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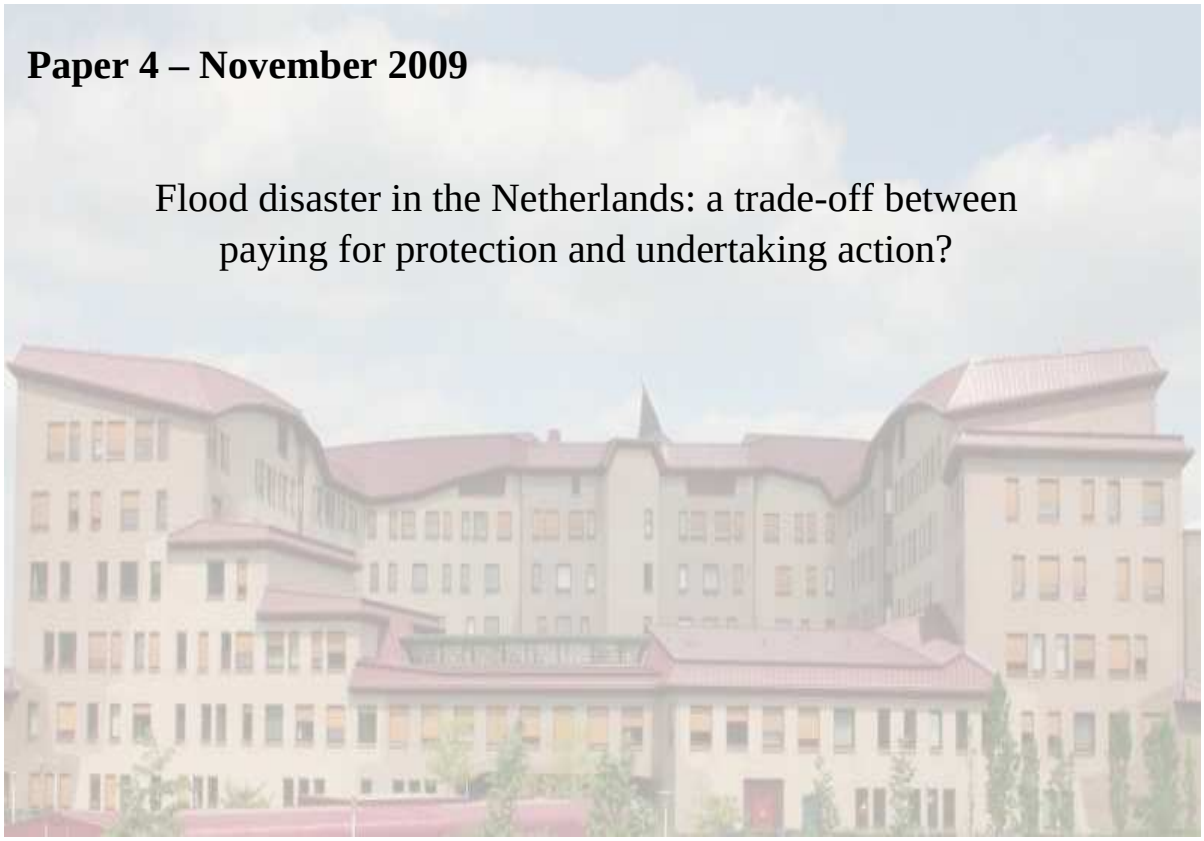

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Flood disaster in the Netherlands: a trade-off between paying for protection and undertaking action?

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Flood disaster in the Netherlands: a trade-off between paying for protection and undertaking action?

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Abstract

Effectively, one of the principal challenges for the Netherlands in the face of climate change is: How should we manage flood risk so that regional needs are adequately captured? Recent studies however point at the existing gap between risk perceptions of the public and the experts, which seems to become an apple of discord in the Dutch flood management. While public authorities are not willing to emphasize the growing threats that flooding are posing to the country, the issue is pressing hard to be addressed.

In this paper we offer a summary of a recent study on flood risk perceptions in the Netherlands that precludes the findings regarding the willingness to pay for (public) measures contrasted to taking (individual) protective action. Clearly, arising debates around the issue of public-private (shared) responsibility in addressing flood risk add more fuel to the fire, where views seem to be polarized. We attempt thus to link this variation in behavioural intention to the willingness to pay for improvements in flood safety and explore the nature of this relationship. We observe in addition that regional differences do matter, which has direct implications for policy and practice. In particular, we suggest that measures tailored to serve local needs and attuned to local perceptions should prove to provide most feasible solutions.

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1. INTRODUCTION

The aim of this paper is to investigate the issue of cognitive perception of flood risk and the readiness of individuals to undertake protective action in the Netherlands. This research is motivated by the emerging change in thinking from flood probability to flood risk in the Netherlands which will have important implications for flood management policy in the country.

The Netherlands is often seen as world leader in flood management, with hundreds of years of experience in building flood defenses and maintaining – mostly – dry feet. Yet this image of the Dutch should not be taken for granted, nor should flood management be seen as a given 'state of affairs'. Rather, approaches, policy and philosophy of managing the threat are evolving. In particular, the country is on the way of change in the last couple of decades in its flood management. A number of processes can be distinguished; the most important of which, in our opinion, is the revival of attention towards potential flood consequences that seemed to be forgotten during the victorious triumph of the Delta Works that were finished in 1997 with the completion of the Nieuwe Maeslantkering (for more information, see www.deltawerken.com).

Without diminishing the importance of engineering solutions to the 'flood problem' in the Netherlands (in the end thousands of km2 behind the dikes are available for living – and flourishing – of the Dutch society), we should remark that indeed, the decades after the devastating flood of 1953 marked by technical solutions at an unprecedented scale have driven away the attention from the potential consequences of a flood. In addition, exactly this 'strong' approach has created a surprisingly firm belief among the public that "we are perfectly safe" against flooding, making the pictures of possible devastation gradually fade away.

However, there were a number of turning points in the recent Dutch water management record. For example, in the 1990's things started to change. Probably, the first evidence of a slow 'revolution' was a shift in attention in engineering approach from dike overtopping due to high water levels to the whole system of flood protection mechanisms in the light of possible failures. Then, more attention was drawn on a more general level to the issue of flood management (instead of flood prevention) and the concept of risk was reintroduced as a product of probability and effect (for a concise outline see Bockarjova et al. 2009). Currently, we are observing an approach that renders risk management, when both the probability and the consequences of calamity are considered in decision-making. However, it is yet in its early phase, and a whole array of issues needs to be addressed, such as what is total (economic) value at risk; what is the level of public risk awareness and food risk perception; in which way should risk be communicated to the public; and so on.

In the face of these changes, risk governance will be affected at various levels, and will interlude the administrative, social and economic perspectives. The question that governs current debate as in academic as in policy-making circles is: Should people be assumed responsible for their undergoing flood risk, or should government be fully assuming this responsibility?

The focal point of our discussion in this context is the designated shift of responsibility on flood protection from belonging exclusively to the public domain to the situation when the responsibility and risks are *shared* between public and private actors. Essentially, in order to ensure this transition, there is first a need to explore the current state of readiness of the public to undertake protective action. In this paper we shall adress a number of questions: For how

far individuals would be ready to take measures in order to protect themselves from flood risk in addition to flood safety measure taken by the government? Would there be a trade-off between individual protective action and financial contribution for the improvements in flood risk safety? Is there a strong connection between risk perception and individual willingness to pay for flood safety in the Netherlands?

This paper contributes on a number of novel issues. The addressed questions are new in hazard research: to date there are few publications relating risk perception to the willingness to pay for an improvement in safety; such studies in flood risk research are even more scarce. There is also few documented evidence on the relationship between behavioural motivation and the willingness to pay: exploring the trade-off between financial contribution and individual action is a novel aspect in hazard research that is of importance for academics and policy-makers.

This paper is organized as follows: We shall first describe the method, and present our findings on flood risk perception in the Netherlands. We shall next look at the willingness to pay for additional flood safety and test a number of models in attempt to explain the variation in WTP with socio-demographic and perception variables. Then, we shall see whether there is a link between the behavioural intention index for undertaking individual action to limit individual potential flood consequences, and consider regional differences in that. We shall close with discussion and conclusions.

2. THE METHOD

We make use of a questionnaire that was set out in September – October 2008 among about 1,000 Dutch households spread in the 4 selected areas (see Table 2A). Almost a quarter of the respondents have had earlier experience with a flood, water nuisance or evacuation; this proportion varies slightly among the regions (so-called dike-rings) differing in flood safety standards and geographical characteristics (see Tables 2A and 3A). About 11% of respondents are rural residents; gender division is fairly equal: 47.5% males and 52.5% females.

Perception indicators are essentially index variables (except for Likelihood which is an indicator of perceived likelihood of a flood in the coming 50 years in the place of residence; and Worry of dying in flooding) constructed on a 11-point scale from 0 to 10 as follows: Vulnerability (5 items, Cronbach's alpha = 0.881), Severity (5 items, Cronbach's alpha = 0.743), Subjective Knowledge (3 items, Cronbach's alpha = 0.530). Due to the public good character of flood safety we have also included a trust measure, Trust in Government (4 items, Cronbach's alpha = 0.827) as a related perception indicator. See Appendix I for the description of constituent items.

In this contribution we shall rather concentrate on a number of questions that are relevant for current policy-making. In particular, at the moment government is considering a change in flood safety approach from belonging to public domain to shared responsibility where individuals are taking protective action in addition to public provisions. Here, individual protective action, as well as financial contribution to improved safety, are considered. Three particular issues shall be covered in this paper in connection to flood risk valuation.

- First, ($1H_0$): whether willingness to pay for extra safety depends on individual characteristics, such as education, age, income and gender.

- Second, ($2H_0$): whether willingness to pay is influenced by individual risk perception, such as worry, vulnerability to flooding, severity of consequences, as well as trust in government and subjective knowledge about flood hazard.
- Finally, we intend to explore ($3H_0$): whether time and effort involved in taking individual protective activites can be considered complementary to financial contribution (so that there is a negative relationship between WTP and intention to act)[2]; or, alternatively, ($3H_A$): because people with high level of behavioural intention can be considered cooperative, they are ready to contribute as in terms of action, as in financial terms to the improvement of flood safety (so that there is a strengthening relationship between behavioural intention and WTP).

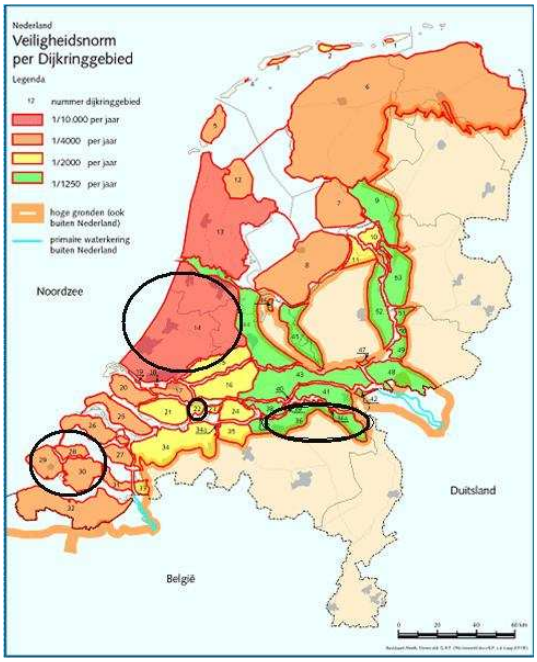

Figure 1. Case study areas.

Our aspiration is to explore the differences in perception, willingness to pay and behavioural intention between four regions in the Netherlands. The selected areas are the so-called dike-ring areas (DR): Land van Heusden / de Maaskant (DR36) south of the river Meuse, 3 islands in Zeeland (DR 28, 29 and 30), a major part of the province Zuid Holland (DR14) on the coast and the Island of Dordrecht (DR22) which is threatened by floods as from the sea as from the river. These areas also differ in the level of flood protection – the legally set standards for dike overtopping probability that vary from 1 in 10.000 years for Zuid Holland to 1 in 1.250 years for dike-ring 36. Here, our hypothesis is that various natural conditions, such as location near the river or coast, as well as (recent) experience with flood and / or evacuation might trigger the formation of various views on the danger that floods are posing (significant, yet very low, correlation between own experience with either flood, water nuisance or evacuation and the dummy for Zeeland (8,4%) and between experience and the dummy for Zuid Holland (-9,2%) were detected; both from two-tailed tests at 1% level).

[2] Note that our hypothesis is different from the so-called 'intention crowding-out' hypothesis where extrinsic benefits (i.e. financial stimulus) are assumed to crowd out individual intrinsic motivation to undertake action; see for example Frey and Jegen (2000), as well as Irlenbusch and Sliwka (2005), Clark et al. (2006), Georgellis et al. (2008), Stern (2008) and Sicilliani (2009).

3. FINDINGS ON FLOOD RISK PERCEPTION

Flood risk perception was measured by means of 5 index variables, Vulnerability, Severity, Subjective Knowledge and Trust in government; and variables Worry and Likelihood. The scores of constructed indexes reported here are by and large in line with the findings of other recent studies (such as Terpstra and Gutteling, 2008 and Terpstra 2008), which pleads for the relative validity of our results. We find, in particular, that the absolute level of public concern (worry) about floods is not as high, for example, as perceived flood Likelihood, Vulnerability and Severity. Trust in government, which is quite substantial, may be suggested here to dampen worry. This becomes in particular visible when examining regional perception profiles, where relatively high trust scores follow low or moderate perception indicators (for example, as is the case with dike-rings Land van Heusden / de Maaskant and Zuid Holland); or relatively high perception indexes precede low or moderate trust scores (like in Dordrecht and Zeeland).

ANOVA's and t-tests have shown that socio-economic individual characteristics of respondents (such as age, education, income or gender) are found to have but limited influence on perception variables. Roughly speaking, less educated, lower-income groups and younger respondents perceive flood risk on average as more likely and more severe, see themselves as more vulnerable and are in general more concerned about flood threat relative to more educated, higher-income and older respondents. Rural vs urban place residence makes a difference for worry, and severity and trust indexes. Rural inhabitants are estimating the consequences of a potential flooding in the place of residence as more severe relative to urban inhabitants; rural residents are showing also more concern about dying in a flood event. At the same time rural residents are having less faith in authorities relative to respondents from urban areas.

However, most differences in sample subgroups are rather determined by prior (near)flood experience and the regional dimension. Respondents with such experience overestimate the likelihood of a flood in their direct environment, consider themselves and the society more vulnerable to a calamity, and see a possible flooding as more severe relatively to respondents without prior calamity experience. "Experience"-respondents also deem themselves more knowledgeable about floods (even more so if they have experienced a flood instead of evacuation or nuisance) and put less confidence in authorities compared to their counterparts.

Finally, we have found numerous differences in flood risk perception based on location. In this way, place of residence acted as a major determinant of disparities in all perception indicators, as well as trust. Major within-regional differences turned out to be attributed to individual (near)flood experience (or the lack thereof) for almost every perception indicator except for worry. We may conclude that the regions with most homogeneous perceptions is Dordrecht and Zuid Holland (for the former, only experience has lead to differences in sub-group means); Land van Heusden / de Maaskant can be considered to be the most heterogeneous. It is the area that has distinguished perception pattern from other regions in almost every respect. Income, age and education level proved to be of no significance in revealing within-regional dissimilarities.

4. WILLINGNESS TO PAY FOR FLOOD SAFETY

In the survey respondents were asked to report their willingness to pay for flood safety. This was done in a contingent valuation format using an open-ended question. So, WTP was elicited in the context of purchasing a house in a flood-prone area comparing to a residence in flood-free area. The difference in prices between the two houses would thus be the maximum willingness to pay per respondent for flood safety. While it would be reasonable to assume that willingness to pay for safety would be positive, there were also negative WTP amounts (so that respondents would rather pay more for a house in a flood-prone area). Interpretation of these answers may vary; on the one hand, these could be respondents somewhat confused by the question (it was asked in the end of the questionnaire, on which about 20 min were already spent), on the other hand, these could be protest bids; or, finally, these could be just risk-seeking respondents (total number of negative WTP's is 35, which is relatively few). For the time being we shall look only at the non-negative WTP values, which interpretation is straightforward. Descriptive statistics for this variable are found in Table 1 in the "WTP gross" column. As we can see, the average extra amount of money that respondents would be willing to pay for a house found in a flood-proof area is 32,062 €; median amount is 20.000 €, which a more common statistic used to report WTP as distributions use to have long right tails (we can see a colossal amount of 300.000€ that is the maximum of what someone asserted to be willing to pay in addition of 200.000€ for a house in a flood-free area). Total number of respondents is 1052, and roughly a third of them have stated a zero WTP.

Table 1. Descriptive statistics for reported WTP.

	WTP gross (in euros)	**WTP per 1% change in P(flood) per year (in euros)**
MEDIAN	20,000 €	5,556 €
MEAN	32,062 €	39,092 €
STD	41,714 €	162,877 €
MIN	0 €	0 €
MAX	300,000 €	2,083,333 €
N respondents total, from which	1052	734
N of zero values	367	210

While this is an interesting piece of information, this WTP in fact is rather difficult to compare between individuals as we do not know which underlying flood risk was assumed by each respondent. This means, that it is important to know for which difference in flood risk they have stated the willingness to pay. While we could assume for simplicity that respondents in a single dike-ring have the same level of flood protection, it can still be perceived differently by different residents of the same dike-ring. Therefore, in fact, we would need to know the perceived likelihood of flood per respondent in order to make individual WTPs comparable. Essentially, we can connect respondents' answers to the Likelihood question (i.e. perceived likelihood of flood in the place of residence in % for the coming 50 years, on which we have reported in previous Section) to the answers on the value of the

house in the flood-free area and obtain the willingness to pay per 1% change in flood likelihood. For these calculations, we make the following simplifying assumptions: i) the stated extra amount would be taken in the mortgage and paid back in 30 years; ii) average interest rate is 5% per year. As a result we use the following formula:

$$\text{WTP}_{\substack{\text{per 1\% P(flood)}\\ \text{per year}}} = \frac{[\text{gross WTP} + \text{gross WTP} \cdot 0.05 \cdot 30] \div 30}{\text{perceived yearly}}$$
$$\text{LIKELIHOOD of flood}$$

This WTP per 1% perceived likelihood of flooding is reported in the last column of Table 1. Peculiarly, mean values of this variable and of gross WTP are nearly the same, for 1% change in flood safety it is 39,092 € per household per year. However, contrary to gross WTP, the difference with median value of WTP per 1% change in flood safety is almost a factor 4 smaller, namely 5,556 € which pleads for a much higher dispersion (seen from the standard deviation values). This variability should in fact be coming from high variability in stated perceived likelihood of flood. As in the case of gross WTP, also here we report a high proportion of zero-values (210 or 28.5%) out of the total number of 738. We can see that the number of respondents with valid WTP per 1% perceived likelihood of flooding is much lower than for the directly stated WTP, which is due to a high number of don't-know and zero answers on the likelihood question.

The next question to answer is what determines the willingness to pay for flood safety; essentially, whether individual characteristics and flood risk perception influence the height of respondents' stated amount of WTP. However, before we answer this question, we shall first introduce the notion of protective action.

5. A MODEL OF MOTIVATION FOR SELF-PROTECTION

In current literature so-called protection motivation framework (PMT) is often used to establish triggers behind individual behavioural intention to undertake protective action. This theory originated in 1975 in a paper by Rodgers, and later has been extended and refined by Bandura (1977); Maddux & Rogers (1983) and Weinstein (1989). PMT has widely been used in health psychology research studying individual motivation to protect self from hazardous influences, but has also been effectively applied in the natural hazard (see for example Martin et al. 2007, applying PMT in combination with transtheoretical stage change model for wildfires in the US) and climate change contexts (Grothmann and Patt, 2005, building their model of private proactive adaptation to climate change based on PMT framework) for analysing the readiness, or motivation of respondetns to undertake individual protective action. Menzel and Scarpa (2005) have used PMT and linked it to the willingness to pay for preserving biodiversity, which is one of the few examples of combining behavioural motivation model with CV-type of study. However, the authors have used WTP as a resulting adaptive behaviour without distinguishing between taking individual action and financial payment for additional safety. In this contribution we shall adress this difference. Let us first briefly introduce the PMT model.

PMT consists in fact of two processes: threat appraisal and coping appraisal. Threat appraisal comes first, implying that individuals should first realise and personalise particular risk before considering adaptive behaviour. This means that it is important that 1) risk is admitted as such, and 2) risk is admitted to pose a threat to individual in question. Thus, the first process, threat appraisal, consists of four elements; it is strengthened by perceived severity of hazard,

and personal vulnerability to a hazard; it is weakened by the the high valuation of intrinsic and extrinsic rewards connected to maladaptive behaviour. The second process of coping appraisal describes the decision process of taking adaptive behaviour, and is facilitated by a strong belief in response efficacy (the perceived effectiveness of alternative mesures) and perceived self-efficacy, i.e. the ability to perform protective actions. These two efficacy measures should be weighted against the costs of engaging in protective behaviour, which can be as material (money), as immaterial (time, effort or inconvenience). The result of going through the two (sequential) processes of threat appraisal and coping appraisal would lead to either adoption or neglection of protective behaviour, i.e. a statement of intended behaviour.

We shall briefly report on the findings from Bockarjova et al. (2009b) here. First, we have found that PMT model offers a good basis for analysing protection motivation of individuals in the context of flooding in the Netherlands. COMPOSITE BEHAVIOURAL INTENTION was measured as an index and is an average of 8 measures[3] valued on a 5-point scale, which was developed following Martin et al. (2007): 1 – will not do; 2 – will do within a year; 3 – will do within 6 months; 4 – will do in 1 to 3 months; 5 – already done. So, the higer the score, the higher the stated behavioural intention to undertake protective action.

We could conclude that, in general, threat appraisal process influences the motivation of respondents to take protective action only through perceived vulnerability to flood (in terms of perceived likelihood), which yet proved to be unstable through the models; rather, individuals are systematically motivated by variables comprising coping appraisal proccess, namely response efficacy and costs of taking protective action (this is also confirmed by Menzel and Scarpa, 2005). Further, higher subjective knowledge would mean higher behavioural intention, and so does prior personal experience with water calamities; trust in government, on the other hand, would be a disincentive to engage in risk reducing activities. Finally, the biggest part of population in the Netherlands is not found in action stage regarding self-protection from flooding: pre-contemplatives are about the half; together with contemplatives they easily form a convincing majority (78%).

The next question to be answered in this paper is: is there a trade-off between undertaking action and paying for extra safety. In other words, would people be rather inclined to pay instead of being engaged in protective activities? This would be a plausible assumption as all resources are scarce, and thus time and effort involved in protective activites can be considered complementary to a financial contribution for a decrease in risk.

6. EXPLAINING VARIATION IN WTP: A SIMULTANEOUS MODEL OF WTP AND RISK PERCEPTIONS

In this section we report the results of the pooled sample simultaneous equations system, which includes three interdependent perception variables of Worry, Severity and Vulnerability, and the willingness to pay for flood safety. Dependent variable for WTP is transformed as log[WTP per 1% change in perceived flood risk] so that its distribution resembles normal one (means of the dependent variables per region are found in Table 5A). In

[3] Proposed measures varied among the respondents, and included: ability to swim, having a (rubber) boat, having a window to the roof, storing valuables on the upper floors, obeying evacuation order, taking part in evacuation exercises, watching out the dikes, arranging a shelter for a case of evacuation, having a flood kit, having flood shields or sand bags, acquire a flood alarm system.

this analysis we use stated WTP that include zero and positive WTP values. Negative WTP's as well as WTP's from respondents that have indicated zero price were omitted in this analysis due to multiple interpretations (N of omitted observations is 106, N included is 781). Our explorative analysis has shown a high degree of correlation between Worry, Severity and Vulnerability, which in a usual OLS would result in multicollinearity. Because of this interdependence, it was decided to build a simultaneous system, where Worry, Vulnerability and Severity are endogenous together with the WTP, and inter-related. So, the three perception variables are defined within the system. Alongside the interaction between the three, also previous experience with a flood or evacuation and the levels of subjective knowledge and trust are assumed to influence individual perception. Perception is further assumed to depend on the individual level of education and age. We have also decided to include regional dummies to check for regional differences in the level of Worry, Vulnerability and Severity.

Willingness to pay, in turn, is assumed to depend on the level of income, age and education; as well as gender, ownership and regional characteristics. Risk perception is also assumed to influence WTP: expectedly, higher perception of Worry, Vulnerability and Severity should lead to a higher willingness to pay for improvements in flood safety.

Simultaneous system of equations is run with Lisrel 8.80 software. The sample includes 734 observations. The resulting structural equations are given in the box on the next page (under the estimated coefficients, also standard deviations are provided (in parenthesis) and t-statistics). The variables for which estimated coefficients are significant at 10% are emphasised in bold.

We may observe that the explanatory power of the regressions is pretty low, especially for the WTP equation, which is about 6% (which generally speaking is not uncommon in this type of studies). R^2 for Worry, Vulnerability and Severity equations are 12%, 26% and 39%, respectively. However, the system converged which implies that all of the equations offer significant improvement in explanation of variation in the dependent variables compared to a mean prediction.

For the three equations of flood risk perception, we can clearly trace a high level of interdependency so that Worry, Vulnerability and Severity are each other's determinants just as we assumed. Also, all three indicators are influenced by the level of subjective knowledge and trust in government. So, Worry, Vulnerability and Severity are increasing together with individual perceived awareness of the flood hazard. On the contrary, trust in government is negatively related to individual risk perception: on average, Worry, Vulnerability and Severity drop as the level of trust in authorities rises. This suggests that respondents with higher trust are in a sense relying on government and are delegating responsibility for flood risk safety which results in a systematically lower level of flood hazard perception.

Regional differences in risk perception are tested against the level of the coastal area Central Holland. So, respondents residing in Zeeland are on average more worried and consider flood consequences (for themselves and also for the society) as more severe; inhabitants of Dordrecht consider themselves as more vulnerable to flood hazard; respondents from the riverside area Land van Heusden / de Maaskant on the contrary, see themselves as less vulnerable, and see the consequences of flood as less severe for themselves and the society on the whole, relative to the inhabitants of Central Holland.

SIMULTANEOUS EQUATIONS MODEL FOR WTP, PERCEPTIONS AND BEHAVIOURAL INTENTION

(std.deviations in parenthesis) N=734, significant effects in bold

```
lgWTP  = - 0.022*VLNRTY - 0.049*SVRTY - 0.0073*WORRY - 0.00049*INCOME + 0.71*rejINK
          (0.054)        (0.086)       (0.041)        (0.00061)        (1.62)
          -0.42          -0.57         -0.17          -0.81             0.44

         + 0.28*EDUC + 0.024*AGE + 0.87*dGENDER
          (0.075)     (0.017)     (0.60)
           3.69        1.37        1.43

        - 2.87*dZEELAND + 0.42*dLANDvH  - 1.20*dDRDRCHT + 1.03*dOwnProp
         (0.94)          (0.96)          (1.18)          (0.92)
        - 3.05            0.43          -1.02            1.12

         - 1.09*INTENTION        Errorvar.= 15.89,        R² = 0.062
          (0.69)                            (0.84)
          - 1.59                            18.97


VLNRTY = 0.23*SVRTY + 0.084*WORRY - 0.019*EDUC - 0.0087*AGE
        (0.015)      (0.018)       (0.052)     (0.013)
        15.00         4.73         -0.36       -0.68

         + 0.13*dZEELAND - 0.90*dLANDvH  + 1.94*dDRDRCHT
          (0.68)          (0.69)          (0.85)
           0.20           -1.30            2.28

         - 0.11*dEXPown + 0.30*sKNWLDGE - 0.22*TRUSTgov,  Errorvar.= 8.56
          (0.62)         (0.051)         (0.041)                    (0.46)
          -0.18           6.00           -5.48                      18.74
                                                          R² = 0.26


 SVRTY = 0.23*VLNRTY + 0.047*WORRY - 0.053* EDUC - 0.0077* AGE
        (0.015)       (0.014)       (0.031)       (0.0075)
        15.00          3.28         -1.72         -1.02

         + 1.44*dZEELAND - 1.27*dLANDvH  + 0.14*dDRDRCHT
          (0.40)          (0.41)          (0.50)
           3.64           -3.11            0.28

         + 0.27*dEXPown + 0.086*sKNWLDGE - 0.12*TRUSTgov,  Errorvar.= 2.95
          (0.36)         (0.030)          (0.024)                    (0.16)
           0.74           2.85           -4.88                      18.77
                                                           R² = 0.39


 WORRY = 0.084*VLNRTY + 0.047*SVRTY - 0.33* EDUC - 0.014* AGE
        (0.018)        (0.014)       (0.063)      (0.016)
         4.73           3.28         -5.17        -0.89

         + 1.12*dZEELAND + 0.57*dLANDvHd + 0.65*dDRDRCHT
          (0.83)          (0.85)          (1.04)
           1.35            0.67            0.62

        - 0.67*dEXPown + 0.30*sKNWLDGE - 0.15*TRUSTgov,     Errorvar.= 12.84
         (0.76)         (0.062)         (0.050)                        (0.68)
         -0.88           4.78           -3.09                          18.92
                                                           R² = 0.12
```

Own experience and age do not play a role in determining individual level of risk perception; yet education does for severity and worry. Thus, more educated respondents tend on average to be less worried and to estimate flood consequences as less severe.

For the WTP equation, we have a number of curious outcomes. First of all, a whole ray of unexpected negative signs: for the three perception variables, Worry, Vulnerability and Severity, and income (defined as average points of 10 deciles). However, because all these predictors are not statistically significant, we may ignore their effects. Also the effect of home ownership does not play a role (its effect is positive, yet insignificant).

It is remarkable that none of the perception variables appeared to be significant in determining WTP, which implies that in fact, (alas) perception of flood risk is not related to the height of willingness to pay for flood safety. This means that we have not found enough evidence in support of hypothesis ($2H_0$), and it has to be rejected: willingness to pay for decreased flood risk is not influenced by individual risk perception. We suspect that this is due to the fact that the Dutch society is in a sense locked-in in an illusion that government will guarantee (full) flood safety, so that everyone is safe in the Netherlands. This overall belief, we suggest, is possibly neutralizing every effect that flood risk perception would have on individual WTP.

Next we may report on the explanatory variables that do have statistically significant effects (at least at 10% level) on the formation of WTP. These are three socio-economic dependents, education (at 5% level), age and gender (at 10% level). All three betas have a positive sign, which means that willingness to pay for additional improvements in flood safety increases with the level of education and with age; as well as it is higher for men than for women. All of these results are in line with empirical findings reported in risk valuation literature. These results also provide support for our hypothesis ($1H_0$) that individual characteristics have influence on the height of willingness to pay, so that it cannot be rejected.

Regional differences captured in our model suggest that respondents from the coastal area of Zeeland are having the lowest WTP from our sample (WTP in three other regions are not significantly different from each other). It is in fact pretty remarkable as Zeeland is the area which was flooded during the last major flooding in the Netherlands in 1953, and where flood-related experiences are most vivid (it has also the highest proportion of respondents with prior experience). Further, as already reported above, respondents residing in Zeeland have on average a higher level of worry and estimate the severity of consequences of a potential flood higher than respondents from other areas. a closer look at these respondents revealed, for example, that inhabitants of Zeeland are most pro-equity in the sense that they consider that the same probability of flooding should be guaranteed in all flood-prone areas in the country as apposed to the view that probability of flooding should be set dependent on the population at risk or the amount of protected value at risk. The low stated willingness to pay of these respondents thus, as we may suggest, might stem from a belief that government, and not individuals, should take all responsibility and should guarantee flood safety for all inhabitants of the Netherlands.

Finally, we may report on the significant association (yet at 10% level) between the level of behavioural intention to undertake individual protective action and the willingness to pay for extra flood safety. Essentially, this relationship is negative implying that a higher level of intention to perform self-protective measures leads to a lower willingness to pay for higher flood safety. We may also notice that the coefficient of behavioural intention is relatively large, suggesting a substantial influence of intentions on WTP. We recall that it is a continuous variable and thus 1.1 reduction in log(WTP) is on average applied to every point increase in the individual behavioural intention index. We may conclude that this outcome

does not provide strong evidence in favour of hypothesis ($3H_A$), however, due to its marginal significance it only points at some support for hypothesis ($3H_0$) where we have assumed that individual action is complimentary to monetary contribution for a decrease in flood risk so that *monetary contribution seems to crowd out individual involvement in protective action.* This means that respondents with high behavioural intention would be rather inclined to pay less; while on the contrary individuals with low behavioural intention to engage in mitigation activities would rather be willing to contribute more in financial terms to the improvements of flood safety.

7. DISCUSSION AND CONCLUSIONS

In this paper we have reported on the findings regarding willingness to pay for flood safety in relation to flood risk perception and the intention to undertake individual protective action. All of these issues are novel for hazard research. We have tested three hypotheses, which postulated association between individual WTP and individual characteristics, flood risk perception and intention to undertake protective action.

A survey method was used to collect data from about 1,000 Dutch households in 4 selected areas in the fall of 2008. We used contingent valuation method to elicit individual willingness to pay for flood safety, which was enriched with the elements from psychological theory of protective motivation (PMT).

We have found support for the first hypothesis ($1H_0$) where we assumed that willingness to pay for extra safety should depend on individual characteristics: these are in our case education (at 5% level), age, and gender (at 10% level). However, income turned out to be insignificant in determining individual WTP.

Next, we have found no support for the second hypothesis ($2H_0$) that willingness to pay is influenced by individual risk perception, such as worry, vulnerability to flooding and severity of consequences. None of these perception indicators appeared to be of statistically significant influence on individual WTP, which we suggest has roots in the general belief among the Dutch population that that government takes necessary measures and guarantees flood safety to all inhabitants of the country. We could also observe low level of risk perception in absolute terms together with a rather high average indicator of trust in government: this again indirectly supports our supposition regarding overall low level of concern about flood danger in the Netherlands.

Finally, we have found weak support for our third hypothesis ($3H_0$) that time and effort involved in taking individual protective activites is complementary to financial contribution for the improvements in flood safety. However, we could not strictly reject it; we have reported a marginal (at 10% level), yet negative association between the height of WTP and individual behavioural intention index. This points in the direction of trade-off that respondetns make between financial contribution to flood safety imporvements and taking indivudual action. This means, that further research into this matter might yield more refined results for example regarding action that is aimed at individual or collective protection measures. However, there is enough evidence at the moment to suggest that government policy attempting at involving individuals in flood safety issues should aim at one thing at a time: either additional financial contribution to improve flood safety or engagement of the public in protective activities.

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APPENDIX.

Construction of scale variables

LIKELIHOOD (11 point scale; 0 = zal zeker niet gebeuren; 10 = zal zeker gebeuren); mean = 4.40

Hoe waarschijnlijk denkt u dat er zich in de komende 50 jaar een overstroming in uw woonomgeving voordoet?

VULNERABILITY (5 items on a 11 point scale, 0 = helemaal niet kwetsbaar; 10 = heel kwetsbaar)
Cronbach's alpha = 0.881; mean = 5.53

Hoe kwetsbaar is volgens u…

…de Nederlandse samenleving als geheel voor een overstroming?

… de Nederlandse samenleving voor grote materiële schade als gevolg van een overstroming?

… de Nederlandse samenleving voor een overstroming met honderden of zelfs duizenden dodelijke slachtoffers?

Hoe kwetsbaar voelt u zich als u er aan denkt dat…

… u en uw gezin materiële schade kunnen lijden als gevolg van een overstroming?

… u en uw gezin slachtoffer, eventueel dodelijk slachtoffer kunnen worden van een overstroming?

SEVERITY (5 items on a 11 point scale, 0 = helemaal niet ernstig / geen schade; 10 = heel ernstig / rampzalige gevolgen; or 0 = geen vertrouwen; 10 = vol vertrouwen) Cronbach's alpha = 0.743; mean = 4.83

Hoe ernstig denkt u dat de gevolgen van een overstroming voor de Nederlandse samenleving als geheel zullen zijn?

Hoe ernstig denkt u dat de gevolgen van een overstroming voor uw woonomgeving zullen zijn?

Hoe ernstig denkt u dat de gevolgen van een overstroming voor u en uw gezin zullen zijn?

In hoeverre vertrouwt u er op dat het wel goed zal gaan met u en uw gezin in het geval van een overstroming? (reverse scale)

In hoeverre vertrouwt u er op dat het wel goed zal gaan met de Nederlandse samenleving als geheel in het geval van een overstroming? (reverse scale)

WORRY (1 item on a 11 point scale, 0 = helemaal niet mee eens; 10 = helemaal mee eens); mean = 2.50

Ik maak me meer zorgen om dood te gaan door een overstroming dan door andere gebeurtenissen.

SUBJECTIVE KNOWLEDGE (3 items on a 11 point scale, 0 = helemaal niet geïnformeerd / niet belangrijk / niet mee eens; 10 = heel goed geïnformeerd / heel erg belangrijk / helemaal mee eens)
Cronbach's alpha = 0.530); mean = 5.66

Hoe goed denkt u dat u geïnformeerd bent over overstromingen en overstromingsgevaar?

In hoeverre vindt u de informatie en kennis over overstromingen die u hebt voor u persoonlijk van belang?

Ik wil heel graag meer te weten komen over het verband tussen het overstromingsgevaar en het nemen van voorzorgsmaatregelen ter bescherming tegen overstromingen.

TRUST IN GOVERNMENT (4 items on a 11 point scale, 0 = helemaal niet mee eens / geen vertrouwen; 10 = helemaal mee eens / vol vertrouwen) Cronbach's alpha = 0.827; mean = 5.94

Ik denk dat de overheid mij informeert als de overstromingsrisico's in mijn woonplaats sterk veranderen.

In hoeverre vertrouwt u de overheid voor wat betreft bescherming tegen overstromingen in Nederland?

Denkt u dat de overheid het altijd goed heeft gedaan wat betreft bescherming tegen overstromingen in Nederland?

In hoeverre vertrouwt u de Nederlandse overheid in het algemeen?

Table 1A. Significant differences in variable means within factors (t-tests).

FACTORS VARIABLES	EXPERIENCE WITH (NEAR) FLOOD (YES / NO)	RURAL / URBAN INHABITANTS	GENDER (MALE / FEMALE)	SAMPLE TOTAL MEAN (STD)
LIKELIHOOD	4.73 / 4.30 (2.148 / 2.154)***	4.27 / 4.41 (1.979 / 2.176)	4.30 / 4.49 (2.157 / 2.159)	**4.40** **(2.159)**
VULNERABILITY	5.76 / 5.47 (1.855 / 1.832)***	5.58 / 5.52 (1.762 / 1.857)	5.50 / 5.56 (1.855 / 1.828)	**5.53** **(1.841)**
SEVERITY	5.04 / 4.77 (1.375 / 1.454)***	5.13 / 4.80 (1.384 / 1.442)***	4.81 / 4.85 (1.409 / 1.470)	**4.83** **(1.441)**
WORRY	2.44 / 2.52 (2.233 / 2.129)	2.82 / 2.47 (1.988 / 2.176)**	2.50 / 2.50 (2.188 / 2.121)	**2.50** **(2.152)**
SUBJECTIVE KNOWLEDGE	5.99 / 5.56 (1.544 / 1.553)***	5.78 / 5.64 (1.662 / 1.552)	5.67 / 5.65 (1.557 / 1.564)	**5.66** **(1.560)**
TRUST IN GOVERNMENT	5.58 / 6.04 (1.780 / 1.637)***	5.69 / 5.97 (1.676 / 1.682)*	5.93 / 5.94 (1.631 / 1.723)	**5.94** **(1.680)**

*, **, *** variable means (standard deviations in parenthesis) - significant differences within factors at 1%, 5% or 10% level.

Table 2A. Perception variable means per region.

	ZUID HOLLAND	ZEELAND	DORDRECHT	LAND VAN HEUSDEN / DE MAASKANT	ENTIRE SAMPLE
LIKELIHOOD	4.25	4.55	5.09	3.80	**4.40**
VULNERABILITY	5.52	5.78	5.76	5.10	**5.53**
SEVERITY	4.80	5.34	4.90	4.27	**4.83**
WORRY	2.34	2.71	2.62	2.24	**2.44**
SUBJECTIVE KNOWLEDGE	5.56	5.91	5.75	5.40	**5.66**
TRUST IN GOVERNMENT	6.01	5.76	5.93	6.07	**5.94**