Residential insurance market responses after earthquake: A survey of Christchurch dwellers

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ABSTRACT

Lack of effective information on the impact of catastrophe on insurance market affects risk assessment and the quantity of insurance coverage. This leads to suboptimal decision making with respect to level of insurance coverage to purchase. This study investigates the New Zealand residential insurance after the 2010–11 earthquakes. A set of hypotheses are used to investigate the impact of catastrophe from an economic analysis perspective with appropriate statistical tests. The results show that change from full replacement value policy to nominated replacement value policy is the key determinant of the direction of change in the level of insurance coverage in the aftermath of the earthquakes. Policyholders increased the level of insurance coverage to comply with the new policy modification; other varying reasons for the insurance coverage change are observed. The earthquakes highlighted the plight of those who were underinsured prompting policyholders to update their insurance coverage to reflect the estimated cost of re-building their property. It is also observed that insurance policyholders update their risk perception immediately after major catastrophe losses. The level of risk aversion has an impact on decisions made post-disaster and both risk aversion and perception are positively correlated with change in the level of insurance coverage at all levels of income. Thus, if insurance demanders perceive a higher possibility of further natural disasters then they will always adjust their insurance coverage appropriately. A more comprehensive data set and robust econometric analysis is required to rigorously investigate this proposition.

1. Introduction

Individuals and organisations have developed many ways to absorb, share and transfer risks, ranging from small informal arrangements to national and global complex risk transfer systems. The aims and design of the systems can differ across countries or even stakeholders within a country. In New Zealand, the fundamental aim of the existing disaster risk transfer system is to provide affordable compensations and distribution of public and private liability fairly and widely within the country. A modern critical objective of such systems in most countries is the reduction of significant social hardships and disruption of national development due to cost spill-overs to major economic activities.

Insurance is one of the commonly used risks financing mechanism that seeks to promote pooling and sharing of risks and losses to a wider group including those from disasters such as earthquakes, floods and storms [1–3]. In the aftermath of a disaster, an insurance mechanism plays a very crucial role of rebuilding the damaged part of the society. This is true for Christchurch City which experienced devastating earthquakes in the years 2010–11 with an estimated economic cost of over NZ$40 billion [4–6]. In appreciating the important role played by catastrophe insurance, the World Bank actively initiated efforts aimed at accessing affordable insurance in the aftermath of the heavy hurricane-related economic losses in the Caribbean Community, [53]. There is varying evidence of how societies cope with the impact of a disaster. A study by Ref. [7] was the first academic work to hypothesise over-reaction by economic agents in the aftermath of a major disaster. Numerous empirical studies [8–11], built on the pioneer work of [7] documents that both insurers and insured decision-making processes are flawed to the extent that they overreact to the occurrence of a major disaster.

According to Ref. [12]; exposure to hypothetical disasters by playing an insurance game increases the real insurance take-up rate by 9.1% points. This is a 46% increase relative to the baseline take-up rate of 20%. Increased climate-related impacts, such as extreme weather events result in the insurance companies charging a higher premium which subsequently decreases insurance demand [13]. [14] analysed

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U.S. property insurers' supply decisions between 1992 and 2012 and found that insurers' responses with respect to the reduction of business volume and exit decisions differ across hazards, with the negative effects of catastrophes on supply decisions being more pronounced after extreme hurricane years compared with tornado years.

The study gives an empirical analysis of pre- and post-Christchurch earthquakes insurance reactions using survey data. The work focuses on the demand-side aspect of residential property insurance coverage. The key interest in the demand-side reaction centres on an analysis of the change in the level of insurance coverage, and variables that contribute to such changes. Changes in the level of insurance coverage are used as proxy of the insurance demand response post-Christchurch earthquakes. The study does not seek to calculate and/or estimate the insurance demand function post-loss. Instead, it examines the change in level of insurance coverage by conducting a demand-side survey to tease out, purely, the insurance market response from the demand-side perspective. The study further investigates how various insurance demand determinant variables influence the change in the level of insurance coverage post-catastrophe. The output of this study is crucial to the understanding of how insurance consumers have adjusted their level of insurance as a result of the contract modifications and the effects of insurance demand determinant variables post-disaster. To this end, the investigation presents a clear picture of insurance demand-side response after the Christchurch earthquakes.

The rest of the paper is organised as follows: Section 2 presents the hypothesis and research question studied in this chapter.The data collection and analysis used are elaborated in Section 3. Section 4 presents the main results and discussions. Section 5 gives the conclusions and recommendations of the study.

2. Hypotheses of the study

Lack of effective information on the impact of catastrophe on specific insurance market causes both insurer and insured to face difficulties in risk assessment and determining the quantity of insurance coverage to supply and demand respectively. [9] work presents a simple homeowner flood insurance model which implies that the demand for flood insurance increases as the expected probability of a future flood increases. However, the insured have difficulty in assessing *low-frequency-high-magnitude* risks due to limited experience in events such as a disaster risk. This leads to suboptimal decision-making with respect to level of insurance coverage to purchase. This study presents a novel area of investigation from New Zealand residential insurance standpoint after the 2010–11 earthquakes. It proposes a set of hypotheses to investigate the impact of catastrophe on specific insurance market's product demand. The hypotheses are discussed from an economic analysis perspective with appropriate statistical tests to explain how insurance demand determinants respond to catastrophe losses.

Firstly, it is hypothesised that insured's assets and annual household income are positively associated with the annual premium consumers willing to pay for full residential property protection. Consequently, these have a positive influence on the change in the level of insurance coverage in the aftermath of disaster. The objective of this hypothesis is to test if household income and property value affect the premium a consumer is prepared to pay. In general, the test will show whether there is any association between these three variables by carrying out a descriptive analysis. This hypothesis draws from the findings of previous literature. For example, in Ref. [15]; the implied income elasticity for the take-up of house insurance is around 0.02. This suggests that after controlling other factors, a 1% increase in income would only result in a 0.01 to 0.02% increase in the likelihood a household would buys house insurance cover. A similar study by Ref. [16] used U.S consumer expenditure survey to assess the effects of age, income and household characteristics on total insurance expenditure. They found insurance expenditure to be positively related to income, age and size of household and that the marginal importance of income is greater for

small households.

Secondly, the demographic characteristics of households are associated with, and influence the change in the level of insurance coverage for residential property insurance in the aftermath of a major disaster. The main demographic factors studied are: age, education, gender and income. Insurance consumer risk aversion is strongly affected by demographic characteristics like the value of insured assets, income, age, and education amongst other features. The degree of risk aversion is a key determinant of insurance demand. Here we use the demographic characteristics of survey participants to deduce a proxy for risk aversion. The main demographic characteristics of households of interest for this hypothesis include: age, gender, education, incomes, and property value. In the insurance literature, the level of risk aversion is hypothesised to be positively correlated with the insurance consumption of an individual assuming that individual is a risk-averse decision-maker. Numerous empirical studies [17–20] have demonstrated a positive and significant relationship between insurance demand and the level of education. This would imply that a higher level of education leads to a greater degree of risk aversion and greater awareness of the need for insurance coverage. However, in macroeconomic and cross-section studies, this hypothesis does not always hold and it cannot be concluded that there is a positive correlation between risk aversion and the level of education. For instance, a survey by Ref. [21] on the relationship between risk aversion and education shows a negative relationship. This implies that higher education leads to lower risk aversion, which in turn leads to more risk-taking by highly-educated individuals. [22] examines the role of income level and education level while purchasing flood insurance for residential properties. Their study found that the propensity to purchase flood insurance increases significantly with income levels while education level does not make much difference. They suggest that the increase is likely a result of property owners suffering greater losses of wealth, accumulated savings from income, from the previous catastrophic floods than increases their risk aversion. According to Ref. [23]; households that face income uncertainty or that suffered losses of income from severe natural disasters show evidence of a greater degree of risk aversion.

Lastly, the increases in both risk aversion and risk perception have a positive influence on the change in the level of insurance coverage for residential property owners in the aftermath of a major disaster. Insurers assess risk by making best estimates of the frequency and severity of a hazard using statistical techniques or catastrophe models. However, an expert's generated risk perception information often has a minimal influence on decision making under risk by a lay person [24]. Some studies [25–27] suggest that individuals often use heuristics and simple rules when they are assessing risk. Thus, individuals may judge an event as risky if it is easy to imagine or recall; for example, individuals who have had an experience of the Christchurch earthquakes may have high expectations that a similar disaster could happen again in the future and therefore report a higher perceived risk than individuals without this experience. An analysis of H3 can be used to infer on the level of risks whether individuals are located in the epicentre of a disaster have a higher risk perception. It is postulated that properties in the epicentre of a disaster event are more likely to have higher levels of insurance coverage post-loss than properties that are far from the epicentre [5,28]. However, if insurers use a risk-based underwriting approach, then it is expected that there would be a positive relationship between the perception of risk and the cost of insurance coverage, and a change in risk aversion and perception would have a positive influence on the demand for insurance by property owners in the aftermath of a major disaster. Thus, at higher levels of risk perception both the price of coverage and the demand for insurance coverage would be higher.

Generally, the underlying research question examines the demand-side insurance market response after the Christchurch earthquakes. A simple description of the survey responses is used to illustrate what actually happened to insurance demand-side related variables as a response to the Christchurch earthquakes.

3. Data collection and analysis

Following the Christchurch earthquakes, many households had left their damaged properties and moved to new suburbs or relocated to other cities. An online survey was considered as the most effective data gathering method for these households. An online survey questionnaire link was distributed through a random sampling of Christchurch dwellers using publicly available emails.

A total of 1,600 households' decision makers were surveyed through emails which were sent to them between September and November 2015. However, it was not possible to verify if all email addresses were still in use. A total of 254 survey participants completed the survey, representing a response rate of 16%. Sorting and cleaning of the completed questionnaires produced a total of 221 responses which could be meaningfully analysed.

The survey data was gathered from four organisations: University of Canterbury, ARA Institute, Christchurch Airport and Christchurch Women's Hospital. The sample consisted of homeowners insured prior to the 2010–11 earthquakes, and the institutions provided access to email contacts which were used for an online survey. Consequently, then, the survey data may not be entirely representative of the entire population, but the survey participants in the sample were all affected by the earthquakes and they had some relationship with the insurance companies. To this end then, the survey data is only intended to be illustrative, not necessarily representative of the entire population. Future research work may well investigate more detailed data across the entire population to examine insurance market responses from demand-side.

Analysis of the survey data is done in two parts. The first part, which forms the main findings of this survey, entails simple descriptive analysis. The main purpose of this analytical approach is to exhibit, in simple manner, what actually happened to insurance demand-related variables after the earthquakes. A chi-square test of independence is also used to examine differences in participants' responses where appropriate.

In most survey analyses, there are key explanatory variables of investigation that are often covariant [29–31]. For example, in this survey response an insurance decision to change the level of insurance coverage is closely related to the value of the insured asset and supply-side policy conditions; which in turn may be a function of several variables including property value, age, gender, income, education or risk perception that vary together with other insurance demand determinant variables. So, to isolate and investigate the effect of an individual variable, a robust statistical approach is normally preferred [32]. However, due to the nature of the survey questions here, and possible interactions of demand and supply determinant variables, the present study acknowledges the inherent statistical shortcomings that emerge when regression analysis is used on this data-set, and in particular the problem of endogeneity has already been identified. Consequently, part two of this survey analysis presents a simple tractable statistical analysis: Correlation analysis of the demand determinants and associated variables is carried out.

4. Results and discussions

The results of the data analysis provide a clear, simple descriptive presentation and visualization figures of the survey and of the survey results. A simple description of these results as in the figures, informs of what actually happened to insurance-related variables after the earthquakes.

4.1. Change in the level of insurance coverage after the earthquakes

Respondents were asked whether they had changed their level of insurance coverage after the earthquakes. Of note, 41.7% of the respondents reported that they had increased their level of insurance

coverage. However, the percentage of the respondents who indicated no change in level of insurance coverage after earthquakes was much higher, 55.5%, and the remaining 2.8% indicated they had decreased the level of insurance coverage after the event. A further assessment is inferred from the participants' response on the question on the reasons for the change of the level of insurance coverage. Respondents who had increased the level of insurance coverage were asked to give the reasons for doing so. "To cover a more valuable asset", was most commonly selected as a reason. A chi-square test of independence showed that there was a significant difference in the reasons both gender survey participants provided for increase in the level of insurance coverage, $\chi^2(4) = 12.37$, $p < 0.01$. However, there was slight variation of results across all the different demographic groups when variation across age, income and level of education is examined.

An examination of change in the level of insurance coverage indicated that the majority of the households in Christchurch marginally changed the level of insurance coverage as indicated by the survey participants; the households' demographic features did not influence the decision to change level of insurance coverage as reported by the survey participants. The main reason for the change in the level of insurance coverage was changes in the format of supply, so the insurance consumers had to adjust coverage as supplied by the insurance market in order to reflect the new policy requirements. The results also indicated that the change from a full replacement value type policy to a customer-nominated replacement value type policy was clearly the key determinant of the direction of change in the level of insurance coverage after the Christchurch earthquakes. The comments provided by the survey participants focused mainly on the issues of changes in the policy format.

4.2. Change in the perception of probability of loss after the earthquakes

The survey participants were asked to identify their perception of how the probability of loss from another earthquake had changed in relation to their current residential property and contents insurance policy. The survey statistics show that, 44.1% of the respondents perceive the probability of loss from another earthquake had increased, whereas 23.7% of the sample perceives the probability had decreased, and 32.2% were neutral on neither increase nor decrease in their perception on probability of loss from another earthquake. In support of these results, previous studies infer that many insurance consumers do not mathematically compute the level of risk, but rather they use heuristic rules to reduce the complex tasks of assessing probabilities and predicting values to simpler judgmental operations [33–35]. An assessment by Ref. [36] found that survey participants who suffered damage in a natural disaster perceived the future risk as higher than those who did not.

Previous research findings by Refs. [16,37] show that demand would increase with an increase in risk. Thus, the perception on risk helps the researcher to assess how past catastrophes impact insurance demand.

This research went further to cross-tabulate the data for these respondents based on gender to compare if there is any meaningful difference in how each gender perceives the risk of another earthquake. The gender distribution of male and female participants shows a significant association between gender and change in the perception of the probability of loss in the aftermath of the earthquakes, $\chi^2(6) = 2.83$, $p < 0.03$. Over half of the female, 56.07%, of the survey participants believed that the probability of loss from another earthquake was higher than before, whereas the percentage of those with a neutral point of view on the issue (i.e. probability neither increased nor decreased) was at 25.23%. The percentage was much lower for male; 30.69% of survey participants believed the probability of loss from another earthquake was increased, and a much higher percentage, 41.58%, were neutral (neither increase nor decrease). The main objective here is to illustrate the effects of insurance demand determinants
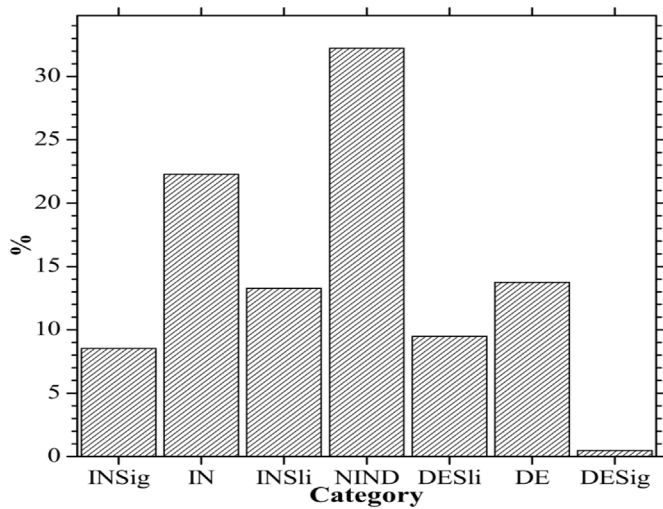
Fig. 1. Probability of loss from another earthquake.
(INSig– Increased significantly, IN – Increased, INSli – Increased slightly, NIND –Neither increased nor decreased, DESli–Decreased slightly, DE – Decreased, DESig– Decreased significantly).
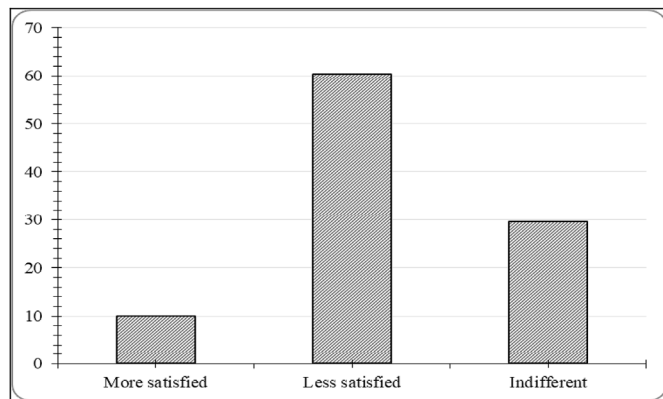

Fig. 2. Satisfaction rate for the policy modification.

Table 1
Relationship between variables to test H1.

Relationship between variables to test H1	Coefficient	p-value	No. of obs.
Premium versus Income	0.233[a]	0.001	221
Premium versus Property value	0.536[a]	0.000	221

[a] Correlation is significant at the 0.01 level (2-tailed).

in the response to the earthquakes. However, it is interesting to note that female participants reported a greater perceived likelihood of catastrophe loss from earthquakes in future. This is supported by previous studies [38,39] on the existence of gender differences in the

propensity to take risks and has been reported in a large number of questionnaire and experimental studies. [38] reviewed numerous studies on gender differences in risk perception, concluded that they indicated that male are more likely to take risks than female.

4.3. Satisfaction rate with the policy modification after the earthquakes

This research further examined the responses provided to assess how the survey participants viewed the policy modification (see Fig. 1). Respondents were asked about their satisfaction with the change in residential insurance contracts from one of full replacement value to a nominated replacement value. The results show that the majority of the survey participants, 60.34%, reported that they were less satisfied with the policy modification. Nearly 30% was indifferent while a slight minority, 10.06%, reported being more satisfied with the policy modifications (Fig. 2).

These results suggest that many respondents viewed with disfavour their own policy modification and the new requirement to value their property themselves. While it might not be surprising that policyholders have a high dissatisfaction rate with the policy modification, a low satisfaction rate within the insurance industry cannot be inferred generally. Although the insurance industry has, since 2012, reported an incremental increase in the gross written premiums across residential insurance cover, the amount of coverage written may not accurately represent customer satisfaction. It is already known from the survey that many people increased coverage while being less satisfied [40].

It is imperative to report that this survey demonstrates the opportunities (for better disaster insurance coverage) provided by the changes introduced in the insurance market after the Christchurch earthquakes, and as such some respondents reported that, "the earthquakes highlighted the plight of those who were under-insured and I don't want that to happen to me". However, the findings reaffirm that under-insurance continues to exist, especially with the new changes in which the policyholders nominate their sum insured.

4.4. Change in insurance coverage per dollar and value of insured assets after the earthquakes

The survey also sought to investigate changes in the value of the insured assets. There is evidence that the value of insured assets is related with the perceived insurance coverage per dollar of property insured [41]. This is premised on the fact that, following the Christchurch earthquakes, many property owners opted to re-build their structures to improved earthquake standards in order to reduce the amount and cost of insurance coverage. This increased the value of the property, and also made the building more tenantable [42]. A change in property values in disaster prone areas is also reported clearly by Ref. [43].

Two variables, the change in insurance coverage per dollar and the change in the value of insured assets, were examined to probe these effects after the earthquakes. For the first variable, survey participants were asked, "Do you perceive insurance coverage per dollar of property insured is greater now than before the earthquakes?" A summary of the results show that, approximately 58% of respondents believed that the

Table 2
Relationship between variables to test H2 and H3.

Relationship between variables to test H2 and H3	Coefficient	p-value	No. of obs.
Change in the level of insurance coverage versus Age	0.373	0.427	221
Change in the level of insurance coverage versus Education	0.469	0.118	221
Change in the level of insurance coverage versus Gender	0.301[a]	0.034	221
Change in the level of insurance coverage versus Income	0.207[b]	0.008	221
Change in the level of insurance coverage versus Property value	0.861[b]	0.000	221
Change in the level of insurance coverage versus Risk perception	0.526[b]	0.001	221

[a] Correlation is significant at the 0.05 level (2-tailed).
[b] Correlation is significant at the 0.01 level (2-tailed).

insurance coverage per dollar of property insured was greater than before the earthquakes. The percentage of respondents who perceived that their insurance coverage per dollar of property insured was not greater than before the earthquakes was much less, 30.5%, whereas only 11.5% of the respondents were unsure of how their insurance coverage per dollar of property insured had changed.

This finding is consistent with those of similar studies [44–46] showing that post-loss perception of improved coverage per dollar of insured asset. However, [47] observed that property prices suggested that the loss of residential properties outstripped the loss of population, generating some excess demand for housing around the Canterbury region. It can be inferred that rational property buyers' behaviour in regard to residential insurance should reflect price-efficient policies relative to disaster risk exposure. Thus, this survey highlights the possibility that, in general, higher property values and greater insurance coverage per dollar of insured assets after the Christchurch earthquakes is a reflection of an increased level of insurance coverage and/or a higher insurance demand. This is also supported in past studies [45,48] which shows that consumers would choose an insurance policy that yields the highest benefit per additional dollar of insurance expenditure holding other factors constant.

4.4.1. Simple statistical analysis results

This section starts by presenting the summary results and discussions of a descriptive analysis on H1. The hypothesis states insured assets and annual household income are positively associated with the annual premium insurance which consumers are willing to pay for full residential property protection, and have a positive influence on the change in the level of insurance coverage. The results of the test of H1 are reported in Table 1.

Referring to the first hypothesis, the computed correlation coefficient value for premium versus income is reported in Table 1 as 0.233 and the associated p-value is 0.001. The observed p-value is less than alpha value, p-value = $0.001^< 0.05$, indicating that the results are statistically significant. Based on the results, r = 0.233, N = 221, p-value = 0.001, it can be inferred that there is a weak positive linear relationship between the annual premium insurance consumers are willing to pay and their annual income. The weak relationship between premium and income is not surprising given that the analysis excludes other variables such as the value of contents, age, gender and education that are closely correlated to income. The results for income versus premium are consistent with the analysis on house insurance in that, controlling for other factors, income by itself should not be a major determinant of demand for insurance cover or the amount of premium consumers are willing to pay [49,50].

Similarly, the computed correlation coefficient value for premium versus property value is reported in Table 1. The correlation coefficient value is 0.536 and the associated p-value is 0.000. The observed p-value is less than alpha value, p-value = 0.000 < 0.05, and therefore, from the results (r = 0.536, N = 221, p-value = 0.000) it can be concluded that the study finds a statistically significant, strong positive linear correlation between the annual premium an insurance consumer is willing for pay to full property protection, and the value of that property.

Although the hypothesis does not examine the influence of the property value on insurance take-up rates, it is observed that an increase in the value of property increases the average level of insurance coverage, holding all else constant. These results could thus imply that the level of insurance coverage and/or insurance demand is a function of wealth (as measured by property value) and income.

Consideration was also given to Hypotheses II (H2); the demographic characteristics of household are positively associated with, and influence, the change in the level of insurance coverage for residential property in the aftermath of a major disaster (where the main demographic factors examined are: age, education, gender and income), and Hypotheses III (H3), Increases in both risk aversion and risk perception

have a positive influence on the change in the level of insurance coverage for residential property owners in the aftermath of a major disaster. The computed correlation coefficient value for a change in the level of insurance coverage versus household demographic features and the individual's risk perception are reported in Table 2. Although annual household income and education levels positively correlate with each other neither variable affects the change in the level of coverage. However, income levels and education are positively correlated with the annual premium insurance which consumers are willing to pay. This observation is in agreement with several existing studies. For example, [16,51]; and [52] showed that income and insured assets were positively related to the demand for insurance in property insurance cover. Likewise, age, education and gender are shown to be positively related to insurance demand for both life insurance and auto-insurance as reported by Ref. [51]. This alone does not provide conclusive evidence that demographic features influence changes in the level of insurance coverage. However, the correlation coefficient offers an opportunity to understand and further investigate how both the response variables and the explanatory variables are interrelated.

Table 2 shows no statistically significant differences in insurance coverage by age and education; the only demographic variables that have a significant association with change in the level of insurance coverage is gender. In reference to the second hypothesis on the demographic variables, only gender shows a relationship with changes in household insurance cover. As far as the third hypothesis is concerned, a change in risk perception also influences the demand for residential insurance cover in the aftermath of a natural disaster.

5. Conclusions

This survey highlights the possibility that, in general, higher property values and greater insurance coverage per dollar of insured assets after the Christchurch earthquakes is a reflection of an increased level of insurance coverage and/or a higher insurance demand. Thus consumers would choose an insurance policy that yields the highest benefit per additional dollar of insurance expenditure holding other factors constant. It is also observed that a change from full replacement value type policy to nominated replacement value type policy contributed to change in the level of insurance coverage, however, it is not clear if policyholders increased the level of insurance coverage so as to comply with the new policy modification.

The earthquakes highlighted the plight of those who were under-insured, prompting policyholders to update their insurance coverage to reflect the estimated cost of re-building their property. This shows that insurance policyholders update their perceived level of risk immediately after major catastrophe losses, and those who have had a recent experience with disaster loss increased risk perception that a similar event could happen in future. Thus, if insurance consumers perceive a higher possibility of future disasters then they will always adjust their level of insurance coverage. The survey data used in this analysis is only intended to be illustrative, not necessarily representative of the entire population. Future research work may well investigate more detailed data across the entire population to examine insurance market responses from demand-side.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijdrr.2019.101166.

References

[1] B. Jongman, S. Hochrainer-Stigler, L. Feyen, J.C. Aerts, R. Mechler, W.W. Botzen, ... P.J. Ward, Increasing stress on disaster-risk finance due to large floods, Nat. Clim. Change 4 (4) (2014) 264–268.

[2] J.R. Skees, B.J. Barnett, Conceptual and practical considerations for sharing

catastrophic/systemic risks, Rev. Agric. Econ. 21 (2) (1999) 424–441.

[3] S. Surminski, P. Hudson, Investigating the risk reduction potential of disaster insurance across Europe, Geneva Pap. Risk Insur. - Issues Pract. 42 (2) (2017) 247–274.

[4] L. Doyle, I. Noy, The short-run nationwide macroeconomic effects of the Canterbury earthquakes, N. Z. Econ. Pap. 49 (2) (2015) 134–156.

[5] R. Mumo, R. Watt, An investigation of residential insurance demand-side reactions after a natural catastrophe: the case of the 2010–11 Christchurch earthquakes, Asia Pac. J. Risk Insur. 11 (2) (2017) 1–12, https://doi.org/10.1515/apjri-2016-0026.

[6] L. Timar, A. Grimes, R. Fabling, That Sinking Feeling: the Changing Price of Disaster Risk Following an Earthquake, Motu Working Paper 14-13 Motu, Wellington, 2014.

[7] P. Slovic, H. Kunreuther, G.F. White, Decision processes, rationality and adjustment to natural hazards, in: G.F. White (Ed.), Natural Hazards: Local, National, Global, Oxford University Press, New York, 1974, pp. 187–205. Reprinted as Chapter 1 of P. Slovic (Ed.), the Perception of Risk (pp. 1-31). London: Earthscan Publications, 2000.

[8] O. Dessaint, A. Matray, Do managers overreact to salient risks? Evidence from hurricane strikes, J. Financ. Econ. 126 (1) (2017) 97–121.

[9] J. Gallagher, Learning about an infrequent event: evidence from flood insurance take-up in the United States, Am. Econ. J. Appl. Econ. 6 (3) (2014) 206–233.

[10] D.O. Kasdan, The ostrich paradox: why we underprepare for disasters, Disaster Prev. Manag.: Int. J. 27 (3) (2018) 360–362.

[11] R.W. Klein, Regulation and Catastrophe Insurance. Paying the Price: the Status and Role of Insurance against Natural Disasters in the United States, (1998), pp. 171–208.

[12] J. Cai, C. Song, Do disaster experience and knowledge affect insurance take-up decisions? J. Dev. Econ. 124 (2017) 83–94.

[13] K. Yuzva, W.W. Botzen, J. Aerts, R. Brouwer, A global review of the impact of basis risk on the functioning of and demand for index insurance, Int. J. Disaster Risk Reduct. 28 (2018) 845–853.

[14] V. Aseervatham, P. Born, D. Lohmaier, A. Richter, Hazard-specific supply reactions in the aftermath of natural disasters, Geneva Pap. Risk Insur. - Issues Pract. 42 (2) (2017) 193–225.

[15] R. Tooth, Analysis of Demand for Home and Contents Insurance, Sapere Research Group, Australia, 2015.

[16] V. Showers, J. Shotick, The effects of household characteristics on demand for insurance: a tobit analysis, J. Risk Insur. 61 (3) (1994) 492–502.

[17] A.L. Alhassan, N. Biekpe, Determinants of life insurance consumption in Africa, Res. Int. Bus. Finance 37 (2016) 17–27.

[18] T. Beck, I. Webb, Economic, demographic, and institutional determinants of life insurance consumption across countries, World Bank Econ. Rev. 17 (1) (2003) 51–88.

[19] S.L. Dragos, Life and non-life insurance demand: the different effects of influence factors in emerging countries from Europe and Asia, Econ. Res.-Ekonomska istraživanja 27 (1) (2014) 169–180.

[20] J.F. Outreville, The relationship between relative risk aversion and the level of education: a survey and implications for the demand for life insurance, J. Econ. Surv. 29 (1) (2015) 97–111.

[21] J.F. Outreville, Risk aversion, risk behavior, and demand for insurance: a survey, J. Insur. Issues 37 (2) (2014) 158–186.

[22] U. Aliagha, T. Jin, W. Choong, M. Nadzri Jaafar, H. Ali, Factors affecting flood insurance purchase in residential properties in Johor, Malaysia, Nat. Hazards Earth Syst. Sci. 14 (12) (2014) 3297–3310.

[23] L. Guiso, M. Paiella, Risk aversion, wealth, and background risk, J. Eur. Econ. Assoc. 6 (6) (2008) 1109–1150.

[24] H. Kunreuther, N. Novemsky, D. Kahneman, Making low probabilities useful, J. Risk Uncertain. 23 (2) (2001) 103–120.

[25] R.E. Dumm, D.L. Eckles, C. Nyce, J. Volkman-Wise, Demand for catastrophe insurance and the representative heuristic, American Risk and Insurance Association Conference, Washington, DC August 2013, 2015.

[26] T. Papon, The effect of pre-commitment and past-experience on insurance choices: an experimental study, Geneva Risk Insur. Rev. 33 (1) (2008) 47–73, https://doi.org/10.1057/grir.2008.8.

[27] W.K. Viscusi, A Bayesian perspective on biases in risk perception, Econ. Lett. 17 (1) (1985) 59–62.

[28] Y. Kahane, Earthquake risk and insurance-policy considerations: the Israeli cCase, Geneva Pap. Risk Insur. 23 (47) (1988) 137–164.

[29] S.D. Brody, W.E. Highfield, M. Wilson, M.K. Lindell, R. Blessing, Understanding the motivations of coastal residents to voluntarily purchase federal flood insurance, J. Risk Res. 20 (6) (2017) 760–775.

[30] G. Oulahen, Flood insurance in Canada: implications for flood management and residential vulnerability to flood hazards, Environ. Manag. 55 (3) (2015) 603–615.

[31] W. Shao, S. Xian, N. Lin, H. Kunreuther, N. Jackson, K. Goidel, Understanding the effects of past flood events and perceived and estimated flood risks on individuals' voluntary flood insurance purchase behavior, Water Res. 108 (2017) 391–400.

[32] D.M. Erceg-Hurn, V.M. Mirosevich, Modern robust statistical methods: an easy way to maximize the accuracy and power of your research, Am. Psychol. 63 (7) (2008) 591.

[33] P.A. Raschky, H. Weck-Hannemann, Charity hazard-A real hazard to natural disaster insurance? Environ. Hazards 7 (4) (2007) 321–329.

[34] M. Rothschild, J. Stiglitz, Equilibrium in Competitive Insurance Markets: an Essay on the Economics of Imperfect Information, Springer, 1992.

[35] P. Slovic, B. Fischhoff, S. Lichtenstein, B. Corrigan, B. Combs, Preference for insuring against probable small losses: insurance implications, J. Risk Insur. 44 (2) (1977) 237–258.

[36] D.S. Mileti, P.W. O'Brien, Warnings during disaster: normalizing communicated risk, Soc. Probl. 39 (1) (1992) 40–57.

[37] L. Eeckhoudt, M. Kimball, Background risk, prudence, and the demand for insurance, in: G. Dionne (Ed.), Contributions to Insurance Economics, Springer, Netherlands, 1992, pp. 239–254.

[38] J.P. Byrnes, D.C. Miller, W.D. Schafer, Gender differences in risk taking: a meta-analysis, Psychol. Bull. 125 (3) (1999) 367.

[39] R. Croson, U. Gneezy, Gender differences in preferences, J. Econ. Lit. 47 (2) (2009) 448–474.

[40] J. Stevenson, J. Vargo, E. Seville, H. Kachali, A. McNaughton, F. Powell, The Recovery of Canterbury's Organisations: A Comparative Analysis of the 4 September 2010, 22 February and 13 June 2011 Earthquake, (2012).

[41] P.R. Kleindorfer, H. Kunreuther, The complementary roles of mitigation and insurance in managing catastrophic risks, Risk Anal. 19 (4) (1999) 727–738.

[42] C. Brown, E. Seville, J. Vargo, The Role of Insurance in Organisational Recovery Following the 2010 and 2011 Canterbury Earthquakes, Resilient Organisations, University of Canterbury, 2013, http://www.resorgs.org.nz/images/stories/pdfs/ Organisationsfacingcrisis/the_role_of_insurance.pdf , Accessed date: 5 November 2016.

[43] W.W. Botzen, E. Michel-Kerjan, H. Kunreuther, H. de Moel, J.C. Aerts, Political affiliation affects adaptation to climate risks: evidence from New York City, Clim. Change 138 (1–2) (2016) 353–360.

[44] M.J. Browne, R.E. Hoyt, The demand for flood insurance: empirical evidence, J. Risk Uncertain. 20 (3) (2000) 291–306, https://doi.org/10.2307/41760986.

[45] M. Kelly, A.E. Kleffner, Optimal loss mitigation and contract design, J. Risk Insur. 70 (1) (2003) 53–72.

[46] F. Powell, A. Harding, Business recovery and the rebuilding of commercial property, Proceedings of Shaken Up'a Workshop on Recovery Following the Gisbourne Earthquake, Opus, Wellington, 2009, pp. 38–59.

[47] M. Parker, D. Steenkamp, The economic impact of the Canterbury earthquakes, Reserve Bank of New Zealand Bulletin 75 (3) (2012) 13–25.

[48] J.A. Nelson, On testing for full insurance using consumer expenditure survey data, J. Political Econ. 102 (2) (1994) 384–394.

[49] C. Kousky, E.F. Luttmer, R.J. Zeckhauser, Private investment and government protection, J. Risk Uncertain. 33 (1–2) (2006) 73–100.

[50] W. Kriesel, C. Landry, Participation in the national flood insurance program: an empirical analysis for coastal properties, J. Risk Insur. 71 (3) (2004) 405–420.

[51] S.-J. Lee, S.I. Kwon, S.Y. Chung, Determinants of household demand for insurance: the case of Korea, Geneva Pap. Risk Insur. - Issues Pract. 35 (1) (2010) S82–S91.

[52] D.B. Truett, L.J. Truett, The demand for life insurance in Mexico and the United States: a comparative study, J. Risk Insur. (1990) 321–328.

[53] A.R. Joyette, L.A. Nurse, R.S. Pulwarty, Disaster risk insurance and catastrophe models in risk-prone small Caribbean islands, Disasters 39 (3) (2015) 467–492.