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Factors affecting flood insurance penetration in residential properties in Johor Malaysia

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Abstract

High impact flood has virtually become an annual experience in Malaysia, yet flood insurance has remained a grossly neglected part of comprehensive integrated flood risk management. Using discriminant analysis, this study seeks to indentify the demand-side variables that best predict flood insurance penetration and risk aversion between two groups of residential homeowners in three districts of Johor State, Malaysia: those who purchased flood insurance and the group that did not. Our result revealed 34 % penetration rate with Kota Tinggi district having the highest penetration (44 %) and thus, the highest degree of flood risk aversion. The Wilks' Lambda *F* test for equality of group means, SCDFC, structure correlation and canonical correlation have clearly shown that there are strong significant attribute differences between the two groups of homeowners based on measures of objective flood risk exposure, subjective risk perception, and socio-economic cum demographic variables. However, measures of subjective risk perception were found more predictive of flood insurance penetration and flood risk aversion.

1 Introduction

In the ranks of natural disaster flood is Malaysia worst nightmare in terms of overall area and population affected, frequency, financial loss, and psychological trauma and the real estate sector is particularly hit hard. Historical records show that Malaysia has experienced major flood event in 1886, 1926, 1931, 1947, 1954, 1957, 1965, 1967, 1970, 1971, 1988, 1993, 1996, 2000, 2006, 2007, 2008, 2009, 2010, 2011 and 2013. It is estimated that the average annual flood damage in Malaysia is about RM 3 billion (USD 912.8 million) (Deloitte, 2003) which can be translated as annual loss to GDP. Record also show the trend has been increasing. This is glaring when one compares two worst flood events in the country vis-à-vis the 1971 flood that cost RM200 million (USD 60.8 million) and resulted to the death of 61 persons and the successive 50 yr

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and 100 yr floods that hit Johor State in December 2006 and January 2007 which cost RM1.5 billion (USD 456.4 million) and led to the death of 18 persons (MNREM, 2007; Badrul et al., 2010; Hamzah et al., 2012).

Flood threat to Malaysia coastal real estate could be enormous when one realise that Peninsular Malaysia has 29 000 km^2 total land area prone to flooding, thus, exposing 4.82 million people to flooding (Liu and Chan, 2003; ADRC, 2011). This is compounded by increasing urbanization and mounting evidence that climate change will exacerbate severity of flood risk (IPCC, 2007; Stern, 2006, 2008; Bubeck and Botzen, 2012). As Keizrul Abdullah, Director-General Drainage and Irrigation Department warned, as Malaysia approaches 2020, Malaysia should expect serious flood management challenges owing to increased severity and frequency of floods. Adding that the largest threat to the entire corridor area may be the exposure of Malaysia 189 rivers basins to climates change (MNREM, 2007, BERNAMA, 21 June 2007). Pundits have warned that property owners in a high-risk area to expect premiums double in the coming years of climate change as the insurance firms operating in these areas experience cost of cover rise by as much as 100 % in the next 10 yr (Gerrit, 2009).

Already some insurance companies in Malaysia have stated reporting flood insurance claims from policy holders affected. It was also estimated that the December and January 2007 flood cost insurance firms in Malaysia about RM100 million (USD 30.4 million). Yet, the claims represent only 7 % of the total damage compared with RM1.5 billion cost to the Government (Singh, 2007). The reason for low insurance claims from flood may lie in the fact that flood insurance penetration rate in Malaysia is very low, about 5 % (Business Times, 5 March 2007) even though, there is huge business opportunity for flood insurance. In contrast with the insurance industry, the government is paying massive amount flood relief damages.

Argument for enhanced flood insurance penetration that is integral part of a comprehensive flood risk management in Malaysia could be established. Under the auspices of Public Works and Irrigation Departments the government has over the years taken some significant structural and non-structural measures to address flood problems.

Amongst structural measures are channel enlargement, construction of levees and embankments, flood bypasses, river diversions, poldering, and construction of flood storage dams and flood attenuation ponds. While non-structural measures include restriction of development along costal corridors, land use zoning, resettlement of population, flood proofing, and flood forecasting and warning systems. Despite these laudable measures the incidents of floods and attendant losses continue to increase. The main reasons are fourfold: (1) Public Works and Irrigation Departments have not or may not be able to protect all areas, control all floods; (2) under increasing urbanisation private construction continued in flood-prone areas; (3) based on observed records, the effect of climate change on frequency and intensity of rainfall has become an accepted reality; (4) even, where structural measures are in place, there is always the probability of residual flood which Plate (2002) and Merz (2006) described as the remaining part of the risk after implementing a protection system. Put differently, residual risk is the portion of risk that remains after flood control structures have been built. In essence there is always the possibility of a flood event greater than the design capacity of levees or embankments occurring within a time period that may result in breaching or overtopping the defenses and flooding adjacent properties. As Kreibich et al. (2005) pointed out, absolute flood protection is impossible.

In US, UK and recently in Australia after the Brisbane flood, flood insurance has been adopted as a part of the tools for residual flood risk management to support and complement nonstructural approach. As a result, flood insurance has been incorporated as part of a comprehensive integrated flood risk management. This is not the case in Malaysia. Flood insurance as a non-structural flood risk management tool is not a common practice in Malaysia as floods are still viewed as an "Act of God" and more so it is not a legal requirement to have flood insurance for flood prone properties in Malaysia, neither is there any incentive from the government to promote flood insurance as an instrument for flood risk management in the country (Kaizrul, 2004; Ho, 2009). Consequently, flood insurance has become a neglected aspect of a comprehensive integrated flood risk management in Malaysia. Flood insurance is also profoundly under researched not only in Malaysia but across Southeast Asia where collateral damage to properties from flood are frequent phenomena. Even numerous studies on flood resilience and adaptations strategies have missed out on flood insurance or have paid only cursory attention to it.

Though flood insurance cannot prevent actual property damages or loss of life as structural measures would do, it can significantly reduce the economic risk associated with flooding. An insured property damaged by flood can be replaced quickly without much financial stress to the government. A community with extensive flood insurance can rebuild faster after flood. Kunreuther and Roth (1998) described flood insurance as serving the purpose of reducing the economic impact of individual losses by arranging for the transfer of all or part of the loss to others who share the same risk. Similarly, Bubeck and Botzen (2012) conceive flood insurance as a private mitigation measure which reduces financial consequences for an individual once a flood occurs. The demand for insurance is driven by individual's knowledge of potential risk and opt to transfer the risk to an insurance company who is in better position to effectively absorb and diversify the risk. Hence, buying flood insurance is regarded as one of the precautionary risk reduction measures taking around flood exposed buildings (Kreibich et al., 2011)

Residential flood insurance penetration requires both demand and supply sides. The demand side is determined by the households while the supply side is mainly controlled by the insurance firms. Our study focuses on the demand-side aspect of residential flood insurance and thus aim to: (1) determine flood insurance penetration rate and degree of flood risk aversion among residential homeowners in three districts of Johor State; (2) determine if there are significant attribute differences in degree of risk aversion between two groups of residential homeowners: those who purchased flood insurance and the group that who did not; (3) determine the most important variables that best differentiate and account for the degree of risk aversion between groups of homeowners that purchased flood insurance and the group that do not purchase; and

(4) determine if there are areas of common ground or commonality between the two groups on the factors that influence flood insurance purchase.

2 Review of related theories and literature

2.1 Prospect theory under flood insurance risk decisions

Two popular theories used to explain decision making under risk or uncertainty are expected utility (EU) theory and prospect theory (PT). *Expected utility (EU) theory*: expected utility (EU) is the standard and rational theory of decision making under risk that relies on linear composite of weighted probability outcomes to compute expected utility. It is founded on the principle of diminishing marginal utility and uses net wealth as the only reference point (Chateauneuf and Cohen, 1994; Rabin, 1997, 2000a; Kunreuther and Pauly, 2005; Desrosiers, 2012). Under insurance decisions making, expected utility theory holds that people will purchase full insurance only if the premiums are fair to a point where premiums are equal to expected losses (Kunreuther and Pauly, 2006a; Ulrich, 2012) In the scenario of expected utility (EU) theory demand for flood insurance for a risk averse person will be based only on the offer of an actuarially fair premium that reflect full coverage where benefits from premium equal the expected losses. Under this condition the individual with cover is not bothered whether there is flood or not. This is because whether the flood disaster occurs or not the utility from cover will remain the same. Perhaps that is why Kunreuther and Pauly (2005) said expected utility theory has a constant absolute risk aversion utility function.

Owing to the fact the expected utility theory is a rational theory that operate on the assumptions of context invariance, availability of all formation and complete knowledge of all possible outcomes, always predict accurate probabilities of outcomes and consistently select the best payoff among alternatives using linear probability weighting (Sebora, 1995; Isenberg, 1989; March and Shapira, 1987) it has been widely criticized for lack of explanatory power. Moreso, Rabin (2000a) argues that if the only reason people are risk averse is the diminishing marginal utility of wealth, which is the only explanation for risk aversion in the EU then they should be very close to risk neutral in modest size risks. Or as Desrosiers (2012) contends, EU theory with its associated decreasing marginal utility of wealth cannot provide plausible explanation for why individuals purchase moderate or small scale insurance. Levin (2006) conceived that one of limitations of the EUT is that it treats uncertainty as objective risk where the probabilities are objectively known or at best as subjective maps of the objective values of possible outcomes (Sebora, 1995. However, Predicting insurance purchase purely on objective measures may be misleading as perception of risk is often subjective Kunreuther, 1978; Slovic, 1987).

Prospect theory (PT): Prospect theory was developed by Kahneman and Tversky (1979) and later examined and quantied further by Tversky and Kahneman (1981, 1992). Prospect theory argues that because of complexities in decision making, limited information, analytical ability, preferences are often not consistent and individual often do not use linear probability weights to determine values. Rather, prospect theory contends that context and subjective values influence decision under uncertainty. As a result decision makers may not select the alternative with the highest payoff and may not use net wealth as the reference point as depicted in the EUT. Empirical evidence suggest that individual often make decisions by comparing changes in their financial status with reference to specific actions rather than impact of the actions on final wealth utility function (Kaheman and Tversky, 1979; Tversky and Kahneman, 1992; Kunreuther and Pauly, 2005). Leaning more on subjective influences measures Slovic (1987), Botzen and Bergh (2009) pointed out that commonly people evaluate and make risk decisions not only on the basis on objective risk exposure but also from the perspective of risk perceptions which involve intuitive risk judgments or risk beliefs.

Moreso, prospect theory postulates that people, including modest risk individuals are willing to take an additional risk by paying more in order to avoid loss. In support of this postulation, studies by Pashigian et al. (1966), Drèze (1981), Cutler and Zeckhauser (2004), Kunreuther and Pauly (2006a), Sydnor (2010), Ulrich (2012) reveal evidence of

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modest risk people often buying insurance policy with premiums significantly exceeding expected losses. Prospect theory explanation for this rests in the concept of "loss aversion" and how people weigh probabilities of outcome. In weighting probabilities of outcome people often overvalue small probabilities while larger probabilities are undervalued (Rabin, 2000b; Sydnor, 2010). This is because there is evidence that people are more sensitive to small gains/losses compared to larger ones (Kahneman and Tversky, 1979; Hershey and Schoemaker, 1980). In the parlance of prospect theory this tendency for people to weigh losses more heavily than gains is called "loss aversion." Under this notion, Rabin (2000b) and Sydnor (2010) pointed that the decision to take up insurance is determined in the loss domain. Prospect theory encourages people to take actions to avoid losses and maximize gain (Eckles and Volkman, 2011). Against this notion, Eckles and Volkman (2011) argue that in line with PT people will "Make insurance decisions in order to minimize the domain where a loss is experienced and maximize the domain where a gain is experienced".

This study is study situated primarily on the prospect theory, thus acknowledging that practically, decision to purchase flood insurance will most likely be motivated by gains and losses as well as agreement that both objective risk exposure and risk perceptions influence insurance purchase decisions. The study is also aligned with prospect theory postulation that people, including modest risk individuals are willing to take an additional risk by paying more than fair premium in order to avoid loss. Though Malaysians living flood prone areas may rationally prefer actuarially fair premium, realistically, some particularly those motivated by loss aversion may be willing to pay slightly more than fair price to avoid expected loss *ceteris paribus*.

2.2 Literature review

Risk aversion house owner would more likely to purchase flood insurance policy (Kriesel and Landry, 2004; Smith, 1968). As Borzen et al. (2009) contend, actual purchase of insurance by an individual is a good indicator of risk aversion since it represents revealed preference for financial protection. Purchasing flood insurance is however contingent upon the degree of objective exposure and susceptibility of the property to flood, the house owner's perception of risk and socioeconomic cum demographic traits of the house owner. Numerous literatures have heighted the specifics variables that underlie these three factors that could influence decision to purchase flood insurance to protect against the risk.

2.2.1 Objective exposure and susceptibility

House location elevation may well determine susceptibility or sensitivity to flood. As such, elevation of a building has been observed to be one of the factors underlying homeowners' perceived probability of loses. Home owners whose buildings are on elevated ground are less likely to purchase insurance for such properties. Dixon et al. (2006) also found out that the probability of people purchasing flood insurance is considerably higher at coastal flooding area than on high elevation or non-coastal areas.

Also, the proximity to large bodies of water exposes homes to flooding. Botzen et al. (2009) found that houses near a river are more likely to suffer flood damage than houses far away from a river once a dike breaches or is overtopped by high water levels. As Dixon et al. (2006) posit, proximity to large bodies of water that is subject to coastal flooding serves as a constant reminder to homeowners in the community of the flood risk they face. From his research, Dixon et al. (2006) found out that location with higher number of properties under the risk of being flooded (known as Special Flood Hazard Area) has higher demand for flood insurance. This argument is further supported by Kriesel and Landry (2004) finding that property owners nearer flood zone are more likely to purchase flood insurance. Their research shows that an increase of 1 % in distance from the flood zone decreases the probability of purchasing flood insurance by 0.88 %.

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2.2.2 Subjective perception of risks

Baumann and Sims (1978) find evidence that past experience with disasters motivates insurance adoption. They found higher insurance uptake among homeowners who had suffered previous damage from a flood. When estimating or predicting the probability of flood, human beings tend not to worry too much but once they have experienced a distasteful event, then they will learn from the event and have better preparations for next occurrence, (Kunreuther, 1978; Kunreuther et al.1978; Epple and Lave, 1988; Kunreuther and White, 1994). According to Burton and Kates (1964), the rare and unpredictable occurrences of disasters are making individuals more unlikely to take any flood mitigation and prevention. Dixon et al. (2006) found that flood experience serves as a reminder of flood damages hence, resulting to higher flood insurance policy subscription rate among property owners. Equally, the time of last flood has been observed to have an influence on the decision of a homeowner to purchase insurance. Not experiencing flood damage for several years has led to decline in renewal rate for policies in comparison to other types of insurance coverage (Kunreuther and White, 1994; Palm, 1991). What this means in essence is that the low probability of flood occurrence has made house owners think that it is not all that necessary to renew their flood insurance policy since flood is something that does not occur frequently. Structural flood control measures, such as dykes, levees, floodwalls, reservoirs, and bypass channels are traditionally used to reduce susceptibility and, as such perception of vulnerability increases when they are not provided. The effect of this may be increase in subscription to flood insurance. Ironically, the opposite is often the case where they are provided. Levees create a false sense of security among coastal residents who believe that they are fully protected against future disasters and therefore feel no need to take flood insurance (WMO, 2006; Kunreuther and Pauly, 2006b).

Brinley (1972) blames the lack of knowledge and awareness of the existence couple with the failure of local authority in seeking eligibility for the coverage to their community for the low penetration rate of flood insurance (Browne and Hoyt, 2000). Browne

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and Hoyt added that increasing information seeded into the public's awareness of the danger posed by the flood may increase the penetration of flood insurance.

2.2.3 Socioeconomic and demographic determinants

Homeowners feel reluctant to insure their property due to premium and budget constraints. The decision to purchase a flood insurance policy to a certain level is dependent upon the income of the property owner. Where ones income is not even enough to meet his immediate needs, purchasing flood insuring policy will not be including in the budget. Smith (1968) noted in his model that people will forgo flood insurance if the premium price for flood insurance is higher than the probability of the total lost from flood. In their own view, Browne and Hoyt (2000) noted that a decrease in the price charged for flood insurance policy would eventually increase the probability of purchasing of flood insurance. Kriesel and Landry (2004) added that the wealth of a house owner may also influence the decision of purchasing flood insurance policy, a house owner with higher income is more likely to purchase flood insurance and higher income may lead to higher penetration rate. According to a research conducted by FEMA (1997), house owners who have not purchased flood insurance felt that they could not afford the premium of flood insurance. Also it is hard to convince property owners to allocate significant part of their income to purchase flood insurance in order to reduce losses that have low probability and when the losses are likely to be less than subscription coverage. Hence, house owners feel that expenditure on insurance is a poor investment (Baumann and Sims, 1978; Johnson, 1978; Kunreuther et al., 1978; Palm, 1981). Lamond et al. (2007) observed that house owners might choose not to purchase flood coverage because they expect that, in long term, the cost of damages from flood will be lower than the sum of annual premiums. In contrast, Blanchard-Boehm et al. (2001) found that those who have purchased flood insurance felt that flood insurance will able to cover the cost of damages.

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3 Data and method

3.1 Data source

The data used in this *s* were based on a stratified random survey on residential homeowners in three districts of Johor State, namely Kota Tinggi, Segamat and Johor Bahru. A total of 315 sets of questionnaire were distributed among the homeowners in each districts. However, the analysis was based on 207 usable responses received.

3.2 Instrument and measures

The questionnaire is designed to tap into homeowners' response to measures of objective risk exposure, subjective risk perception and socio-economic cum demographic variables that could determine their likelihood of purchasing flood insurance, and hence, influences their flood risk aversion orientation. Two variables used to elicit measures of objective flood risk exposure are: (1) distance from flood prone river; and (2) house location elevation of property. The two variables were measured in interval scale. On subjective risk perception, the measures are (1) numbers of high impact flood experienced; (2) expectation of future increase flood frequency; (3) likelihood of dropping flood insurance if flood is not experienced for 2 yr; (4) perceive flood insurance premium to be high but willing to pay slightly higher than fair price; (5) perception of non reliability of insurance firms to pay insurance claims as well as their reluctance to provide flood insurance cover; and (6) perception that flood protection system are not adequate. Except question 1 all the questions tapping into subjective risk perception contained statements that were designed to elicit respondent's level of agreement using a 5-point likert scale (1 = strongly disagree, 5 strongly agree). On the other hand socio-economic cum demographic variables were assessed using: (1) income level, (2) education level; (3) gender; (4) race; and (5) age. Questions 1 and 5 were measure interval scale. While question 2 was in rank scale, question 3 and 4 were in nominal scale.

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The study attempted to discover if there were significant differences between those who purchase flood insurance and those who do not using the discriminant analysis method. To this end, the dependent grouping variable (do you have flood insurance?) is a dichotomous variable measured nominally as 1 = "yes, I have flood insurance"; 2 = "no, I do not have flood insurance". The variable was also used to classify the homeowners into whether they are risk averse or not. As pointed out earlier, Borzen et al. (2009) contend that real purchase of insurance by a person is a good indicator of risk aversion because it represents revealed preference for financial protection. This even more applicable in Malaysia where flood insurance is voluntary.

3.3 Participants

The questionnaires were self-administered randomly to owner-occupied households aged 21 yr and above. Out of the 207 usable questionnaires received, 44 % were from Kota Tinggi ($N = 91$) where 48 % (44) of them were male and 55 % (47) were female. On the other hand 26.6 % (55) were from Segamat where 44 % (24) of them were male and 56 % (31) were female. 29 % (61) were from Johor Bahru 46 % (28) and 54 % (33) of them male and female respectively. In other words, out the 207 respondents, 46 % (95) of them are males while and 54 % (112) female. On race profile, 37 % of the respondents were Malays ($N = 76$), Chinese 52 % ($N = 108$) and Indians constitute 11 % ($N = 22$). In terms of age profile the pattern of response from the highest order was 29.5 % (61) from within the age of 31–50; 25 % (52) within the age of 21–30; 23 % (47) within the age of 31–40; 15 % (31) within the age of 51–60; and 7.7 % (16) above the age of 60.

3.4 Method

Discriminant analysis was adopted as the analytical statistics for this study. The rationale for its use lies with the fact that the study involved testing group mean differences between two groups of respondents: those who "do" and "do not" purchase flood insurance based on a set of predictive variables. Discriminant analysis is an appropriate statistical technique for testing for equality of group means and building a predictive model of group membership based on a set of observed discriminating variable (Hair et al., 1987). Discriminant analysis provides descriptive statistics (total mean and group mean) and inferential statistics identifying and analyzing group differences. Inferential statistics include *F* test for Wilks' Lambda, model Wilks' Lambda, standardized canonical discriminant function (SDFC), eigenvalues, canonical correlation, and functions at group centroids. The lambda is varies from 0 to 1, closer to 0 imply group means differ and closer to 1 imply less group means difference. ANOVA (*F*) for Wilks' lambda test if there are significant group mean differences. In other words, *F* for Wilks' lambda provides useful statistics to identify variables that make significant differentiation between or among groups. The standardized discriminant function coefficients used to assess each variable's unique contribution to discriminant function. A low standardized coefficient implies that the groups do not differ much on that variable. The canonical correlation depicts the multiple correlation between the predictors and the discriminant function. The structure matrix coefficient on the hand shows the correlation between each predictor variable and the discriminant function. Correlations that have loadings ≥ 30 are considered significant and therefore have practical significance (Hair et al., 1998; Ndubisi, 2011). In group mean difference analysis, discriminant analysis has an advantage over the *t* test because it compares the groups in terms of group centroids, thus, takes into account the interactions between the individual variables (Ndubisi, 2008).

4 Result and discussion

On flood insurance penetration rate, the result revealed that out of the 207 respondents sampled in the study, only 34 % (72) insured their property against flood while the rest (66 %) or 135 did not. This also implies that 34 % homeowners who purchased flood insurance could be described as more risk averse than the 66 % that did not, *ceteris paribus*. The flood penetration rate could be considered somewhat low and below aver-

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age. The breakdown of flood insurance penetration amongst the three districts showed that Kota Tinggi had the highest rate (48.3 %) followed by Segamat 40 % and Johor Bahru 8.2 %. In other words homeowners in Kota Tinggi and Segamat are more risk averse than Johor Bahru homeowners in terms flood insurance. This is not unexpected as the incidence and severity of flood is higher in Kota Tinggi and Segamat.

Table 1 provides group mean scores and tests of equality of group means statistics used to identify variables that make significant differentiation between group of respondents that purchased flood insurance and the group that do not purchase. The column for test of equality of group means shows that the number of flood experience (NUMEXP) the respondents' have had in the past has strong discriminant power and emerged as the most significant variable ($\lambda = 0.870$, $F = 30.767$, $p < 0.001$) differentiating between group of respondents who purchased flood insurance and group of respondents who did not purchase flood insurance. The result shows a very high mean difference of 1.0 between respondents who have purchased flood insurance (GROUP1) and those who have not purchased (GROUP2). The mean value for GROUP1 is 3.23 as against 2.22 for GROUP2.

To further understand the explanation for the differences in group mean we carried out cross tabulation between flood insurance purchase and flood experience. The result showed that 88 % of respondents who purchased flood insurance had experienced flood two or more times compare to 42 % for those who did not purchase. Moreover 46 % of the respondents who did not purchase flood insurance had never experienced flood while only 6 % that has flood insurance never experienced flood and 7 % once. These suggest there is inter-relationship between flood experience and the tendency to purchase flood insurance. This may be attributed to the fact that increase in flood experiences translates to higher subjective risk perception and vulnerability which concomitantly could lead to demand for flood insurance. In essence, the property owners with higher number of flood experience are most likely to purchase flood insurance than those with lower number of experience. However, the fact that 7 % of the homeowners that experienced flood once and 6 % that never experienced flood actually purchased

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flood insurance supports prospect theory assertion that moderate and small size risk individuals also voluntarily buy insurance. Our finding is consistent with previous study by McPherson and Saarinen (1977), Kunreuther (1978), Kunreuther et al. (1978), Epple and Lave (1988), Kunreuther and White (1994) that which show that probability of purchasing flood insurance increases with frequency of flood experience.

The distance of respondents' property in the study area influenced their willingness in purchasing flood insurance. As shown in Table 1 distance of property from flood prone river (DISTFD) registered strong discriminatory power and therefore was significant ($\lambda = 0.885$, $F = 26.564$, $p < 0.001$) in differentiating between group of respondents who purchased flood insurance (GROUP1) and group respondents who did not purchase flood insurance (GROUP2. The variable shows a very high mean difference of 1.08 between the groups. The mean value for GROUP1 is 1.38 as against 2.46 for GROUP2.

To investigate further the underlying sources of these differences we performed a cross tabulation between house distance from flood prone river and flood insurance purchase. The result revealed that 76 % of respondents who subscribed to flood insurance live in houses located less than 3 km from flood prone river and another 18 % live within 3–6 km. In contrast, only 46 % of the respondents who did not subscribe flood insurance live houses located less than 3 km from flood prone river. Moreover, 41 % of the people who did not purchase flood insurance are from houses located more than 6 km from river while only 6 % of the respondents who bought flood insurance live more than 6 km from river. What could be deduced from this result is that the nearer a house is located to flood prone river, the higher the tendency the house owner will subscribe flood insurance. In other words proximity to flood prone river contributes to degree of risk averseness such that homeowners located less than 3 km from flood are more risk averse than homeowners located beyond. This result conforms with to a great extent with the findings of Kriesel and Landry (2000, 2004), Landry and Jahan-Parvar (2011), that proximity of a property to a river has positive effect on flood insurance purchase. Our finding is consistent with previous works by Baumann and Sims (1978), Kunreuther (1978), Dutta et al. (2003), and Dixon et al. (2006) which show that probability of pur-

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chasing flood insurance increases with frequency of flood experience, flood depth and lower ground location.

Elevation of their property (ELEVTN) has weak discriminat power but still significant ($\lambda = 0.974$, $F = 4.178$, $P < 0.05$) in differentiating between group respondents who purchased flood insurance and group respondents who did not purchase flood insurance. While GROUP1 had lower mean elevation value of 1.32, GROUP2 recorded higher mean elevation value of 1.49. More so, cross tabulation of house location elevation with flood insurance purchase shows that 68 % of respondents who purchased flood insurance reside at low elevation area while the 32 % reside at high elevation area. On the other hand 54 % of the respondents who did not subscribe to flood insurance property live on low elevation while the 46 % reside at high elevation area. The result is expected as low elevation location increases physical exposure and vulnerability to flood which culminates to risk aversion. What this result suggests therefore is that the elevation of a property in the study area does affect risk aversion and therefore determine whether the property owner is likely to subscribe to flood insurance or not. The finding is also in agreement with that of Dixon (2006), Kriesel and Landry (2000, 2004) which holds that higher elevation of property has positive effect on flood insurance purchase.

The result tests of equality of group means for the three variables above (NUMEXP, ELEVTN, DISTFD) provide sufficient evidence to reject the hypothesis of equal group means and we hence, conclude that there is significant mean difference between group of respondents who purchase flood insurance and group of respondents who do not purchase flood in terms of house distance from flood prone river, house location elevation, and numbers of flood experience.

Expectation of increased flood frequency (EXPFRQ) exhibited poor discriminant power and therefore was not significant ($\lambda = 0.999$, $F = 0.002$, $p > 0.05$) Rather, there are more commonality of opinion than differences between groups who have purchased and have not purchased flood insurance on expectation of increased flood frequency. Both groups shared the same opinion on anticipation that of flood frequency that will increase in the future, but the extent this could make difference in level of risk aversion and likelihood of purchasing flood insurance is not clear as the group mean difference is too marginal to make a difference.

The price or flood insurance premium (FLPREM) was found to be a major factor in the decision to purchase flood insurance. The variable demonstrated strong discriminant power and emerged as third most significant ($\lambda = 0.890$, $F = 25.370$, $p < 0.001$) in contributing to differentiation of the two groups on their propensity to purchase flood insurance. The basis of this difference may be seen in group mean score. On the variable, group of respondents who did not purchase flood insurance recorded higher mean score (3.08) than group that purchased flood insurance (2.45). The differences in group mean (0.63) was large enough to make significant difference. The group that did not purchased flood insurance has the notion that the premium for flood insurance is expensive and more unwilling to pay slightly higher than fair price compared to those who have purchased flood insurance. Thus, GROUP 1 demonstrated more willingness to pay slightly higher than fair price to protect against loss which also imply they more risk averse. The result is consistent with prospect theory postulation that people, including modest risk individuals are willing to increase premiums somewhat than fair price in order to pay for expected losses (Pashigian et al.,1966; Drèze, 1981; Cutler and Zeckhauser, 2004; Kunreuther and Pauly, 2006a; Sydnor, 2010; Ulrich, 2012). We also argue here that if the homeowner are willing to take additional risk by paying more than actuarially fair premium that could exceed expected loss then their decision to buy flood insurance may be located within loss aversion because they weigh more on their expected loss than expected gains. This result is consistent with the findings of Smith (1968), MacDonald et al. (1987), Browne and Hoyt (2000), Dixon et al. (2006), Kunreuther et al. (1978), Palm (1981), Lamond et al. (2009), and Blanchard-Boehm et al. (2001).

The respondents view about the insurance companies and how it affects their decision to purchase flood insurance or not was tested. Results show that there is a significant difference in their mean value with respect to perception of non reliability of

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insurance firms to pay insurance claims as well as their reluctance to provide flood insurance cover (V-INSREL) ($\lambda = 0.963$, $F = 7.856$, $p < 0.01$). Respondents who did not purchase insurance had a higher mean value (3.36) compared to those who purchased (2.92). It could therefore be said that those who never purchased flood insurance felt was difficult get the insurance companies keen or interested to cover flood insurance.

The roles of income level and education were also examined. The contribution on income level (INCOML) on group differentiation was found to be significant ($\lambda = 0.964$, $F = 9.645$, $p < 0.01$.) but level of education (EDUCTN) was not ($\lambda = 0.922$, $F = 1.659$, $P > 0.01$). On income level, examination of the group mean shows that the group that has purchased flood insurance registered higher mean (1.83) compared to the group that did not (1.48). In other words, the propensity to purchase flood increase significantly with higher income while education does not make difference on the propensity. While group 1 registerd higher income that could increase their affordability of flood insurance, it is highly likely the group suffered greater loss of wealth (accumulated savings from income) from previous multiple high impact flood experiences that foster their risk aversion. As Luigi and Paiella (2008); Cameron and Shah (2011) pointed out, households who face income uncertainty or suffered loss of income from severe natural disaster exhibit greater degree of risk aversion.

On the perception of state of flood defense measures, there was common opinion than difference that existing technical flood protection systems are not adequate (FLPROT), Hence the variable displayed poor discriminant power and did not contribute significantly in differentiating between the groups ($\lambda = 0.987$, $F = 2.682$, $p > 0.05$). Though examining the group means shows that group 1 recorded higher mean, the mean difference was too marginal to make a significant difference to flood insurance purchase or degree of risk aversion.

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4.1 Predicting discriminant function for group propensity to purchase flood insurance

One of the objectives of this study is to build a model that include only the most important predictive variables that best differentiate between group of homeowners who purchased flood insurance and the group that who did not as well as account for the group's degree of risk aversion. To this end stepwise method of enter/remove for deriving discriminant functions is most effective (Huberty, 1994). A discriminant function, also called a canonical root, is a latent variable which is a linear combination of discriminating (independent) variables. Stepwise method selects only variables that significantly contribute to discriminant function and predict group membership by selecting variable that minimizes the overall Wilks' Lambda at each step. As a result, all the 11 variables were subjected to stepwise method.

Table 2 shows that at 30 terations and at.05 significant level, 5 out of the 11 variables entered the model in the following descending order of magnitude of stepwise Wilks' Lambda: number of flood experience (V-NUMEXP); perceive flood insurance premium to be high but willing to pay slightly higher than fair price to insure my house (V-FLPREM); perception of non-reliability of insurance firms to pay insurance claims as well as their reluctance to provide flood insurance cover (V-INSREL); distance of property from flood prone river (V-DISTFD); and income level (V-INCOML). Table 2 also provides statistics for verifying the significance of the discriminant function and identify the variables that have the greatest impact and correlation with the discriminant function. The table reveal the canonical correlation (CCr) of.507 which implies that the function explained 42 % (CCr^2) of variance in the group differences. However, examining the function's Wilks' lambda (Λ), the function is considered significant ($\Lambda = 0.743$; $\chi 2\,(df = 5) = 60.254$ $p < 0.01$). Thus, we substantively infer that there is a significant discriminant function that clearly differentiate and separate the two groups of homeowners on the basis of likelihood purchasing flood insurance or concomitantly on the basis of flood risk aversion.

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The table also displays the standardized discriminant function coefficients and structure matrix correlation used to assess each variable's unique contribution in terms of impact and correlation with the discriminant function. Consistent with ANOVA (F) test, the standardized discriminant function coefficients (SCDFC) and structure matrix correlation (within group correlation) show that the variables that have strongest impact and correlation with the discriminant function are perceive flood insurance premium to be high and willing to pay slightly higher than fair price to insure my house ($\beta = 0.452$ and within group correlation = 0.598); number of high impact flood experienced ($\beta = 0.428$ and within group correlation = 0.658; distance from flood prone river ($\beta = 0.369$ and within group correlation = 0.611; and perception of non reliability of insurance firms to pay insurance claims as well as their reluctance to provide flood insurance cover ($\beta = 0.325$ and within group correlation = 0.333).

The classification result provides efficiency and predictive accuracy of the discriminant function. The model achieved a ht ratio of 80.2 % indicating that 80.2 % of the residential homeowners were correctly classified into "have flood insurance" or "have no flood insurance" and consequently according to their flood risk aversion orientation. The achieved impressive hit ratio suggests the model has practical significance in predicting demand-side factors distinguishing between groups of respondents that purchase flood insurance and those that does not.

The study probed into the reasoning for not purchasing flood fnsurance. Figure 1 shows that 31 % of respondents did not state any reason for not subscribing to flood insurance while 14 % felt is not necessary. For these two categories it is difficult to explain their position but we suffice to say they are either risk-neutral (indifferent) to risk of flooding and therefore unwilling to take up flood insurance or they underestimate the likelihood of a future flood risk. Flood insurance will not be attractive to individuals who think that flood is not coming soon have the perception that loss may not be much. Camerer and Kunreuther (1989), Kunreuther (1996), Kunreuther and Paul (2006a), Rees and Wambach (2008) who argue that households will likely not buy flood insurance if they underestimate probability of its occurrence. 21.32 % noted that they did not purchase flood insurance because they were not living in flood prone area. This group may be living in area of higher elevation and therefore see higher elevation as substitute to flood insurance. They may be said to have low degree of risk aversion because they perceive probability of loss from flood very low. 16 % did not have adequate knowledge about flood insurance which again is a potential source of low degree of risk aversion. This underscores market failure in providing adequate information necessary for flood insurance purchase decision. 7 % stated the refusal of insurance companies to cover property as their main reason. This category are risk averse and willing to pay premium for their property but are unable to get insurance company agree to provide the cover. High premium charged by insurance companies was a major reason for 6 % of the respondents. This category is risk averse but given their level of income or wealth are unwilling to buy an unfair insurance policy in which the premium is higher than expected value of the claims should the averse event (flood) occur. Some other reasons given by respondents for not purchasing flood insurance which could also account for low degree of risk aversion include: low probability of experiencing flood (2 %) and perception that their building is too old (1 %).

5 Conclusion

The cardinal objective of this study is to determine flood insurance penetration rate among residential homeowners in three districts of Johor and predicts the best variables that best differentiate between group of homeowners who purchase flood insurance and those that do not on their likelihood of purchasing flood insurance as well as in as well as determine the group's degree of flood risk aversion. Our result revealed 34 % penetration rate with Kota Tinggi having the highest penetration (44 %) and thus, the highest degree of flood risk aversion. Overall we can say the flood insurance penetration rate is below average. The Wilks' Lambda F test for equality of group means, SCDFC, structure correlation and canonical correlation have clearly shown that there are strong significant differences between the two groups of homeowners based on

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their objective flood risk exposure, subjective risks perception, and socio-economic cum demographic variables.

The most important variables distinguishing between those who did purchase flood insurance and those who did not were number of high impact flood experienced; perception that flood insurance premium is high but willing to pay slightly higher than fair price; perception of non-reliability of insurance firms to pay insurance claims as well as their reluctance of insurance firms to provide flood insurance cover; distance from flood prone river; and income level. The variables constituted the dominant deciding anchors in the homeowners' decision to purchase or not purchase flood insurance policy. Evidence from SCDFC, structure correlation shows that subjective risks perception measures such as number of high impact flood experienced were found to have more impact and within group correlation with flood insurance decision and flood risk aversion than measure of objective flood risk exposure vis-à-vis distance from flood prone river.

The research has some notable implications. The result showed the two groups have convergence of opinion on the expectation of future increase in flood frequency and on the perception that existing technical flood protection systems are not adequate. So there is common apprehension of greater vulnerably of their property under the current poor state of flood defense systems and foreseeable increase in flood frequency. To reduce this apprehension it may be necessary to enhance the structural flood defense systems. Though some of the homeowners said they may drop flood insurance if they don't experience flood for about two years this may not lead to substantial drop in flood insurance subscription

It was noted that 16 % of the group of homeowners who did not purchase insurance indicated that they do not have adequate knowledge about flood insurance. Thus, we recommend flood risk awareness programme that include flood insurance promotion in flood hit coastal areas.

It was clear from our findings that non-reliability of insurance firms in paying insurance claims as well as their reluctance to provide flood insurance cover was a significant factor accounting for difference in flood insurance purchase. Specifically 7 % the non purchasing group stated the refusal of insurance companies to cover property as their main reason. Against this backdrop there is need for further investigation into reasons insurance firms are reluctant to provide flood insurance and examine ways to sensitize and incentivize them to provide cover. Policies that compel insurance firms who provide flood insurance to redeem insurance claims will instill confidence among policies takers and also increase flood insurance subscription.

References

Badrul, H. A. S., Marzukhi, M. I., and Daud, A. R.: The worst flood in 100 yr: Johore experience, Community Health, 15, 1–14, 2010.

Baumann, D. D. and Sims, J. H.: Flood insurance: some determinants of adoption, Econ. Geogr., 54, 189–196, 1978.

BERNAMA: Malaysia Faces Serious Challenge in Handling Floods and Drought, availavle at: http://www.piam.org.my/index.php/news/test-insurance-news/115-insurance-news/2007/431-malaysia-faces-serious-challenge-in-handling-floods-and-drought 21 June 2007.

Blanchard-Boehm, R. D., Berry, K. A., and Showalter, P. S.: Should flood insurance be mandatory? Insights in the wake of the 1997 New Year's Day flood in Reno-Sparks, Nevada, Appl. Geogr., 21, 199–221, 2001.

Botzen, W. J. W., Aerts, J. C. J. H., and van den Bergh, J. C. J. M.: Dependence of flood risk perceptions on socioeconomic and objective risk factors, Water Resour., 45, W10440, doi:10.1029/2009WR007743, 2009.

Browne, M. J. and Hoyt, R. E.: The demand for flood insurance: empirical evidence, J. Risk Uncertainty, 20, 291–306, 2000.

Bubeck, P., Botzen, W. J. W., and Aerts, J. C. J. H.: A review of risk perceptions and other factors that influence flood mitigation behaviour, Risk Anal., 32, 1481–1495, 2012.

Burton, I. and Kates, R. W.: The Perception of natural hazards in resource management, Nat. Resour. J., 3, 412–441, 1964.

Business Times: Floods set to hit insurers with RM100 m in claims, http://www.piam.org.my/index.php/news/test-insurance-news/115-insurance-news/2007/458-floods-set-to-hit-insurers-with-rm100m-in-claims 5 March 2007.

Cameron, L. and Shah, M.: Risk-taking behavior in the wake of natural disasters risk aversion, Monash University University of California, Irvin, CA, 2011.

Chateauneuf, A. and Cohen, M.: Risk seeking with diminishing marginal utility in a non expected utility model, J. Risk Uncertainty, 9, 77–91, 1994.

Ho, J. C.: Coastal Flood Risk Assessment and Coastal Zone Management Case Study of Seberang Perai and Kuantan Pekan in Malaysia, Erasmus, Mundus Master's Thesis in Coastal and Marine Engineering and Management (CoMEM), University of Southamption, United Kingdom, 2009.

Kunreuther, H. and Roth R. J Sr., (eds.): Paying the Price: The Status and Role of Insurance against Natural Disasters. Washington, DC, Joseph Henry Press, 1998

Cutler, D. M. and Zeckhauser, R.: Extending the theory to meet the practice of insurance, in: Brookings–Wharton Papers on Financial Services, edited by: Litan, R. E. and Herring, R., Brookings Institution, Washington, DC, 1–47, 2004.

Eckles, D. L. and Volkman Wise, J.: Prospect Theory and the Demand for Insurance, The Risk Theory Society, American Risk and Insurance Association (ARIA), Philadelphia, PA USA, available at: http://www.aria.org/rts/proceedings/2012/default.htm, 2011.

Deloitte, K. C.: Institutional Study for DID - Final Report June 2003, Department of Irrigation and Drainage, Malaysia, 2003.

Desrosiers, M. A.: How individuals purchase insurance: going beyond expected utility theory casualty actuarial society, E-Forum, 2, 18 pp., available at: http://www.casact.org/pubs/forum/12wforumpt2/Desrosiers.pdf, 2012.

Disaster Insurance Protection: Public Policy Lessons, Wiley, New York, 1978.

Dixon, L., Clancy, N., Seabury, S. A., and Overton, A.: The National Flood Insurance Program's Market Penetration Rate, Estimates and Policay Implications, Rand Infrastructure, Safety, and Environment and Institute for Civil Justice, 2006.

Drèze, J. H.: Inferring risk tolerances from deductibles in insurance contracts, Geneva Pap. Risk Ins., 6, 48–52, 1981.

Dutta, D., Herath, S., and Musiake, K. A.: Mathematical model for flood loss estimation, J. Hydrol., 277, 24–49, 2003.

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Eckles, D. L. and Volkman, J. W.: Prospect theory and the demand for insurance, The Risk Theory Society, American Risk and Insurance Association (ARIA), Philadelphia, PA, USA, available at: http://www.aria.org/rts/proceedings/2012/default.htm, 2011.
Epple, D. and Lave, L. B.: The role of insurance in managing natural hazard risks: private vs. social decisions, Risk Anal., 8, 421–433, 1988.
FEMA: Mandatory purchase of flood insurance guidelines. Nevada policies, Federal Emergency Management Agency, FEMA (1997c), Washington, DC, 1997.
Gerrit, W.: Munich re urges climate action, Financial Times, available at: http://www.ft.com/intl/cms/s/0/98a3ac0a-f4e2-11de-9cba-00144feab49a, 2009.
Hair, J. F., Anderson Jr., R. E., and Tatham, L. R. L.: Multivariate Data Analysis with Readings, McMillan Publishing Company, New York, 1987.
Hamzah, J., Habibah, A., Buang, A., Jusoff, K., Toriman, M. E., Mohd Fuad, M. J., Er, A. C., and Azima, A. M.: Flood disaster, impacts and the tourism providers' responses – the Kota Tinggi experience, Advances in Natural and Applied Sciences, 6, 26–32, 2012.
Hershey, J. and Schoemaker, P.: Risk taking and problem context in the domain of losses: an unexpected utility analysis, J. Risk Ins., 47, 111–132, 1980.
Hershey, J. C. and Schoemaker, P. J. H.: Probability versus Certainty Equivalence Methods in Utility Measurement: Are They Equivalent?, Management Science 31, 1213–1231, 1985..
Hickcox, D. H.: The Great Flood of 1993, Part III: whither the flood plain?, Focus, 44, 27–30, 1994.
Ho, J. C.: Coastal Flood Risk Assessment and Coastal Zone Management Case Study of Seberang Perai and Kuantan Pekan in Malaysia. Erasmus Mundus Master's Thesis in Insurance against Natural Disasters, Joseph Henry Press, Washington, DC, 2009.
Huberty, C. J.: Applied Discriminant Analysis, Wiley and Sons, New York, 1994.
InsuranceInfo: available at: http://www.insuranceinfo.com.my/_system/media/downloadables/houseowner_insurance.pdf, 2011.
Intergovernmental Panel on Climate Change (IPCC): Fourth Assessment Report: Climate Change 2007, Contribution of Working Group II, Cambridge University Press, Cambridge, UK, 2007.
Isenberg, D.: How senior managers think, in: Decision Making, edited by: Bell, D., Raiffa, H., and Tversky, A., 525–539, 1989.
Johnson, W. K.: Physical and Economic feasibility of Nonstructural Flood Plain Management measures, US Army Corps of Engineers, 1978.

NHESSD
2, 3065–3096, 2014

Factors affecting flood insurance penetration in residential properties

U. Godwin Aliagha et al.

Kahneman, D. and Tversky, A.: Prospect theory: an analysis of decision under risk, Econometrica, 47, 263–292, 1979.
Keizrul, A.: Floods in Malaysia, available at: http://www.icharm.pwri.go.jp/publication/jan_20_22_2004_ws/pdf_output/abdullah.pdf (last access 13 June 2012), 2004.
Klecka, W. R.: Discriminant Analysis, Sage Publications, Beverly Hills, CA, 1980.
Koch, N. K.: Geohazards: Natural and Human, Prentice-Hall, Englewood Cliffs, NJ, 1995.
Kreibich, H., Thieken, A. H., Petrow, Th., Müller, M., and Merz, B.: Flood loss reduction of private households due to building precautionary measures – lessons learned from the Elbe flood in August 2002, Nat. Hazards Earth Syst. Sci., 5, 117–126, doi:10.5194/nhess-5-117-2005, 2005.
Kreibich, H., Christenberger, S., and Schwarze, R.: Economic motivation of households to undertake private precautionary measures against floods, Nat. Hazards Earth Syst. Sci., 11, 309–321, doi:10.5194/nhess-11-309-2011, 2011.
Kriesel, W. and Landry, C.: Participation in the National Flood Insurance Program: an empirical analysis for coastal properties, J. Risk Ins., 71, 405–420, 2004.
Kunreuther, H. C.: Even Noah built an ark, The Wharton Magazine, summer, 28–35, 1978.
Kunreuther, H. C.: Mitigating disaster losses through insurance, J. Risk Uncertainty, 12, 171–187, 1996.
Kunreuther. H. and Pauly, M.: Insurance decision making and market behavior, Foundations and Trends in Microeconomics, 1, 63–127, 2005.
Kunreuther, H. and Pauly, M.: Neglecting disaster: why don't people insure against large losses?, J. Risk Uncertainty, 28, 5–21, 2004.
Kunreuther, H. and Pauly, M.: Insurance Decision-Making and Market Behavior, Now Publishers Inc, Hanover, MA, 2006a.
Kunreuther, H. and Pauly, M.: Rules rather than discretion: lessons from hurricane Katrina, J. Risk Uncertainty, 33, 101–116, 2006b.
Kunreuther, H. C. and White, G. F.: Flood hazard delineation: the one percent standard, Water Resources Update, 95, 31–35, 1994.
Kunreuther, H., Ginsberg, R., Miller, L., Sagi, P., Slovic, P., Borkan, B., and Katz, N.: Disaster Insurance Protection: Public Policy Lessons, Wiley, New York, 1978.
Lamond, J., Proverbs, D, and Hammond, F.: Flooding and Property Values – Findings in Built and Rural Environment, Royal Institute of Chartered Surveyors, London, 2009.

Liu, P. S. and Chan, N. W.: The Malaysian flood hazard management program, International Journal of Emergency Management, 1, 205–214, 2003.
Luigi, G. and Monica Paiella, M.: Risk aversion, wealth, and background risk, J. Eur. Econ. Assoc., 6, 1109–1150, 2008.
MacDonald, D. N., Murdoch, J. C., and White, H. L.: Uncertain hazards, insurance, and consumer choice: evidence from housing markets, Land Econ., 63, 361–371, 1987.
March, J. and Shapira, Z.: Managerial perspectives on risk and risk taking, Manage. Sci., 33, 1404–1416, 1987.
McPherson, H. J. and Saarinen, T. F.: Flood plain dwellers' perception of the flood hazard in Tucson, Arizona, Ann. Regional Sci., 11, 25–40, 1977.
Merz, B.: Hochwasserrisiken: Grenzen und Möglichkeiten der Risikoabschätzung, Schweizerbart, Stuttgart, 2006.
MNREM (Ministry of Natural Resources and Environment Malaysia): Flood and Drought Management in Malaysia, available at: http://www.met.gov.my/files/ClimateChange2007/session1b/K2%20Husaini_P.doc (last access 22 May 2012), 2007.
Ndubisi, N. O.: Socio-environmental marketing in developing nations: a comparison of African and Asian businesses, J. Asian Afr. Stud., 43, 251–277, 2008.
Ndubisi, N. O.: Factorial and discriminant analyses of environmental sensitivity and initiative of Nigerian firms, Thunderbird International Business Review, 53, 19–35, 2011.
Palm, R. I.: Real Estate Egents and Special Studies Zones Disclosure: the Response of California Home Buyers to Earthquake Hazard Information, Monograph No. 32, University of Colorado, Institute of Behavioral Science, Hazards Research and Information Application Center, Boulder, CO, 1981.
Pashigian, B. P., Schkade, L. L., and Menefee, G. H.: The selection of an optimal deductible for a given insurance policy, J. Bus., 39, 35–44, 1966.
Plate, E. J.: Flood risk and flood management, J. Hydrol., 267, 2–11, 2002.
Rabin, M.: Risk Aversion, Diminishing Marginal Utility, and Expected-Utility Theory: a Calibration Theorem, 1997.
Rabin, M.: Diminishing marginal utility of wealth cannot explain risk aversion, in: Choices, Values, and Frames, edited by: Kahneman, D. and Tversky, A, Russell Sage Foundation, Cambridge University Press, Cambridge, UK, 202–208, 2000a.
Rabin, M.: Risk aversion and expected utility theory: a calibration theorem, Econometrica, 68, 1281–1292, 2000b.

Sebora, T. C.: Expected utility theory vs. prospect theory: implications for strategic decision makers, Journal of Managerial Issues, 7, 41–61, 1995.
Singh, P.: Floods set to hit insurers with RM100 m in claims, New Straits Times, available at: http://www.highbeam.com/doc/1P1-135651064.html, 2007.
Slovic, P.: Perception of risk, Science, 236, 280–285, doi:10.1126/science.3563507, 1987.
Smith, V. L.: Optimal insurance coverage, J. Polit. Econ., 76, 68–77, 1968.
Stern, N.: The Economics of Climate Change: the Stern Review, Cambridge University Press, Cambridge, UK, 2006.
Stern, N.: The economics of climate change, Am. Econ. Rev., 98, 1–37, 2008.
Sydnor, J.: Over insuring modest risks, Appl. Econ., 2, 177–199, 2010.
Tobin, G. and Montz, B. E.: The Great Midwestern Floods of 1993, Saunders College Publishing, Harcourt Brace, Inc., Orlando, FL, 1994.
Tversky, A. and Kahneman, D.: The framing of decisions and the psychology of choice, Science, 211, 453–458, 1981.
Tversky, A. and Kahneman, D.: Advances in prospect theory: cumulative representation of uncertainty, J. Risk Uncertainty, 5, 297–323, 1992.
Ulrich, S.: Insurance Demand under Prospect Theory: a Graphical Analysis, Working Paper No. 1764, Kiel Institute for the World Economy, Hindenburgufer, Germany, 2012.
World Meteorological Organization (WMO): Social Aspects and Stakeholder Involvement in Integrated Flood Management, Geneva, Switzerland, 2006.

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Table 1. Group mean differences and test of equality of group means.

Variables	Total means	Group Means			Tests of Equality of Group Means		
		[1] Has Flood Insurance	[2] Has no Flood Insurance	Mean Diff.	Wilks' Lambda	F^a	**Sig.**
Numbers of high impact flood experienced (V-NUMEXP)	2.57 (1.32)	3.23 (0.97)	2.22 (1.35)	1.00	0.870	30.767	0.000
Distance from flood prone river (V-DISTFD)	2.09 (1.51)	1.38 (0.87)	2.46 (1.64)	1.08	0.885	26.564	0.000
Elevation of property (V-ELEVTN)	1.44 (0.49)	1.32 (0.47)	1.49 (0.50)	0.17	0.974	4.178	0.048
Perceive flood insurance premium to be high but willing to pay slightly higher than fair price to insure my house (V-FLPREM)	2.57 (1.32)	3.23 (0.97)	2.22 (1.35)	−1.00	0.870	30.767	0.000
Expect flood frequency to increase in future (V-EXPFRQ)	3.19 (1.18)	3.18 (1.21)	3.19 (1.17)	0.01	1.000	0.002	0.963
Perception of non reliability of insurance firms to pay insurance claims as well as their reluctance to provide flood insurance cover (V-INSREL)	3.21 (1.10)	2.92 (1.22)	3.36 (1.01)	0.44	0.963	7.856	0.006
Perception that flood insurance premium is high and I am not willing to pay slightly higher than fair price (V-FLPREM)	2.86 (0.90)	2.45 (0.97)	3.08 (0.79)	0.63	0.890	25.370	0.000
I will drop flood insurance if I do not experience flood for 2 yr	2.80 (1.13)	2.44 (1.27)	2.99 (1.00)	0.56	0.945	11.899	0.001
Income Level (V-INCOML)	1.60 (0.89)	1.83 (1.00)	1.48 (0.80)	−0.35	0.964	7.645	0.006
Education Level (V-EDUCTN)	1.41 (0.78)	1.31 (0.62)	1.46 (0.84)	0.15	0.922	1.659	0.199
Flood protection system are not adequate (V-FLPROT)	3.24 (1.22)	3.20 (1.29)	3.26 (1.19)	0.06	0.999	0.113	0.737

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Table 2. Predictive model of flood insurance purchase.

Variables Entered/Removed[a,b,c,d]

Step	Entered	Wilks' Lambda Statistic	df1	df2	df3	Exact F Statistic	Exact F df1	Exact F df2	Exact F Sig.
1	Numbers of high impact flood experienced (V-NUMEXP)	.870	1	1	205	30.767	1	205	.000
2	Perceive flood insurance premium to be high but willing to pay slightly higher than fair price to insure my house (V-FLPREM)	.803	2	1	205	24.993	2	204	.000
3	Perception of non-reliability of insurance firms to pay insurance claims as well as their reluctance to provide flood insurance cover (V-INSREL)	.781	3	1	205	18.978	3	203	.000
4	Distance from flood prone river (V-DISTFD)	.760	4	1	205	15.955	4	202	.000
5	Income level (V-INCOML	.743	5	1	205	13.932	5	201	.000

At each step, the variable that minimizes the overall Wilks' Lambda is entered.

a. Maximum number of steps is 30
b. Minimum partial F to enter is 3.84
c. Maximum partial F to remove is 2.71
d. F level, tolerance, or VIN insufficient for further computation.

Functions at Group Centroids:
Has flood insurance .423
Has no flood insurance -.811

Standardized Canonical Discriminant Function Coefficients	Function 1	Impact Ranking	**Structure Matrix** (Within Group correlation)
Number of high impact flood Experienced	-428	2	-.658
Perception that flood insurance premium is high but willing to pay slightly higher than fair price	.452	1	.598
Perception of non-reliability of insurance firms to pay insurance claims as well as their reluctance to provide flood insurance cover	.325	4	.333
Distance from flood prone river	.369	3	.611
Income level	-.300	5	-.328

Canonical Correlation (CCr)	.507
(CCr^2)	.4251
Eigenvalue	.347[a]
Wilks' Lambda	.743
Chi-square (df=5)	60.254
Classification Accuracy (hit ratio)	80.2%
Sig	.000

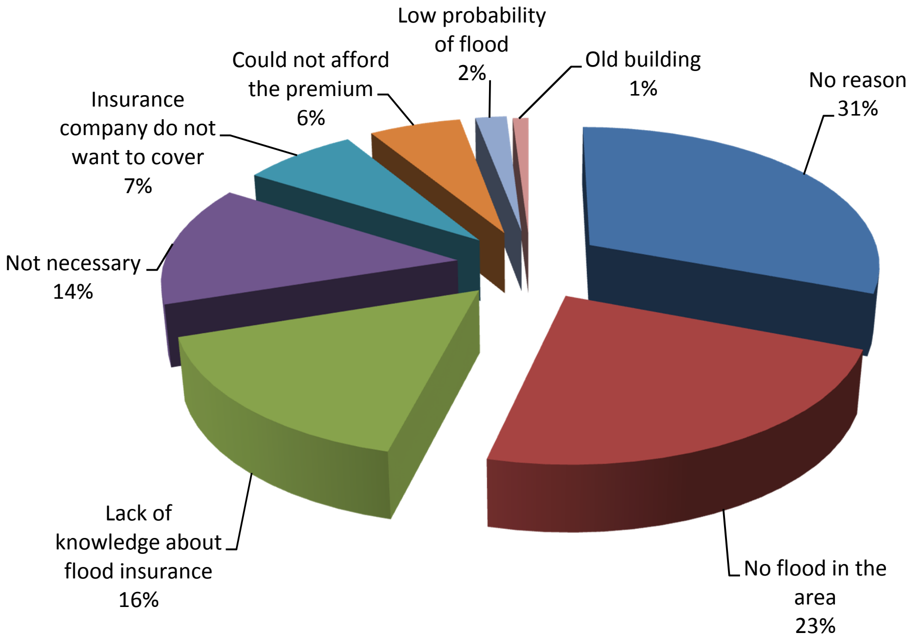

Fig. 1. Reasoning for not purchasing flood insurance.