Valuing the reduction of floods: Public officials’ versus citizens’ preferences

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ABSTRACT

This paper analyses the preferences of public officials and citizens related to the impacts of floods in the Gothenburg region in Sweden. Citizens and public officials in the flood-prone region answered identical choice-experiment surveys characterized by the negative impacts of floods: property damage, traffic disturbances, and water supply security. By having citizens and public officials respond to identical surveys, it was possible to analyse whether and, if so, how priorities and monetary valuation differed in respect of the different negative effects of floods. The overall finding is that public officials’ and citizens’ preferences seem to converge, and that both citizens and public officials are willing to pay to reduce flood-related costs. Public officials have similar priorities to citizens, in that security of drinking water provision was given priority over property damage, while traffic disturbances were ranked lowest. In terms of their respective willingness to pay for avoiding the negative impact of floods, public officials were willing to pay more than citizens to pay for securing the drinking water supply and for restoring damaged property, though these differences were not substantial. There are, however, some differences in preference between citizens and public officials: the latter preferred not to spend anything to reduce traffic disturbances caused by floods, while citizens were willing to do so. These results imply that decisions made within the public sector will not come to differ substantially from citizens’ preferences.

1. Introduction

In the light of climate change, with predicted increases in precipitation and flood risk in many parts of the world – including Sweden (IPCC, 2014), decisions made by governments today will affect the costs associated with floods faced by citizens tomorrow. Since citizens will have to bear the consequences of these decisions, it is reasonable that the decisions reflect citizens’ preferences. The aim of this paper is to analyse the preferences of public officials and citizens with regard to the impacts of floods. The methodology employed is the choice experiment (CE), which enables several aspects of flooding to be researched. By letting citizens and public officials in the flood-prone region of Gothenburg, Sweden, face identical CEs regarding the negative impacts of floods, possible differences in prioritisation of these negative effects can be analysed. In this CE, the negative impacts of floods are attributed to property damage, traffic disturbances and water supply security.

Addressing the issue of flood risk in the Gothenburg region is important in order to limit the future costs caused by floods. Flood risks are expected to increase more than the national average (Swedish Civil Contingencies Agency, 2011), which implies that further investments in flood-risk-reducing measures need to be made. Although such measures have already been taken in the region,
including the regulation of rivers, the Municipality of Gothenburg is now also considering constructing a large-scale movable barrier off the coast of Gothenburg (SWECO, 2015).

When decisions are taken by public officials on investments made with public funds, it is important that such decisions correspond with the preferences of the citizens. If social choice aims at maximising welfare, policymakers should choose policies that generate the maximum net benefits for society as a whole. To distinguish between the welfare offered by different options and reach efficient decisions, a prerequisite is having knowledge about the costs and benefits associated with measures aimed at, for example, reducing the negative impacts of flooding. This measure of benefits (together with the costs) underlies the concept of economic efficiency. The costs are usually known, although with some degree of uncertainty; however, the expected benefits are generally non-monetary and are unknown. By estimating the valuation of the benefits of reducing the negative effects of floods, which is the focus of this paper, it is possible to compare the benefits with their associated costs. The non-priced benefits are defined by individuals’ preferences, and even though the measurement of benefits is operationalized through money, its conceptual basis is utility. Thus, at the very heart of the concept of economic value lies the human well-being that goods and services provide to individuals. Thus, if the aim is to maximise social welfare as defined above, the aggregation of individuals’ preferences for the goods and services in question should be taken into account when officials take decisions.

Furthermore, the notion of the responsiveness in administration in relation to citizens’ preferences is central to most concepts of democracy (Arrow, 1963; Dahl, 1967; Lipshart, 1984; Sen, 1970). Due to the threat of electoral sanction, politicians are generally assumed to respond to public preferences. Flood risk management in Sweden can be described as a less developed and decentralised policy area, meaning that it is not a policy area that has been given that much attention nationally, and it is handled primarily by public servants at the local level (Ek et al., 2016). Although decisions regarding larger investments, i.e. those that go beyond municipal departments’ budgets, are made by the politically elected municipal assemblies (Ch. 6, s. 7, Local Government Act, 1990-900), public officials hold significant influence since they are responsible for gathering the information on which the assemblies base their decisions. Since public servants do not answer to the general public directly, one cannot necessarily assume that the implementation of flood risk-management measures corresponds with citizens’ preferences.

It is important to make a distinction about the role(s) of decision makers. The Swedish flood risk management decision-making process resembles a problem-solving task administered by public officials, with influences from expert recommendations about feasibility/technical judgements, but also from public officials using their own set of preferences in trying to devise the best course of action. Public officials also need information about citizens’ preferences, since public officials’ preferences do not necessarily align with citizens preferences. One tool that can be used to gain information on the citizens’ preferences is Cost-Benefit-Analysis (CBA). In Sweden, however, the use of CBA as a decision-making tool has been limited to date (Rosén et al., 2008). Thus, public officials’ central role in the decision-making process and the limited use of CBAs mean that such officials are likely to have a significant influence on public investments aimed at reducing flood risks. In order for citizen’s preferences to be accounted for in this kind of decision-making process, there needs to be evidence that their preferences align with those of public officials, or otherwise there needs to be a place in the decision making process where citizen’s preferences are explicitly evaluated and considered. It should be noted that consideration of citizen’s preferences does not always mean they will be adopted, as preferences may reflect options that are not feasible.

Previous literature has further found that public officials’ private preferences play an important role in decisions made within the public sector. There is evidence from the field of psychology (Nilsson et al., 2004), as well as political science (Lipsky 1980, Wilson 1989) that decisions made by officials within the public sector are greatly influenced by their private norms. Knowledge regarding the differences between the environmental values held by individuals and experts/public officials in the economics literature is limited. Carlsson et al. (2012), studied how public administrators and the general public prioritised risk reduction in relation to different public safety projects. Other research has focused on the differences in preferences regarding improvements in environmental quality (Carlsson et al., 2011), protection of the forest landscape (Nordén et al., 2015), and urban regeneration (Alberini et al., 2006). To the best of this author’s knowledge, however, there are no similar studies focusing on preferences regarding flooding.

This paper contributes to the literature not only by analysing the potential differences between how citizens and public officials value flood risk management, but also by making a direct comparison of the preferences of the citizens and officials. The direct comparison is achieved by asking both citizens and public officials to answer the CE questionnaire as private individuals, which implies that both groups would be subject to equivalent budget constraints, thus enabling a direct comparison of preferences of the groups. Previous studies such as those by Carlsson et al. (2011), Nordén et al. (2015) and Alberini et al. (2006) have used identical elicitation techniques and questionnaires for the different groups, but administrators/public officials were asked to answer as if they were decision-makers. This implies that the administrators/public officials were not asked to spend their own money and any differences in valuation may at least partly stem from an incentive compatibility issue (see Carson and Groves, 2007), for a more elaborate discussion on incentive compatibility. The only previous paper that, to the author’s knowledge, has used a direct comparison is Rogers (2013), who performs a CE focusing on marine reserves in Australia, where both citizens and scientific experts were asked to answer the questionnaire as private individuals. Rogers’ results show that there are differences in the two groups’ preferences and valuations. Public officials’ preferences have to my knowledge never been compared to the preferences of the public via a direct

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1 The measuring of officials and citizens preferences is not to be confused with the concept of preference orderings, which implies distinguishing between an individual’s ‘public’ and ‘private’ preferences. Understandably, the public nature of the costs associated with floods may trigger the issue of respondents using their public rather than private preferences. Individuals may be choosing according to moral values about what individuals, in their role as citizens, think is right for the society as a whole, rather than how the environmental good affects their personal utility as a consumer. However, as argued by Sagoff (1988), such behaviour may be present in the sample of public officials as well as in the sample of citizens. Analysing preference orderings is, however, beyond the scope of the study reported here.
comparison. This paper contributes to the existing literature by directly comparing private preferences of public officials to the private preferences of citizens, by asking both the general public and public officials to answer the CE questionnaire as private individuals.

The remainder of this paper is organised as follows: Section 2 describes the case study and survey design, including the methodology and econometric model employed; Section 3 provides the model results; and Section 4 discusses the main findings and their policy implications.

2. Choice experiment development and model specification

The CE method is well established for estimating the value of changes in the characteristics of environmental goods and qualities (Hanley et al. 2001, Hoyos 2010). The adoption of the CE method for this research, namely to estimate the benefits of reducing the negative effects of floods, is motivated because it can value hypothetical future scenarios and allow for estimating the marginal value of change in each characteristic included in the CE. By being able to measure the marginal value of change rather than a discrete change in the aggregate environmental good, one is able to estimate the relative importance of reducing the different characteristics of floods. This provides policymakers with valuable information that can be used to help prioritise the various types of action to be taken.

2.1. Case study description and attribute selection

The CE included the following flood impacts that were selected as attributes: (i) property damage, (ii) traffic disturbances and (iii) water supply security. A cost attribute was defined as an annual municipal fee paid by all households for ten years in order to fund measures to reduce the impacts of flooding in the region.

The decision to focus on the valuation of the effects of floods rather than the valuation of a specific policy programme aimed at reducing floods is based on the fact that individuals may choose an alternative not only for its anticipated outcomes in terms of the expected impacts of floods. They may also choose an alternative because of the perceived qualities of the policy programme itself, such as its effectiveness, fairness and sustainability (Glenk and Fischer, 2010). Many policy programmes – including those on flood risk management (e.g. green roofs, wetlands, floating houses) – may be valued also on their aesthetic and biological properties, thus capturing the valuation of something other than the impacts of floods. Thus, it can be difficult to distinguish between the value of and preferences for outcomes in terms of the impacts of floods and the value of and preferences for a policy programme.

The Gothenburg region (here defined by six municipalities, namely Ale, Göteborg, Kungälv, Lilla Edet, Mölndal and Partille) lies in southwestern Sweden and has a population of about 760,000. Common features for the region are a high degree of annual precipitation (900 mm/year), as well as shorter periods with heavy rainfall (Persson et al., 2011). Furthermore, strong westerly winds can raise the water levels along the coast, which can cause damage to the many residential homes and locales for business and leisure along the shoreline and rivers in the region (Källerfeldt et al., 2012). In the last decade alone, the region suffered flooding in 2002, 2006, 2007 and 2011, which caused damage primarily to roads, railways and buildings (Källerfeldt et al., 2012).

According to the Swedish Civil Contingencies Agency (2011), flood risks in the Gothenburg region are expected to surpass the national average, and several cities in the region have been pointed out as significantly vulnerable to fluvial flood risks in the preliminary assessment performed under the European Union (EU) Floods Directive. In terms of climate change, flood risk stands out as one of the most significant issues that can come to affect society as a whole (Källerfeldt et al., 2012). According to a climate change analysis of the region (Persson et al., 2011), the annual precipitation is expected to increase by 10–30%. The frequency of heavy rainfall is also predicted to rise. Discharges into watercourses during winter are anticipated to surge by 50–60%. A rise in sea levels – although partly offset by land elevation – will amount to 65–80 cm along the regional coastline.

In this CE, the change in environmental quality caused by floods is characterised by property damage, traffic disturbances and water supply security. The selection of these attributes is motivated by the significant costs they are expected to imply to society. Källerfeldt et al. (2012), who analysed the societal consequences of climate change in the region, also highlighted that roads, railways, buildings and the drinking water supply were particularly vulnerable to future flood risk.

Impacts on roads and railways include roads becoming flooded or washed away. These impacts, in turn, imply interruptions in traffic and, potentially, traffic accidents. Riverfront properties will also suffer from increased flood risk because of higher water levels, whilst other properties are likely to become flooded more frequently due to excess surface water and overloaded sewerage systems (Källerfeldt et al., 2012).

The drinking water supply is also expected to be affected by increased flooding (Källerfeldt et al., 2012; Swedish Water and Wastewater Association, 2007). The Göta River serves as the primary supply of drinking water for around 700,000 inhabitants of the region. Increased precipitation, heavy rainfall and higher levels of discharge into watercourses imply an additional risk of rivers being polluted, e.g. by run-off from farmlands. Because the drinking water supply consists mainly of surface water, it is particularly vulnerable to microbiological contamination. In 2014, sources of drinking water supply other than the Göta River were used for about 90 days (divided into 75 different occasions), due to microbiological impacts on the water (Water Quality Association of the Göta älv, 2014). These alternative sources of drinking water are finite, and there have already been occasions where such sources have been fully exploited. If nothing is done to resolve the issue, climate change could compromise the security of the drinking water supply – even triggering regional supply shortages (Källerfeldt et al., 2012).

The attributes – Property damage, Traffic disturbances and Water supply security – and their associated levels were established with the help of the above-mentioned public reports, local data, newspaper archives and experts from the municipalities concerned and
The respondents were informed that it was possible to reduce the negative consequences of flood up to their responsibilities. and national governments, and between the public and private sectors; and to what extent they believed these institutions were living they thought the responsibility for taking measures to reduce the risks and consequences of flood was a status quo option. Both respondent groups, i.e. citizens and public officials, were asked to choose, as individuals, which one of the three alternatives they preferred the most.

The cost attribute consists of six levels. The attributes property damage and water supply security consists of three levels, and the attribute traffic disturbances consists of two levels (See Table 1).

The choice of letting the traffic disturbances attribute only have two levels is motivated by the fact that respondents, during testing of the questionnaire, had difficulty making distinctions between more than two levels because of the magnitude of the attribute levels being rather small. Rather than increasing the distance between the attribute levels to unrealistic proportions, the choice was made to reduce the number of attribute levels to two levels. The medium levels of property damage, traffic disturbances and water supply security correspond to the prevailing impacts of floods. Because respondents were asked to value the reduction of future flood risk (20 years from the time of the survey), the medium and lower levels correspond to an improvement (i.e. decreased flood risks), while the higher levels imply the projected future flood risk with no intervention.

Two of the alternatives in each choice set, i.e. A and B, correspond to a future scenario where measures are undertaken to decrease flood risk. These alternatives are associated with an increased annual cost. The third alternative, C, corresponds to a future scenario where no action is taken to decrease flood risk; hence, Alternative C is not associated with any additional cost. This non-cost option implies a higher flood risk than today. Thus, the Status quo alternative in this case represents the future if no additional measures against flood risk are taken, given the expected impact of the changing climate, rather than the presently prevailing situation.

2.3. The questionnaire

A small focus group, consisting of individuals living in the region, was also used in order to evaluate the extent to which the selected attributes and their description were perceived as relevant and meaningful. The focus group and two pre-tests were employed before the questionnaire was finalised in order to enhance the understanding of the survey questionnaire and the choice task.

The focus group, comprising five citizens from the region – three women and two men, all aged between 28 and 38 – were asked to answer questions on how the negative effects of floods were perceived. The first of the two pre-tests, which was conducted on four women and five men from the region who were between the ages of 28 and 59, focused on the clarity of the questionnaire and the choice task. The second pre-test, which was conducted on a group of 30 university students in another part of the country, involved fine-tuning the questionnaire before it was sent out to the respondents. Both pre-tests resulted in small adjustments in the formulation of the questions and the text in the questionnaire.

The final questionnaire consisted of three sections. The first was concentrated around the respondent’s previous experiences, knowledge, and concerns regarding flood risks and the expected impacts of flooding. For example, in this first section, both respondent groups were asked if they had been affected by a flood; if they knew of any measures being taken to reduce flood risks; how they thought the responsibility for taking measures to reduce the risks and consequences of floods should be divided between local and national governments, and between the public and private sectors; and to what extent they believed these institutions were living up to their responsibilities.

The second section of the questionnaire included the CE. Both respondent groups were provided with current information on how flood risks negatively impacted on property, traffic and water provision, and the expected change in the future due to climate change. The respondents were informed that it was possible to reduce the negative consequences of floods by taking various mitigating
measures, but that it would imply costs which could be financed through an annual municipal fee paid by all households in the region (during the coming ten years). Fig. 1 shows an example of an actual choice set used in the study.

The third part of the questionnaire focused on the respondent’s socio-economic and demographic characteristics.

2.4. Data collection

In March 2015, data was collected on both citizens and public officials. The citizens’ data was collected via a web panel containing approximately 90,000 individuals in Sweden. The members of the panel itself are randomly recruited by telephone, while individuals invited to answer the questionnaire were selected according to their geographic location and age. All individuals in the citizens group resided in one of the six municipalities in the Gothenburg region (Ale, Göteborg, Kungälv, Lilla Edet, Mölndal, and Partille), and were over 18 years old. 3,641 respondents were invited to answer the questionnaire. The final citizen sample consisted of 800 individuals, meaning that the response rate was 22%.

The officials’ data was collected by sending out an email with a link to the same web questionnaire as the citizens answered. The group of public officials consisted of employees at the municipalities of Ale, Göteborg, Kungälv, Lilla Edet, Mölndal, and Partille and at the regional authority, the County Administrative Board of Västra Götaland. The group of public officials worked within departments responsible for urban planning, emergency management, water production, environmental management and transport (including maintaining and planning for road networks and public transportation systems). Public officials from these departments were considered a relevant group to target because, in their undertakings to prevent floods in relation to their specific policy area, they influence and shape flood risk management. Of the 421 public officials invited to answer the questionnaire, the final sample group consisted of 102 individuals, which corresponds to a response rate of 24%.

For both respondent groups, therefore, the response rate was slightly above 20%. The average response rate for other surveys using the same web panel is 23%. A response rate of slightly above 20% also seems to be in line with other surveys using web panels in Sweden. Elgan and Leifman (2013) used the same web panel as in this paper to gather information regarding public health and alcohol problems in Sweden and reported a response rate of 35%. Svensson (2010) states that a 20–30% response rate, when using web panel surveys, is common. The response rate reported for the current study, therefore, does not differ significantly from what can be considered a common response rate when using web panels. Nonetheless, although the response rate is in line with what can be
expected from using web panel surveys, the fact that 77% of the panel did not participate could have implications for the representativeness of the sample. For example, the responses of those who answered the questionnaire may differ from those who declined to answer the survey.

2.5. Model specification

In the survey, each choice set involved making a discrete choice among three options: Alternatives A and B corresponded to an improved future scenario, while Alternative C corresponded to a future scenario where no action was taken to mitigate flood risk. Each respondent was assumed to have chosen the alternative that provided him/her with the highest expected utility.

2.5.1. The Random Parameter Logit Model

The Random Parameter Logit (RPL) Model can model choice as a function of the attributes of the alternatives, together with the respondents’ characteristics. The RPL Model is seen as a more flexible version of the Multinomial Logit (MNL) Model, as it allows unobserved factors to be random and follow any distribution. A general description of the RPL Model is provided below (for an in-depth description, see Train, 2009, and Hensher and Greene, 2003).

An individual \( n \) (\( n = 1, \ldots, N \)) faces \( t \) (\( t = 1, \ldots, T \)) number of choice situations. In each choice situation \( t \) the individual faces a choice among \( j \) (\( j = 1, \ldots, J \)) alternatives. Thus, the utility of individual \( n \) from choosing alternative \( j \) in choice situation \( t \) is specified as

\[
U_{nt} = \beta_{n}^{\prime}x_{nt} + \epsilon_{nt}
\]

where \( x_{nt} \) is a vector of observed variables that capture the attributes of the alternative \( j \) in choice situation \( t \), faced by individual \( n \).

\[
\beta_{n} = \beta + \Delta z_{n} + \Gamma_{n}
\]

Vector \( \beta_{n} \) represents the individual’s taste; \( z_{n} \) represents observed heterogeneity, i.e. characteristics of individual \( n \) that influence the mean of the taste parameter, and \( v_{n} \) captures unobserved heterogeneity, and is a vector of random variables with zero means and known variance. The matrix of the non-zero elements of the lower triangular Cholesky matrix is represented by \( \Gamma \). The individual is then assumed to choose alternative \( i \), given that each alternative corresponds to a specific utility level, if and only if \( U_{ni} > U_{nj} \) \( \forall j \neq i \), i.e. choosing the alternative which provides him/her with the highest expected utility. In the RPL Model, unlike the Standard Logit Model, two types of variation in preferences are accounted for: the variation associated with individual specific characteristics (e.g. income), and a random unobservable preference heterogeneity captured by the standard deviation (\( \theta \)) of the distribution \( f (\beta) \) of the \( \beta \)‘s in the population. If the standard deviation is statistically significant, the coefficient varies across individuals. In the MNL Model, preferences are able to vary according to individual specific characteristics but are otherwise assumed to be homogenous across individuals.

Because \( \beta_{n} \) is unknown and follows a random distribution, the simulated choice probability is defined as the integral of \( L_{in}(\beta_{n}) \):

\[
P_{in} = \int L_{in} \left( \frac{R}{1} \prod_{j=1}^{T} \prod_{j=1}^{J} \left( \frac{e^{\beta_{n}^{\prime}x_{ijn} + \epsilon_{ijn}}}{\sum_{j=1}^{J} e^{\beta_{n}^{\prime}x_{ijn} + \epsilon_{ijn}}} \right) \right) f (\beta|\theta) d\beta
\]

where \( P_{in} \) is the simulated choice RPL probability evaluated at different values of \( \beta \). Given a specified distributional form of \( f (\beta) \) (such as normal, lognormal or triangular), the parameters \( \theta \) of the distribution \( f (\beta) \) can be estimated via a simulated maximum-likelihood estimation. We are, therefore, able to estimate the mean and standard deviation of the distribution of the populations’ taste for the attributes of the alternatives. Given \( R \) draws, one obtains simulated choice probabilities by averaging the logit expression over these draws. In this study Halton draws is used, as previous literature (see e.g. Bhat, 2001; Train, 2009) has found simulation variance to be lower when using Halton draws instead of random standard draws, thus making Halton draws more efficient. Furthermore, since each respondent faces \( t \) (\( t = 1, \ldots, T \)) number of choice situations, in which individual faces a choice among \( j \) (\( j = 1, \ldots, J \)) alternatives, the simulated choice probabilities are obtained by taking the products of the logit expressions over the \( T \) number of choice situations and \( J \) alternatives.

3. Results

3.1. Descriptive statistics

With regard to socio-economic and demographic representation, Table 2 below compares the two groups in the sample with each other as well as with the regional average in respect of a selection of descriptive statistics.

Regarding the representativeness of the citizen sample, the descriptive statistics show that, in comparison with the regional average reported by Statistics Sweden (2015), the gender and age distributions are similar. In respect of education, both sample groups are more educated, on average, in comparison with the regional population. Similar differences with respect to education have been found in previous Swedish studies (Ek and Persson, 2014; Ek and Söderholm, 2008). Although the income levels of the two sample groups and the regional population are not entirely comparable (as the sample groups’ household income is given as a span rather than a specific number), the households in the citizen sample seem to have somewhat higher incomes than the regional population average. Since a higher household income lessens economic constraints, these differences between the samples and the
regional population average may imply that the results are not entirely representative. These differences need to be borne in mind when interpreting the results.

When comparing the sample of public officials with the sample of citizens, public officials were more likely to have a university degree, they were younger, and they had higher income levels. There were also more women than in the citizen sample group. These differences are statistically significant, see Appendix, Table A1.

Table 3
Sample-specific statistics.

| Variable | Citizens | Public officials | Test statistics of equal means |
|----------|----------|------------------|-------------------------------|
|          | Mean (%) Std dev. | Mean (%) Std dev. | Min. | Max. | z      | Prob. | |z| > Z* |
| Affected by low water supply security | 16 0.36 | 11 0.30 | 0 1 | −5.86 | 0.0000 |
| Affected by traffic disturbances | 73 0.44 | 81 0.39 | 0 1 | 7.84 | 0.0000 |
| Affected by property damage | 22 0.41 | 22 0.32 | 0 1 | 0.11 | 0.9151 |
| Knowledge | 19 0.39 | 76 0.42 | 0 1 | −18.95 | 0.0000 |

Statistics Sweden (2015).

Table 4
Descriptive statistics: Concern regarding environmental and societal risks.

| Options       | Not worrying at all | Not particularly worrying | Neither nor | Quite worrying | Very worrying | Don't know |
|---------------|---------------------|----------------------------|-------------|---------------|---------------|------------|
| Climate change | 4|2 | 12|8 | 24|12 | 4|35 | 19|41 | 1|1 |
| Flooding      | 4|2 | 24|15 | 33|29 | 34|43 | 4|8 | 0|1 |

The numbers represent the percentages of citizens or officials, for each of the given answering options.

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Table 3 gives an overview of selected answers to questions relating to the respondents’ experiences and knowledge regarding floods. Both respondent groups were asked if they had been affected by the negative impacts of floods in relation to property damage, traffic disturbances and water supply security. 22% of both sample groups had been affected by property damage caused by flooding; a relatively large proportion – 73% of the citizen group, and 81% of the public official group – had been negatively affected by flood impacts in respect of traffic disturbances; while 16% of the citizen sample and 11% of the public official sample had been affected by interruptions in water provision caused by flooding. According to the result of the test of equal means between the two sample groups, the mean of the groups differ for all the descriptive variables, except for the variable Affected by property damage.

The respondents were also asked whether they perceived themselves as having more knowledge about flood-related issues than people have in general. Some 76% of public officials affirmed this was the case, whilst only 19% of the citizen sample considered themselves as being more knowledgeable about flooding than the average person.

The respondents were further asked how worrying they found the impacts of climate change and the risk of flooding. The results displayed in Table 4 show that both respondent groups were more worried about the impacts of climate change in general than about flooding in particular. Public officials were also more worried about the consequences of climate change and floods than citizens were.

Other questions posed to the respondents were which actors they perceived as bearing the main responsibility for reducing the negative effects of floods. The responses, as presented in Table 5, show that both sample groups considered the municipality to bear the largest overall responsibility, followed by state (regional and national government) actors and lastly citizens.

The trust in the capacity of the public authorities to live up to their responsibility was, however, overall relatively low amongst citizens. The public officials in the study, on the other hand, showed more trust that municipalities were doing a good job with respect to reducing flooding. The opposite was true for the public officials group when it came to their reported level of trust in individuals: only 1% of public officials believed that individuals assumed the required responsibility to reduce the negative impacts of floods.
The RPL Model, which allows accounting for heterogeneity in taste, was used. Two separate estimations were estimated, one for each respondent group. The flood descriptive attributes – Property damage, Traffic disturbances, Water supply security and the Status quo – are random parameters that are assumed to follow a normal distribution. It is assumed that the Cost parameter is fixed. A fixed cost parameter implies that the gain in marginal utility and marginal income is equally valued across all individuals. In order to test the model, other distributional assumptions, including the uniform and triangular distribution were also tested for. The results show that the likelihood values for the different specifications are not statistically different from each other at the 5% level, implying that there is no difference between the various specifications. Thus, the normal distribution was chosen. Table 6 reports the results of the RPL Model. These results were estimated via the statistical software program NLOGIT 5, using 2000 Halton draws.

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2 Other specifications were examined before choosing to estimate the two respondent groups separately using the RPL model. The possibility of combining the datasets were explored by the test procedure suggested in Louviere et al. (2000), which tests the hypothesis that the model parameters are equal in the two respondent groups, while controlling for scale differences. The test indicated that the model parameters are homogenous and a combined model is therefore possible. In order to account for potential scale heterogeneity, the GMXL Model was run using a combined data set including both respondent groups; public officials and citizens. The results from estimating the GMXL Model show that the coefficient of the unobserved scale heterogeneity is not statistically significant, i.e. no evidence of heterogeneity in scale was found. A latent class model was also run, however broke down even with few classes, suggesting that using the model may be inappropriate for the data set. Details of these models and tests can be obtained from the author upon request. Although combining the data samples are possible, estimating the two respondent groups separately were considered more informative and illustrative, given that the objective of this paper is to examine possible differences in prioritisation of the negative effects of floods by the two groups.
All respondents were given eight choice sets, each of which consisted of three alternatives. Each respondent answered all choice sets; thus, there are no missing observations. In the citizen sample, there were 809 respondents, who generated 6472 observations. For the group of public officials the final number of respondents was 102; thus, the sample constituted 816 observations. In the citizen sample, the Status quo alternative was chosen in 11% of the choice sets; in the public official sample, the Status quo alternative was chosen in 7% of these sets.

The cost attribute Fee and the attributes Water supply security and Property damage are statistically significant for both groups. The coefficients all have negative signs, which is to be expected. Decreasing the water supply security, i.e. increasing the number of days for which the Göta River cannot be used to produce drinking water, should have a negative impact on the respondents’ utility and the probability of choosing an alternative. In addition, increasing the number of houses that suffer flood damage should also have a negative effect on the individual’s probability of choosing an alternative. Results for the Status quo option, which corresponds to doing nothing to reduce the negative effects of floods, are also statistically significant and negative, for both citizens and public officials, which implies a negative status quo bias. This entails that respondents in both groups refrain from choosing the Status quo.

With regard to the Traffic disturbances attribute, increasing the number of days on which floods cause traffic disturbances has a statistically significant negative effect on the probability of citizens choosing a specific alternative. However, no such relationship is found for the sample of public officials.

The estimated standard deviations of the random parameters of the RPL Model are statistically significant at the 1% level, except for traffic disturbances in public officials’ sample. Thus, heterogeneity among the respondents is found in both sample groups.

The results of the RPL Model suggest that citizens and public officials do not differ substantially in their preferences if one looks at the signs and statistical significance of the estimated parameters. The only attribute for which the results of the two respondent groups differ significantly is Traffic disturbances.

Although the results presented in Table 6 are informative in terms of differences in statistical significance, signs and heterogeneity, they do not offer the opportunity to compare the relative importance of the various attributes and their respective levels. In order not only to make such relative comparisons, but also to be able to say something about the monetary valuation of reducing the negative effects of floods, the respondents’ marginal willingness-to-pay (WTP) for alleviating the negative impacts of floods has been calculated and analysed. These results are displayed in Table 7.

The values evident in Table 7 may seem quite low at first glance, but this is due to the unit of measurement used. Thus, for Property damage, the interpretation of the marginal WTP is the value of reducing, by one house, the number of houses with property damage caused by floods, while the marginal WTP for Traffic disturbances relates to the value of reducing, by one day, the number of days with traffic disturbances caused by floods. The marginal WTP for Drinking water provision insecurity is interpreted as the value of decreasing, by one day, the number of days for which the Göta River cannot be used to produce drinking water.

The WTP estimates show that, overall, both citizens and public officials are willing to pay to reduce the negative effects of floods; however, some differences also exist between citizens and public officials in respect of the valuation of the various attributes. For the citizen sample, the WTP for all three attributes is statistically significant at the 1% level: the WTP ranges from €0.3 for Property damage to €1.4 for Traffic disturbances. The sample of public officials, however, was only prepared to pay to reduce flood-related negative effects associated with water supply security and property damage. Both WTPs for Property damage and Water supply security are statistically significant at the 1% level. Apart from Traffic disturbances, therefore, the valuations by citizens and public officials seem rather similar, with both public officials and citizens willing to pay €0.8, for increasing the water supply security. For property damage, citizens were willing to pay €0.3 and officials €0.4.

For citizens, the WTP estimate for reducing traffic disturbances is considerably higher than for improving water supply security and property damage. The differences between the attributes may first appear as large, but it is important to remember that the endpoints – i.e. the levels used in the status quo and the change in the respective attribute levels for the different scenarios vary considerably for the attributes. In order to relate the marginal WTP from Table 7 to the scenario attribute levels used in the experiment, Table 8 gives the marginal WTP for each attribute, from their respective end-points. The marginal WTPs shown in Table 8 has been calculated by running the RPL models again using dummy coded variables for the attribute levels, and thereby calculating the marginal WTP of each attribute level. All variables except the cost attribute was normally distributed. See Appendix 1; Table B1 for the statistical models.

The WTP for reducing traffic disturbances refers to reducing, from eight to two, the number of days a year with flooded, eroded or washed-away roads and railways. The corresponding change regarding water supply security corresponds to reducing, from 200 to 100 and from 200 to 50, the number of days a year that the water from the Göta river cannot be used for producing drinking water from 200 days to 100 days, and from 200 days to 50 days, a year respectively. For the attribute property damage the change refers to

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**Table 7**

| Marginal willingness-to-pay | Citizens | Public officials |
|-----------------------------|---------|-----------------|
| Variable                    | Coefficient | Standard error | Coefficient | Standard error |
| Property damage in SEK(Euros)/(property) | 3 (0.3)** | 0.275 | 4 (0.4)** | 0.543 |
| Traffic disturbances in SEK(Euros)/day | 14 (1.4)** | 2.187 | 1 (0.1) | 3.850 |
| Drinking water provision insecurity in SEK(Euros)/day | 8 (0.8)** | 0.366 | 8 (0.8)** | 0.892 |

***, **, * indicate significance level at 1%, 5%, and 10%
reducing the number of damaged properties from 100 to 40 properties, and from 100 to 10 properties, a year.

The scenario-related WTPs from the RPL Model show that, compared with taking no action to reduce future flood risk, i.e. maintaining the status quo, Water supply security has the greatest impact on both the citizens’ and public officials’ utility, with a WTP of €109 for citizens and €107 for public officials in respect of a highly secure provision of drinking water. For a medium water-provision security scenario, citizens are willing to pay €71, and public officials €69, in comparison with taking no action and maintaining the status quo.

The scenario-related WTPs for Property damage are smaller than those for Water supply security. For the scenario where property damage is low, citizens are willing to pay €30 and public officials €31; for property damage on a medium scale, the WTPs are €31 for citizens and €33 for public officials, respectively.

Finally, although citizens awarded Traffic disturbances the lowest priority, this attribute had a scenario-related WTP of €8. Apparent in Table 8 is that public officials, on the other hand, did not have a statistically significant WTP.

The WTP estimates of Table 7 and the scenario-related WTPs from Table 8 suggest that both citizens and public officials are willing to pay to reduce flood-related costs. With regard to reducing water supply security and property damage, public officials’ and citizens’ WTPs do not differ extensively. Traffic disturbance is the only attribute where the two sample groups’ preferences differed substantially.

From the scenario-related WTPs in Table 8, it is visible that citizens’ prioritisations were the same as those adopted by public officials, with top priority being given to reducing water supply security before addressing property damage, followed by dealing with traffic disturbances. As described above, the WTP estimates and the scenario-related WTPs clearly have different units of measure. Nonetheless, in relation to the WTP estimates, the scenario-related WTPs give a more realistic view of change. If policymakers are to make new investments, it is unlikely that they would spend money making small incremental changes such as reducing the number of houses, with property damage caused by floods, by one house. Thus, from a policy perspective, the interpretation from the scenario-related WTPs is more informative. This result suggests that citizens and public officials make similar prioritisations regarding the negative effects of floods.

As stated above, most citizens (89%) and public officials (93%) seem to choose an option that implies reducing the negative effects of floods. Although the individuals choosing the status quo compose a smaller portion of both samples, it is still interesting to further investigate citizens’ and officials’ probability of choosing the Status quo alternative. If it is possible to identify variables that can explain why individuals do not want to reduce the negative effects of floods, this information could be used to gain further public support for new investments aimed at reducing flood-related damage. In addition, although public officials and citizens seem to have quite similar preferences, there are still some smaller differences in magnitude and statistical significance. Potentially, variables explaining the probability of choosing the status quo could be indicators of variables that could make citizens and public officials’ preferences converge or diverge. In order to investigate the probability that citizens and public officials would choose the status quo, several explanatory variables were interacted with the Status quo alternative (i.e. the alternative specific constant); the RPL Model, with the attributes coded as continuous, was once again run with two separate models, one for each respondent group. The results in Table 9 notably reveal that the coefficients for Water supply security, Property damage, Traffic disturbances and Cost, after the inclusion of more explanatory variables, still display the same signs and statistical significance. The preferences over the attribute levels seem to be stable across specifications.

For the citizen sample, gender influences the respondents’ probability of choosing the status quo: women were less likely than men to choose the alternative of not contributing towards reducing the negative effects of floods. This result is in line with findings from previous studies (Cameron, 2005; Devkota et al., 2014). No such effect is found in the sample of public officials.

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3 The marginal WTP estimates assume a constant marginal utility.

4 Notably, in the process of finding the final model, several explanatory variables were interacted with the Status quo variable. For citizens as well as public officials, neither a university degree nor knowledge of floods had any explanatory power. The effect of the respondents’ income, which was also tested, was not statistically significant for either sample group’s probability of choosing the status quo; testing for the effect of age produced similar results. Earlier studies, such as those by Agren et al. (2006) and Johansson-Stenman (2008), have found that these more socio demographic and knowledge-related variables provide explanations for discrepancies between the decisions taken by officials and the preferences of the general public. This study can conclude that neither of these categories of variables were found to have any statistically significant effect on either citizens’ or officials’ probability of choosing the status quo of doing nothing to reduce the negative effects of floods.
Table 9
Estimated Random Parameter Logit Model including explanatory variables (standard errors in parentheses).

| RPL        | Citizens       | Standard deviation | Officials      | Standard deviation |
|------------|----------------|--------------------|---------------|--------------------|
| Variable   | Coefficient    |                    | Coefficient    |                    |
| Water provision security | $-0.176 (0.001)^{***}$ | 0.019^{***}        | $-0.035 (0.006)^{***}$ | 0.024^{***}        |
| Property damage | $-0.004 (0.001)^{***}$ | 0.012^{***}        | $-0.013 (0.005)^{***}$ | 0.012^{***}        |
| Traffic disturbances | $-0.033 (0.007)^{***}$ | 0.096^{***}        | $-0.003 (0.020)$ | 0.046              |
| Fee        | 0.002 (0.000)^{***} | 0.004^{***}        | $-0.004 (0.001)^{***}$ | 0.003^{***}        |
| Status quo (stq) | $-0.154 (0.467)$ | Fixed              | $-3.602 (2.849)$ | Fixed              |
| Woman (stq) | $-0.595 (0.166)^{***}$ | Fixed              | 0.019 (0.697) | Fixed              |
| Climate change (stq) | $-0.361 (0.074)^{***}$ | Fixed              | $-0.71532 (0.294)^{**}$ | Fixed             |
| Trust in state (stq) | $-0.548 (0.132)^{***}$ | Fixed              | $-0.131 (0.353)$ | Fixed              |
| Trust in municipality (stq) | 0.084 (0.128) | Fixed              | 0.741 (0.490) | Fixed              |
| Trust in citizens’ (stq) | 0.248 (0.100)^{**} | Fixed              | 0.514 (0.527) | Fixed              |
| Affected by water provision | 0.248 (0.133) | Fixed              | 0.088 (0.824) | Fixed              |
| Affected by property damage | $-0.028 (0.143)$ | Fixed              | 1.069 (0.662) | Fixed              |
| Affected by traffic disturbances | 0.119 (0.119) | Fixed              | $-0.429 (0.515)$ | Fixed             |
| Log likelihood value | $-4774.309$ |                     | $-421.535$ |                   |
| Mc Fadden $R^2$ | 0.329 |                     | 0.436 |                   |

^{***, **, *} indicate significance level at 1% 5% and 10%.

The only explanatory variable that has a similar impact on both groups is climate change: concerns about climate change reduces the probability of choosing the Status quo alternative in both samples. Moreover, if one includes individual differences in perceptions about climate change as an explanatory variable in the model, the Status quo variable becomes statistically insignificant. Thus, it seems that climate change concerns are an important driver for the negative status quo bias. These results are consistent with previous findings (Botzen and Van den Bergh, 2012a,b).

Citizens’ probability of choosing the Status quo alternative is further statistically reduced if they have trust in the state. In other words, citizens are more likely to choose a costly option – which implies doing something to reduce the social costs of floods – if they are confident that state actors (government, national authorities) live up to their responsibility to prevent the negative effects of floods in respect of property damage, traffic disturbances and water supply security. For the sample of public officials in the current study, no such statistically significant relationship between trust in government institutions and the probability of choosing the status quo was found.

Both sample groups were also asked about the extent to which they trusted that citizens would fulfill their responsibility to prevent the negative effects of floods with regard to property damage, traffic disturbances and water supply security. For the citizen sample, trusting the individual to live up to his/her responsibility increases the probability that citizens would choose the Status quo alternative. This result is statistically significant at the 5% level. This outcome seems reasonable: if citizens trust that private individuals live up to their responsibility to reduce the negative effects of floods, less needs to be done in this regard by public institutions. For the sample of public officials, no statistically significant relationship was found between trust in the individual and the probability of choosing the Status quo alternative.

Finally, the three variables concerning the citizens’ and public officials’ previous experience of the relevant flood-related events – namely property damage, traffic disturbances and water supply security – were included in the RPL Model. It was hypothesised that respondents’ willingness to accept higher costs to reduce the negative impacts of floods would be influenced if they had been affected by such impacts. For the sample of public officials, the results show no such statistically significant relationship. For the citizen sample, however, individuals that had experienced low water quality and drinking water shortages were more likely to choose the status quo than those who had not. This result seems somewhat surprising at first, given that experiencing a shortage in drinking water is expected to have a negative effect on an individual’s well-being. However, it is possible that an individual’s actual experience of an interrupted drinking water supply was regarded as being less of a problem than an imagined interruption. The coefficient is only statistically significant at the 10% level.

4. Conclusion

This paper has analysed the preferences of public officials and citizens regarding the negative impacts of floods. Citizens and public officials in the flood-prone Gothenburg region answered identical CE surveys characterised by the following negative impacts of floods, namely property damage, traffic disturbances and water supply security. By having citizens and public officials respond to identical surveys, differences in prioritisation amongst the negative effects of floods and their monetary valuation were analysed.

In general, the estimated marginal WTP suggests that floods have a negative impact on the utility of both groups: both citizens and public officials were willing to pay to reduce such impacts. This implies that both public officials and citizens would benefit from further investments in flood-risk-reducing measures being made in order to limit the future costs caused by floods in the Gothenburg region.

Furthermore, public officials generally seemed to make similar prioritisations to those that citizens did, with water supply security being considered a more important matter to address than property damage, which was in turn considered more important that traffic...
disturbances. Further, public officials’ and citizens’ WTP for increasing the water supply security and decreasing property damage did not differ extensively. Given public officials’ central role in the decision-making process regarding flood risk management, and despite the rather limited use of CBA, decisions made within the public sector will not come to differ substantially from citizens’ preferences.

There are, however, some differences in the preferences expressed by citizens and public officials. For example, public officials were not willing to spend anything on reducing traffic disturbances caused by floods, whilst citizens were prepared to do so. The result regarding the public officials’ preferences in respect of flood-related traffic disturbances is somewhat surprising: given that most public officials’ report that they commute daily and have personally been affected by flood-related traffic disturbances, these officials were anticipated to be more willing to accept a higher fee to reduce such disturbances. On the other hand, public officials’ frequent commuting and their actual experience with flood-related traffic disturbances may have desensitised them to such disruptions. In addition, since Gothenburg is the second largest city in Sweden, traffic disturbances are not uncommon – whether or not they are caused by floods. Given that the scale for the number of days with flood-related traffic disturbances is quite small, i.e. it ranges between two and eight days, to a respondent that commutes daily this may seem like less of a problem than having to deal with disturbances caused by congestion and car accidents, for example. In the case of traffic disturbances, public officials who take only their own and not citizens’ preferences into account when making investment decisions will cause such investments to be socially suboptimal.

Decisions made by officials within the public sector have been largely influenced by their private norms (Nilsson et al., 2004; Wilson, 1989). Public officials in this study were therefore asked to answer the questionnaire as private individuals rather than as decision-makers. Thus, unlike the earlier studies, public officials’ private preferences were compared with citizens’ preferences. The overall finding in the current study, i.e. that public officials’ and citizens’ preferences were quite similar, differs to some extent from findings in previous studies. Although several other studies seemed to find at least some similarities between citizens’ and public officials’ preferences, the differences between them were more noticeable (Ägren et al., 2006; Carlsson et al., 2011, 2012; Terwel and Ter Mors, 2015). The difference in results between the current study and others could at least partly be explained by the point of view public officials were asked to hold when answering the questionnaire. This implies that, given that public officials in the current study used their private preferences when making public decisions, the differences between public decisions and private preferences are potentially smaller than indicated by earlier research.

Rogers (2013), which is the only study to the author’s knowledge, who also used a direct comparison, did in contrast to this study, find differences in the two studied groups’ preferences and valuations. Rogers (2013) did however study scientific experts’ preferences in comparison to citizens’ preferences, instead of public officials. Scientific experts having more knowledge and awareness about the issue at hand was given as the explanation for the divergence found between the groups. Although there are also differences found between public officials and citizens in terms of education, and perceived knowledge of floods, the level of difference in education and awareness is most likely larger between scientific experts and citizens, than between public officials and citizens. Thus, the contrasting findings in this study, compared to Rogers (2013), could potentially be attributed to the knowledge- and awareness gap between scientific experts and citizens being larger than the gap between public officials and citizens.

The current study also found a statistically significant relationship between trust in government institutions and citizens’ WTP to reduce the negative effects of flood events. According to Pharr et al. (2000), perceived trust may influence individuals’ perceptions about the effectiveness of different measures targeted towards reducing the negative effects of floods, for example. Thus, individuals may place high values on reducing the negative impacts of floods, but their willingness to contribute towards paying for such measures may be limited as a result of lack of trust in government institutions’ ability to actually produce such reductions. Other studies also have shown, trust in government institutions is important for legitimising the decisions made by these bodies (Levi, 1997; Scholz and Lubell, 1998) and, by extension, for raising the financial resources such bodies need to achieve their societal goals (Gamson, 1968). The importance of legitimacy for policy implementation is also visible in research by Chen and Hua (2015), Oh and Hong (2012) and Kountouris et al. (2015), whose findings suggest that public projects can be hindered by a lack of trust in the government. The current study’s findings also show that trust in the state seems to be one of two principal variables (the other being climate change concerns) when it comes to individuals’ willingness to contribute towards alleviating the negative impacts of floods. The citizen sample’s level of trust is rather low (averaging at around 20%) when it comes to believing that government institutions live up to their responsibility to handle the negative effects of floods. Given this rather low level of trust it seems important for public officials to gain further legitimacy of their decisions relating to flood risk-management policies, but also their ability to raise financial resources to implement measures to reduce the negative effects of floods.

The results further suggest that respondents – whether public officials or citizens – who reported being concerned about climate change were less likely to choose the Status quo alternative, instead opting for an alternative that implied reducing the negative impacts of floods. These results are consistent with previous findings (Botzen and Van den Bergh, 2012a,b; Veronesi et al. 2014). About 60% of the citizen sample and 80% of the public official respondents reported that they were concerned about climate change. The 20% difference could potentially be a result of a knowledge gap between public officials and citizens. Almost 80% of public officials surveyed – compared with only 19% of citizens – perceived themselves as having more knowledge about flood-related issues than people in general. Also, although the Gothenburg region is already currently exposed to flood risk, only 26% of all citizen sample respondents had been given information on regional flood risk, and only 19% of the respondents had prior knowledge about flood-mitigating measures proposed or implemented in the region. There is great scope, therefore, for public officials to gain further support for flood risk-management policies by increasing citizens’ knowledge of the negative effects of floods in the region.
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Appendix A.

Table A1
Test statistics of equal means for the two groups.

| Variable                                  | z    | Prob. |z| > Z* |
|-------------------------------------------|------|-------|------|
| Female                                    | 8.71 | 0.0000|      |
| University education                      | 29.73| 0.0000|      |
| Age                                       | -16.23| 0.0000|      |
| Monthly income per household              | 37.37| 0.0000|      |

A t-test of equal means is used to determine if the means of the two sample populations, public officials and citizens, are equal. The null hypothesis of equal means is rejected if the critical value of the standard normal distribution is smaller than the test statistic. The test follows the procedure described by Greene (2008) in the LIMDEP NLOGIT Forum, i.e. “T-Test for comparing means of two groups”. The test was performed in LIMDEP by combining the two sample groups and creating a dummy variable for the public official sample. The t-test was performed by regressing the variable in question (e.g. monthly income) on a constant and a dummy variable. The reported t-statistic for the dummy variable constitutes the test statistic for the hypothesis of equal means for the two sample groups. The results of these tests, as presented in Table 3, show that the null hypothesis of equal means for the two samples could be rejected for the various socio-demographic variables.

Table B1
Estimated Random Parameter Logit Model with dummy coded attribute levels (standard errors in parentheses).

| RPL   | Citizens                      | Officials                     |
|-------|-------------------------------|-------------------------------|
|       | Coefficient | St.deviation | Coefficient | St.deviation |
| Traffic disturbances – Low (8 → 2 days/year) | 0.185(0.042)*** | 0.009 | -0.003(0.020) | 0.046 |
| Water supply security – High (200 → 50 days/year) | 2.439(0.164)*** | 1.462** | -0.004(0.001)*** | 0.003*** |
| Water supply security – Medium (200 → 100 days/year) | 1.584(0.123)*** | 0.006 | -3.602(2.849) Fixed |
| Property damage – Low (100 → 10 properties/year) | 0.704(0.106)*** | 0.502** | 0.019(0.697) Fixed |
| Property damage – Medium (100 → 40 properties/year) | 0.684(0.137)*** | 0.001 | -0.7153(0.294)*** | Fixed |
| Status quo                                  | -3.102(0.272)*** | 3.677*** | -0.131(0.351) Fixed |
| Fee                                         | -0.002(0.000)*** | Fixed | 0.741(0.490) Fixed |
| Log likelihood value                        | -4852.006          | Fixed | 421.535          |
| Mc Fadden R²                                 | 0.318             | Fixed | 0.436             |

***, **, * indicate significance level at 1% 5% and 10%.

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