustrated in Table 1, they are entirely separate in public policy. This research aims to include the overlooked health costs, and connect the causes to the effects. In so doing, it will explore efficiency, equity, resilience, and resistance in disaster policy.

REFERENCES

O'Dea D. and Wren J. 2012. New Zealand Estimates of the Total Social and Economic Cost of Injuries. Report to New Zealand Injury Prevention Strategy. Wellington, New Zealand.