Behavioural Economic Studies of Flood Insurance Demand

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Summary in English

Flooding occurs every year in many regions around the world. The causes of floods are diverse, and can range from extreme rainfall to intense snowmelt over an extended period of time which may lead rivers to overflow their banks. Or they may arise due to other weather dynamics like hurricanes, which can generate storm surge and flooding in coastal areas. General consensus is that flood impacts will increase in the future because of population growth and economic development in flood-prone regions, as well as climate change.

A range of structural flood protection measures are in place across Europe such as embankments to protect against high water levels, and dams which are used to control water flow. However, structural flood protection does not completely mitigate flood risk because there is a probability of protection failure. Nevertheless, government compensation arrangements often exist to cover (some of) homeowners' property damage costs in the event of flooding. But, this compensation is subject to political will and is considered to be uncertain. Moreover, it is questionable whether government compensation is sufficient to cover the projected increase in future flood impacts.

In light of the residual flood risk which exists despite structural flood protection and uncertain compensation, there is room for homeowner-level measures for limiting risk, such as flood insurance. In order to develop flood insurance arrangements that offer sufficient coverage, it is necessary to form a good understanding of the potential causes of underinsurance. For example, government compensation may crowd out insurance demand (charity hazard), and the limited cognitive ability of individuals and insufficient information on flood risk for individuals to access, may result in boundedly rational flood insurance choices. In general, many individuals tend to forgo insurance against low-probability/high-impact (LPHI) risks, like flooding, because of these factors. Nonetheless, successful insurance arrangements hinge on a sufficient level of demand for insurance, so that the revenue generated from premium payments is enough to cover insurance claims.

This thesis examines the possible origins of underinsurance related to charity hazard and bounded rationality, as well as ways in which underinsurance may be overcome through a novel behavioural economic intervention. For these purposes a range of tools were employed, such as a literature

review, economic experiments and a field survey. Large samples of homeowners were utilized for the latter, which are the population of interest regarding insurance demand against LPHI risks.

A natural starting point for the thesis was to review the previous experimental, survey and market data studies on insurance demand against LPHI risks (Chapter 2). Overall, 80 studies were reviewed with some focus on the design methods employed, like the country focus, incentives and samples, as well as insurance characteristics in terms of the insurance context, deductibles and loading factors used. A number of theories featured, of which some are closer to rational economic decision making models (Expected Utility Theory), as well as alternative theories which are often utilized to reconcile boundedly rational behaviour (Prospect Theory) and choices under ambiguity. In contrast to the cognitive procedures assumed by theoretical models, the review also examined some heuristics individuals may use in choices about LPHI risk (availability heuristic and gambler's fallacy) and behavioural biases (framing effects). The aim of the review was to extract lessons from the previous studies and to provide a future research agenda. The review provided a basis for the design of the experimental studies in later chapters of the thesis, and highlighted some knowledge gaps which were also addressed in some of the later chapters.

One research gap highlighted by the literature review was the absence of a controlled economic experiment on the charity hazard problem, despite the potential for factors which can confound the relationship between government compensation and flood insurance demand in market data studies, like objective risk levels. I performed an experimental study of charity hazard related to the impact of various degrees of ambiguity and risk in government compensation on flood insurance demand (Chapter 3). Additionally, Expected Utility Theory and the Klibanoff et al. (2005) smooth model of decision making under ambiguity were used to formulate theoretical predictions. It was found that risky government compensation, where individuals know the probability of being fully compensated by the government, and certain compensation, where in the event of a flood individuals are partially compensated for sure, crowd out demand for flood insurance in line with theory. However, ambiguous government compensation, where the probability of receiving full government compensation is not known, does not crowd out demand. Moreover, individuals who were more ambiguity averse according to an incentivized measure of ambiguity aversion, were more likely to demand flood insurance when government compensation was ambiguous relative to risky which is also in line with the theoretical predictions. Whereas,

risk preferences do not play a role in whether individuals are more or less likely to demand insurance under risky vs. certain compensation.

A further possible cause of underinsurance against flood risk which is closer to bounded rationality, namely the individual usage of the threshold level of concern decision heuristic, was examined in another experimental study (Chapter 4). The heuristic implies a threshold probability is unconsciously set by individuals. If the (subjective) probability of the risk falls below the threshold, then the likelihood of the risk is treated as having a zero chance of occurring. The threshold was defined as the number of consecutive times individuals were willing to pay zero to cover flood risk as the probability of flooding increased, after those who remained uninsured for all insurance decisions were omitted. I found that individuals who worry about flooding and anticipate regret about not purchasing insurance in the event of a flood, have lower threshold levels of concern.

Using the same dataset as Chapter 4, the determinants of maximum willingness-to-pay for flood insurance and probability neglect of flood risk were analyzed (Chapter 5). Zero willingness-to-pay for flood insurance was used as a proxy for probability neglect, given that this is likely caused by the rounding of very low probabilities to zero. The risk specific emotions of worry and regret were related to flood insurance demand through both probability neglect and willingness-to-pay for flood insurance. Whereas, incidental emotion (mood) had no relationship to flood insurance demand. Moreover, a survey measure of the threshold level of concern variable was related to flood insurance demand through probability neglect, not willingness-to-pay, which is consistent with the mechanisms underlying usage of the heuristic. It is important to mention that at this stage I could not separate whether the psychological determinants of flood insurance demand, are related to demand through probability weighting and/or outcome processing, which are two components of risk preference according to Prospect Theory.

In order to separate the relation between the variables of interest on flood insurance demand through probability weighting and outcome processing (utility curvature), structural models of decision making were estimated (Chapter 6). In addition to the risk specific and incidental emotions, as well as threshold level of concern, locus of control was investigated. Locus of control measures the degree to which individuals believe they can exert control over outcomes in their own life (have an internal locus of control), in contrast to external influences like fate. The variable

has been shown to explain decision making with respect to higher probability disaster risks. In addition to anticipated regret about not purchasing insurance in the event of a flood, internal locus of control was related to higher flood insurance demand. Due to high collinearity between the probability weighting and utility curvature parameters, I examined each as a function of the variables of interest separately. Regret and locus of control were related to both components of risk preference in the separate analysis. Whereas, adoption of the threshold level of concern heuristic was related to risk preferences (flood insurance demand) through probability weighting, which is unsurprising given that the heuristic is associated with the way in which individuals process probabilities.

Policy recommendations were discussed in chapters 3, 4, 5 and 6 to avoid charity hazard, utilization of the threshold level of concern decision heuristic and regret, for instance. The recommendations can be broadly categorized as those intended to increase demand for flood insurance by bundling flood risk with other risks into one policy or multiyear insurance; implementing education policies on the importance of preparing for disaster risks; developing risk communication strategies so that individuals appreciate the gravity of risk they are facing; and policies that nudge homeowners towards better flood insurance decisions through worst-case scenario framing, and extending the time horizon over which the probability of flooding is framed.

Another knowledge gap highlighted in the literature review and some other previous research, was the absence of a study on the impact of setting flood insurance coverage default options to nudge individuals towards more insurance uptake (Chapter 7). I investigated in a field survey whether setting an opt-out default, where individuals had to remove flood insurance coverage from an insurance policy to face flood risk uninsured, impacted flood insurance demand, compared to an opt-in default, where individuals had to pay additional insurance premiums to include flood coverage in the insurance policy. The nudge was studied in the Netherlands, where flood insurance penetration rates are currently very low, and recent flood events have caused only minor damages, and the United Kingdom, where the converse is true. It was found that the opt-out default leads to significantly higher flood insurance demand (71% purchased actuarially fair insurance against a 1 in 1,250 yearly likelihood of experiencing €80,000 flood damage), compared to the opt-in default (52% purchased the insurance). However, there was an insignificant impact of the default on flood insurance demand on aggregate in the United Kingdom (83% purchased the insurance). Moreover,

using statistical control I was able to ascribe the difference in default effects between the Netherlands and the United Kingdom to reported flood insurance purchasing and previous flooding experience. Furthermore, risk preferences moderated the influence of the default on flood insurance demand in the United Kingdom. That is, higher levels of risk seeking makes one less prone to the default here, and leads to more opting out of flood coverage. Lastly, the regret individuals might expect for not purchasing flood insurance in the event of a flood loss and perceived flood insurance cost, partially mediated the impact of the default on flood insurance demand in the Netherlands.

Given the difficulties experimenters have with incentivizing LPHI risks, I was also interested in whether incentives in accordance with the random problem selection mechanism combined with randomly paying only a subset of subjects at a specified exchange rate can offer improvements with respect to choice behaviour, over hypothetical payments. Given the high-impact nature of flood risks, the method offers an affordable alternative to only implementing the random problem selection mechanism. However, like the random problem selection mechanism, the payment of only a subset of subjects and applying an exchange rate can be criticized because it is uncertain whether subjects are treating risks in each decision in isolation, or the compound risk which includes the random selections of choices and subjects. I found that incentives in line with the procedure, in which only one subject is paid, do not impact on whether individuals are willing to pay zero or non-zero amounts for insurance against LPHI risk. In contrast, the procedure did influence levels of insurance that individuals were willing to pay, and the influence is through probability weighting according to a best fitting structural model of decision making.

As well as, factors of influence on demand for flood insurance, chapters 4, 5 and 6 were indicative of levels of demand. The mean risk premiums (maximum willingness-to-pay for flood insurance minus expected flood damage) for flood probability 1 in 10,000, 1 in 1,000, 1 in 100 and 1 in 20, are €233, €471, €611 and €-704 under incentivized payments, and €167, €285, €164 and €-1,325 under hypothetical payments, respectively, once those who are not willing to pay anything are omitted. Moreover, the subgroup of the sample who had zero willingness-to-pay for flood insurance corresponds to 26%, 13%, 10%, and 8%, respectively. Overall, there are subgroups of Dutch homeowners for which the demand for flood insurance is sufficient and insufficient, which is in line with the bimodal pattern of risk attitudes found in some previous studies.

To summarize, the thesis demonstrates how insights into how individuals perceive and act upon LPHI risks, can be used to create effective flood insurance arrangements, and to advance our scientific understanding of the influence of such risks on individual behaviour. The different chapters focus on the potential causes of underinsurance, and policy solutions for underinsurance. The thesis concludes with directions for further research. First, I suggest that some of the policy recommendations are worth testing empirically, such as the impact of bundling and risk communication aids on flood insurance demand and comprehension of risk. Second, the usage of smart defaults which gather consumer specific information in the context of flood risk and preferences, would be a valuable exploration in order to achieve a solution to underinsurance which would also result in better choice behaviour. Third, the testing of defaults and other nudges in a field experiment would provide more clarity about whether they can be used in practice. Lastly, further experiments which follow the procedures of neuroeconomics may allow researchers to more precisely establish behavioural motivations of flood insurance demand, than standard survey-based response formats.