# Valuation of coastal erosion policy in Vietnam: Scope insensitivity assessment

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**Abstract**

Insensitiveness of respondents to the scope of goods to be valued has been a subject of strong concern in the environmental economic literature based on stated preference. Different types of scope tests have been proposed to assess whether elicited values are sensitive to changes in quantity or quality of environmental goods, but empirical applications still report mixed evidence. Here we propose to test the presence of a scope effect using a choice experiment approach in the context of coastal erosion management in Vietnam. We use a split-sample design to assess how respondents value different segments of a beach presenting different characteristics. We investigate if households' preferences for the same coastal erosion management policy vary across beach segments which differ in particular in terms of size and speed of erosion. Our choice experiment has been conducted in the city of Hội An located along the coastline in the central part of Vietnam. Hội An has been listed as a UNESCO World Heritage site since 1999 and its main beach (Cua Dai beach) is considered as one of the most beautiful beaches in Vietnam. In recent years, erosion has occurred severely on Cua Dai Beach to an extent that sandy beach is no longer presented in some areas and shore adjacent buildings are threatened. Preliminary results suggest that respondent's preferences for coastal erosion management policy differ across beach segment. However, their preferences are sensitive with length of beach, but indifferent with speed of erosion. This result may be interpreted has some form of sensitiveness of respondents to the scope in the context of coastal erosion in a developing country.

Keywords: Coastal Erosion, Scope Insensitivity, Discrete choice experiment, Vietnam, Stated preferences

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# 1 Introduction

Validity and reliability tests for stated preference methods in estimating willingness-to-pay (WTP) are controversial issues in the literature on stated choices (Hausman, 2012). Scope insensitivity test, which causes debates about its usefulness, is considered as one of essential concerns regarding the validity and reliability when eliciting preferences using stated choices (Rolfe and Windle, 2010). NOAA panel on Contingent Valuation Method (CVM) emphasized testing for scope effect as an important and standard validity test for CVM approach (Arrow et al., 1993). Scope insensitivity was firstly recognized in CVM studies by Kahneman (1986), and Kahneman and Knetsch (1992). These papers pointed out empirical evidence that in non-market valuation, the size or amount of the valued good do not have an effect on respondents' choice behavior. Several studies also confirmed scope insensitivity in different setups (see, among others, Diamond et al., 1993, and Desvousges et al., 1993). But other studies detected a scope effect and indicated an increase of WTP to a bigger scope of goods (Carson and Mitchell, 1993a, Smith and Osborne, 1996, Carson, 1997, and Bandara and Tisdell, 2005).

Environmental valuation literature of scope test has generated a hot controversial in the context of contingent valuation (Mikolaj Czajkowski, 2009). In choice experiment technique, one advantage is that scope effect can directly measured and scope of valued good can be estimated on multiple dimension with different level of attributes (Hanley, Wright, and Adamowicz, 1998). Scope test is thus relating to testing the significant of these parameters (Hanley et al., 2003).

There is a conflict of scope insensitivity and economic theory which specifies that WTP is increasing with a more quantity or quality of a good (Diamond and Hausman, 1994). There are several reasons for scope insensitivity. Insensitivity of scope might be related to "preference satiation", in which marginal utility for valued good is diminishing (Rollins and Lyke, 1998). Poorly definition of goods and the changes in provision are also a sources that lead respondents miscomprehend about the increase on quantity or quality of value goods are also a source for scope indifference (Ariely et al., 2003, Michell Carson, 1989). Several studies pointed out relation of invariant to scope and "warm glow effect", which is the fact that people are "purchasing moral satisfaction" rather than paying for actual valued goods (Kahneman and Knetsch, 1992, Nunes and Schokkaert, 2003). This effect implies that an increase in WTP might not directly be derived from changes in quantity or quality of valued goods, but might be considered as a reflection of motivation for having this public goods (Johansson-Stenman 1998).

Previous studies on economic valuation of a coastal erosion management pointed out a strong preference of respondents towards coastline development of having a wide sandy beach by beach nourishment instead of visible structures (Landry, Keeler, and Kriesel, 2003; Huang, Poor, and Zhao, 2007; Matthews, Scarpa, and Marsh, 2017; De Salvo, Signorello, Cucuzza, Begalli, and Agnoli, 2018), but found out a scope insensitivity of beach restoration length (Matthews, Scarpa, and Marsh, 2017). Of our concern is to know (1) whether preferences for coastal erosion policy differ across beaches, and (2) what are the truly underlying preference variance across beaches, i.e. whether preferences for a favour coastal erosion policy is sensitive with the actual scope of erosion and size of beach, or it is motivated by households' perspective on the severity of erosion. We design a Discrete Choice Experiment with different geographical scope: four CEs with same erosion management policy in four segments of a long beach which are different in terms of beach length and erosion magnitude. This design allows for testing some hypothesis which deepen the scope effect and the policy impli-

cations. Our case study is Hoian, a UNESCO World Heritage Site, which has one of the most beautiful beaches in Vietnam. The city is facing with severe erosion which sandy beach is no longer presented in some areas.

The paper is structured as follows. In the next section, background information of our case study location is described. Section 3 introduces the design of choice experiment and the implementation of the survey. Methodology framework is discussed in section 4. Section 5 and 6 present results, discussion and policy implications.

## 2 Background information on coastal erosion in Hoi An

Hội An is located along the coastline in the central part of Vietnam. Its ancient town is inscribed as a UNESCO World Heritage site since 1999 (https://whc.unesco.org/en/list/948). Cua Dai beach, a part of Hoian is listed as one of the most beautiful beaches in Vietnam.

In recent years, erosion has occurred severely on Cua Dai Beach to an extent that sandy beach is no longer presented in some areas and shore adjacent buildings are threatened (Figure 1). One particularity of the beach in Hoi An is that it is not homogeneous from one end to the other. The southern end of the beach has substantially changed in last 13 years and the shoreline position has been retreated by about 500 meters. The situation is different in northern stretch since the sandy beach has been existed up to the present time but is eroding at a high rate (12m/year on average) (Viet, Hoang, and Tanaka, 2015).

Figure 1: Erosion Problem in Hội An beach (2004-2018)


Google Earth Image of Hoian beach in 2004 and 2018.

Several research projects have been conducted to identify the mechanisms leading to coastal erosion in Hội An (Fila et al. 2016, Viet et al. 2017, Duy et al. 2017). According to these projects, there are several contributors to the recent erosion rate: sea level rise, increase of storms frequency, reduction of sediment supply in the Thu Bon River due to sand mining and dam construction, and

natural variation. In terms of economic impacts, the problem of erosion is twofold. One side is the threatening onto hotels and resorts built along the beach. The amount of investments along the beach and their proximity to the sea makes beach erosion a big problem. The other side is the loss of an attractive landmark for tourism reducing an important income resource for the city. To alleviate and stop structural erosion of the Cua Dai Beach in Hội An, various technical solutions have been proposed and applied, including concrete revetment and sandbags.

# 3 Design of the choice experiment

## 3.1 Questionnaire development

The questionnaire development thoroughly follows the guidelines proposed by Johnston, Boyle, Adamowicz, Bennett, Brouwer, Cameron, Hanemann, Hanley, Ryan, Scarpa, Tourangeau, and Vossler (2017); Hensher, Rose, and Greene (2005) and previous studies (Phillips, xxxx, Huang and Poor, 2006). It has been developed by research team in collaboration with Vietnamese specialists of coastal erosion.

The survey consists four parts. The first part is devoted to households' knowledge and attitudes towards coastal erosion issue in Hội An. This "warm-up" part which includes rating scale questions aims at attracting respondents' attention, values the attitudes heterogeneity and assesses the relationship between their experience with utility towards the issue of coastal erosion in Hội An (Krupnick and Adamowic, 2006; Hoyos, 2010).

The second part is the discrete choice experiment section. The baseline should be clearly described in terms of circumstances and the changes related to the current situation, aiming at helping respondents to predict the possible impact of changes to their utility (Johnston, Boyle, Adamowicz, Bennett, Brouwer, Cameron, Hanemann, Hanley, Ryan, Scarpa, Tourangeau, and Vossler, 2017). In order to clearly present the baseline, videos introducing current problem of coastal erosion for the entire beach and for each of its segments, comparing to coastal situation of those beaches 10 years ago, explaining costal erosion reasons, and presenting the impact and expected situation in next 10 years are attached on the questionnaire. Regarding the valuation response formats, binary and multinomial choice are the formats that can increase incentive compatibility and reliability to welfare analysis (Johnston, Boyle, Adamowicz, Bennett, Brouwer, Cameron, Hanemann, Hanley, Ryan, Scarpa, Tourangeau, and Vossler, 2017). We apply multinominal format for choice experiment which includes two alternatives with treatments and a status quo.

Based on previous multidisciplinary project on coastal erosion in Hội An (Thao et al. 2014, Fila et al. 2016), focus groups workshop and pilot survey, five attributes are identified to characterize a coastal erosion program in Hội An (see Table 1). These five attributes are: (1) protection structures, (2) average beach width, (3) public access, (4) recreational offers and facilities, and (5) payment vehicle. Compared to the pilot survey, the number levels of attribute "Recreational offers and facilities" are reduced to combination of trees and restaurants instead of a combination of trees, restaurants and sunbathing chairs in order to make respondents easier to absorb information. A video interpreting attributes and their levels is conveyed in the survey, ensuring that all the survey will transmit same information.

Payment vehicle is a crucial attribute for a choice experiment. Payment method should be real-

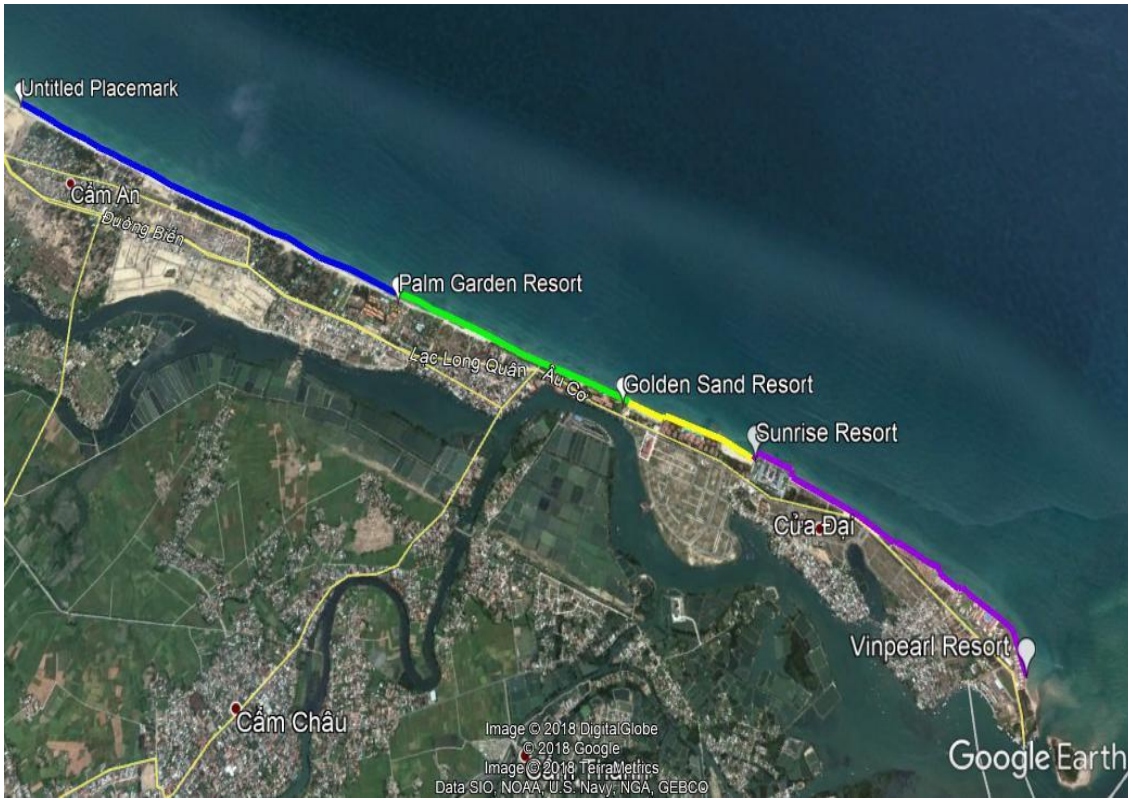
Table 1: Attribute description and attribute level for the choice experiment

| Names | Descriptions | Levels |
|---|---|---|
| Protection structures | Type of hard or soft protection structures that must be built along the coastline to fight against and prevent erosion | No hard or soft structures Sandbags Stair revetment Groynes Nothing |
| Average beach width (in meters) | The average width of the beach at high tide (in meters). Compared to the current situation, the width is increased by a technique solution called beach nourishment, which adds more sand to beach. | 0, 25, 50, 75, 100, 150 |
| Public Access | Percentage of the beach with public access and totally free access to all people | 0 25 50 75 100 (%) |
| Recreational offers and facilities | Type of recreational offers and facilities presented in the beach | Trees Restaurants Restaurants and trees Nothing |
| Payment vehicles | All the money collected from this tax will be dedicated to coastal erosion reduction. Household: Tax will be paid by each resident in Hội An from 18 to 60 years old per year. | 0 50 100 150 200 VND (equal to 0 2.2 4.4 6.7 8.9 USD) |

istic and binding for respondents (Johnston, Boyle, Adamowicz, Bennett, Brouwer, Cameron, Hanemann, Hanley, Ryan, Scarpa, Tourangeau, and Vossler, 2017). In Vietnam, residents annually have to pay an additional fee for natural disaster management (Regulation 94/2014/ND-CP, 2014). In this study, household tax are selected as payment vehicle.
After each single choice set, a self-report certainty question which include five-point scale from highly uncertain to highly certain is added. This certainty report can account for mitigating hypothetical bias (Matthews, Scarpa, and Marsh, 2017; Ready, Champ, and Lawton, 2010). Follow-up questions are also presented after choice experiment part to evaluate the validity, assess the respondents' acceptance on information and define protest answers (Krupnick and Adamowic, 2006).

The third part addresses demographic questions, including age, gender, household income, household size, education, profession. The final part deals with respondents' personal preference. These questions in addition to first and third parts will serve as covariates to explore preference heterogeneity of respondents.

Figure 2: Location of the four Hội An beach segments




### 3.2 Design used for generating the choice sets

Because of the heterogeneity of Hoian beach's characteristic, we divide the beach into four segments based on current level of coastal erosion and adaption structure (see Figure 1):

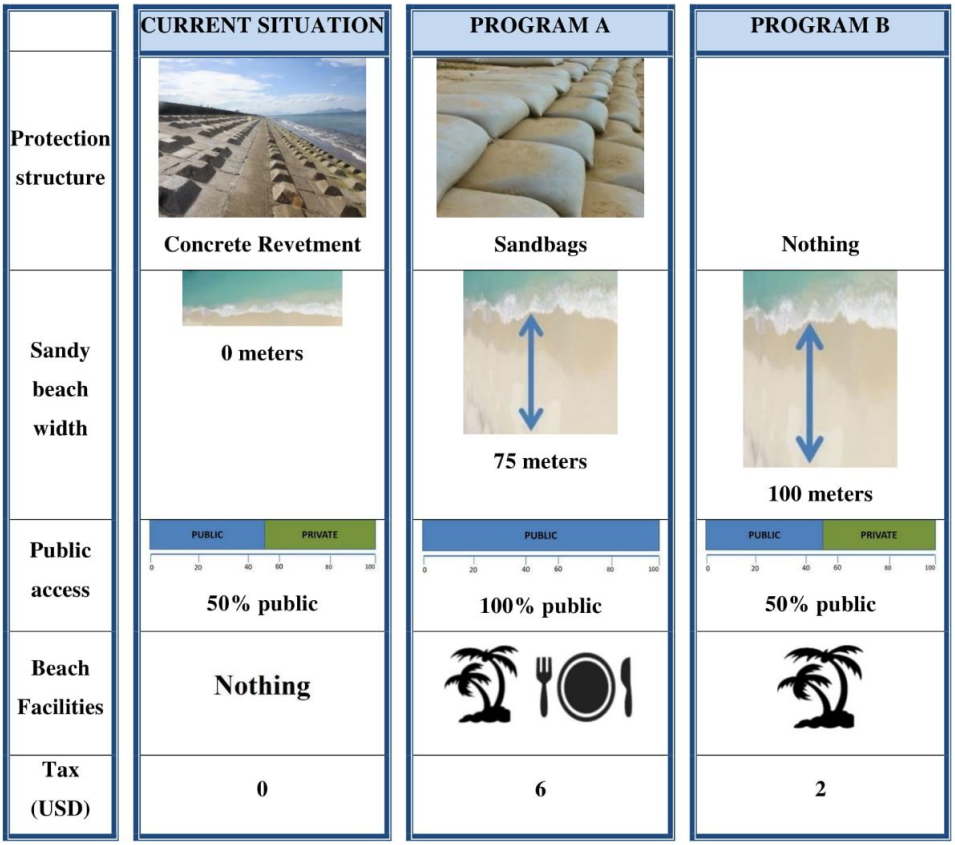
- Beach A which is now protected by concrete revetment is the place where several luxury hotels and resorts have been built in the past.
- Beach B has lost about 60 to 120 meters of beach width but is now not protected by different structures.

– Beach C was a popular beach in the past but it is now in an urgent situation of coastal erosion.

– Beach D has faced moderated erosion in the past 13 years and there no protection structure in this segment.

The choice experiment is then separated into four designs for each segment. A split sample approach in which each respondent has been randomly allocated to one of four beach segments is used.
Figure 4 gives an example of choice set. In order to give clear information of a choice set, each level of all attributes was displayed using both text description and static visualization.

Figure 3: Example of choice set




A D-efficient design using *Stata* software with prior getting from estimation of pilot data are generated, resulting in 36 alternatives for each segment of beach. All of them are blocked into 3 versions which consist of 6 choice sets.

An efficient experimental design counts on the balance of both statistical and response efficiency (Johnston, Boyle, Adamowicz, Bennett, Brouwer, Cameron, Hanemann, Hanley, Ryan, Scarpa, Tourangeau, and Vossler, 2017). There is a trade-off between statistical efficiency and the design with constraint on unrealistic, implausible and dominant alternatives. However, a decrease of some statistical efficiency is at a small cost to improve the relevance of design (Cherchi and Hensher, 2015; Collins, Bliemer, and Rose, 2014). Unrealistic and irrelevant combination of attributes can be a priori

excluded (Cherchi and Hensher, 2015). Elimination of irrelevant alternatives can reduce the bias of status quo, parameters of utility function and WTPs (Terawaki et al., 2003). However, in our design, there is no clear irrelevant alternative, thus there is no constraint of unrealistic combination of attribute levels prior.

Though it is currently difficult to exclude dominant alternatives before building design, dominance of alternatives can be reduced when the number of attributes and levels is increased (Cherchi and Hensher, 2015). However, statistic report on number of each attribute levels from pilot survey shows no dominance and the fact that there are some categorical variables in choice set leads to be difficult to point out the dominance level.

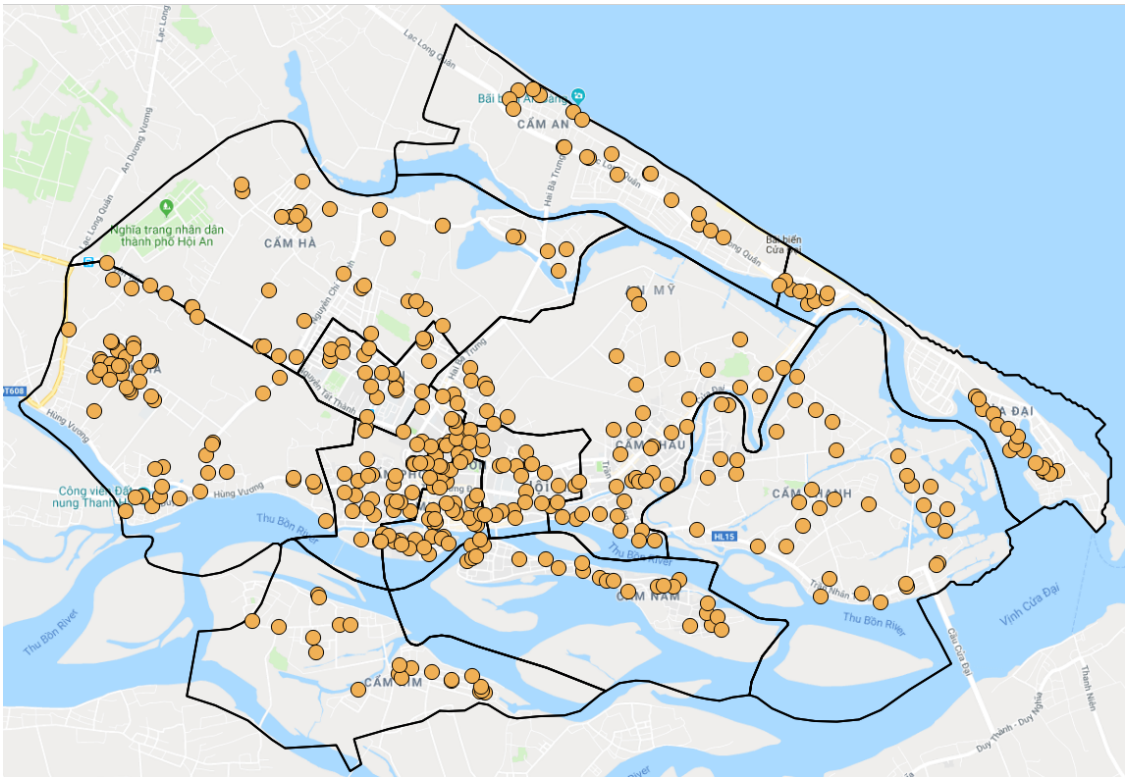
### 3.3 Survey implementation

**Survey** The survey is conducted in a mixed mode of computer-administered and in-person survey. The survey has been transferred to an app version using XLSform and SurveyCTO application (for more information see `https://www.surveycto.com/index.html`) and uploaded into tablets. This computer-administered survey can provide visual materials, exclude inconsistent answer, decrease implementation cost and keep updated on the survey execution (Champ and Welsh, 2006). A face-to-face survey was conducted by eight interviewers who are local resident and undergraduate students in economics and environment economics. Upon complement of a survey, household will receive 40.000 VND (equal to 1.8 USD). Such incentives might have an affect on response rate, response quality, sample composition and response distribution for a in-person survey(Singer and Ye, 2012) The survey was officially approved by the local authorities of city of Hội An.

**Sampling** The pilot survey was undertaken of a sample of 120 households from 23 to 31 March 2018, while the final was organized from 14 to 21 July 2018 with a sample of 399 households.
Stratified random sampling was used. According to Hội An administrative division, there are 12 inland communes in Hội An which consists of 73 sub-communes. The number of interviewed households in each village is proportional to the ratio of each village's number of households over total number of Hội An households. In order to get a list of assigned households that are chosen to interview, we extract from a full list of household in each village by random function in VBA. However, for a village that has number of assigned household below 4, we select 4 households instead of taking too few respondents to avoid to have meaningless statistical analysis for village's representative.

Data on number of households is exploited from census of 12 inland communes and Hội An in 2016. A full list of households in each commune which include names and address is provided by Department of Population of all communes.

Figure 4: Location of Household Sample




**Data** Table 2 presents social-demographic characteristics of the sample. There are 399 households accepting to participate a survey. Among them, 221 households (55.4% of household sample) agree to provide their socio-economic information. Number of male respondents are moderately greater than number of female participants in household sample.

Table 2: Demographic characteristics of the respondents

| | Category | Residents |
|---|---|---|
| Gender | Female | 31.3 |
| | Male | 68.7 |
| Age | Mean | 52.1 |
| | Min | 18 |
| | Max | 86 |
| Education | High-school graduate & below | 70.6 |
| | Some college/Professional/University | 26.7 |
| | Post-graduate | 1.8 |
| Monthly Household Income | Below 500 USD (10 million VND) | 62 |
| | From 500 USD to 1000 USD ( 10-20 million VND) | 28.1 |
| | From 1000 USD to 2000 USD (from 20-50 million VND) | 8.6 |
| | From 2000-5000 USD (from 50-100 million VND) | 1.4 |
| | Above 5000 USD (above 100 million VND) | 0 |
| Number Response | Completed Demography Answers | 221 |
| | Total Response | 399 |

# 4 Modelling approach

**Choice Models.** The paper applies mixed logit modelling framework which allows preferences to vary across individuals (Train, 2009). In this framework, the utility of person $i$ obtains from the alternative $j$ in choice occasion $t$ is defined as

$$U_{ijt} = \beta_i X_{ijt} + \epsilon_{ijt} \tag{1}$$

where $X_{ijt}$ is the vector of attribute values for alternative $j$ individual $i$ faces in choice scenario $t$; $\beta_i$ is the corresponding vector of parameters whose values are individual $i$ specific; $\epsilon_{ijt}$ is idiosyncratic error term and assumed to be i.i.d. extreme value. Various assumptions about the statistical distribution of the parameters in vector $\beta_i$ are then made (normal distribution, uniform distribution...). Mixed logit modelling enables to explain preference heterogeneity in individual preferences. As defined in Eq. (1), it only accounts for unobserved heterogeneity but fails to point out source of heterogeneity. To deal with this limitation, observed heterogeneity can be represented by adding individual-specific variables as explaining means of some of the random parameters $\beta_i$ (Greene, 2012).

**Hypotheses Testing.** The objectives of this paper is enlarged on three hypotheses.

**The first hypothesis.** This hypothesis investigates if households' preferences for a same coastal erosion management policy are insensitive across four different geographical located segments of a beach. The test aims to compare choice behaviour derived from four samples. The null hypothesis states that households' preferences towards coastal erosion policy in different parts of a beach remain unchanged.

$$H_0^1 : SP_{beach_i} = SP_{beach_j} \tag{2}$$

while $SP_{beach_i}$ and $SP_{beach_j}$ is preferences of coastal erosion policy in two beach segments $i$ and $j$. The paper applies Swait and Louviere (SL) test procedure (Swait and Louviere, 1993) to test this null hypothesis. The SL test involves two steps which take into account that differences in preferences for two different beaches may come from differences in either preference parameters or scale parameters.Thus, in the first step, test for equality of preference parameters in the two different samples, while assuming that scale parameters differ between samples, is performed. The corresponding null hypothesis can be written as

$$H_1^{SL} : \beta_1 = \beta_2 = \beta \tag{3}$$

This null hypothesis can be tested using the Log-Likelihood Ratio test statistics:

$$\lambda_A = -2[L_p^{\lambda_1 \neq \lambda_2} - (L_1 + L_2)] \tag{4}$$

where $L_j$ is the maximum log-likelihood obtained for sample $j$ ($j = 1,2$), and $L^{\lambda_1 \neq \lambda_2}$ is maximum log-likelihood for pooled sample assuming different scales parameters for each sample. Details about maximization of this last likelihood are given in Swait and Louviere (1993).

If $H_1^{SL}$ cannot be rejected, the second stage consists in testing the equality of scale parameters, i.e.testing the null hypothesis

$$H_2^{SL} : \lambda_1 = \lambda_2 \tag{5}$$

The LLR test statistics is now

$$\lambda_B = -2[L_p^{\lambda_1 = \lambda_2} - L_p^{\lambda_1 \neq \lambda_2}] \tag{6}$$

Now, if $H_1^{SL}$ is clearly rejected, it is meaningless to carry on the test involved in the second stage. In this case, the difference in preferences between the two samples has been detected. However, because preference parameters are identified up to a scale in each sample, it is impossible to perceive what causes the differences: differences in both scale and preference parameters, or differences in merely preference parameters.

**The second hypothesis** . This hypothesis deals with the existence of geographical scope effect on a coastal erosion adaption policy, i.e. whether preferences for a desirable erosion management policy are insensitive to an increase of spatial scope of beach. In order to test this hypothesis, *length* is included as observed heterogeneity in the random parameters of model that pooled four segments. From equation (1), random coefficients become:

$$\beta_i = \beta + \pi_1 Length + \epsilon_i \tag{7}$$

In this case, the null hypothesis is thus specified as follow:

$$H_0^2 : \pi_1 = 0 \tag{8}$$

Previous studies on economic valuation of a coastal erosion management pointed out a strong preference of respondents towards coastline development of having a wider sandy beach by beach nourishment instead of visible structures (Landry, Keeler, and Kriesel, 2003; Huang, Poor, and Zhao, 2007; Matthews, Scarpa, and Marsh, 2017; De Salvo, Signorello, Cucuzza, Begalli, and Agnoli, 2018). Our concern is that whether there is a truly linkage between erosion issue and preference of sandy beach preservation and protection structures, and whether erosion problem in reality or the individuals' own perspective of this issue influences their preferences. **The third hypothesis** explores the fact that erosion rate and perception about coastal erosion issue influences households' inclination to a visibly protected beach and a wider sandy beach. Again, these variables are added in the random parameters *Width* and *Protection* of pooled model and results in testing the following the null hypothesis:

$$\beta_{width_i} = \beta + \pi_{21} Erosion + \pi_{31} Perspective + \epsilon_i \tag{9}$$

$$\beta_{protection_i} = \beta + \pi_{22} Erosion + \pi_{32} Perspective + \epsilon_i \tag{10}$$

$$H_0^{3a} : \pi_{21} \neq 0 \& \pi_{22} \neq 0 \tag{11}$$

$$H_0^{3b} : \pi_{31} \neq 0 \& \pi_{32} \neq 0 \tag{12}$$

# 5 Results

## 5.1 The sensitiveness of preferences across beaches

Table 3 presents Mixed Logit estimations results for four beach segment samples. A random alternative specific constant (ASCs) is added in order to investigate the potential status quo effect (Scarpa et al., 2005; Meyerhoff Liebe, 2009). Continuous variables are assumed to be normal distributed, except tax which follows log-normal distribution, results in an assumption that preference for paying an increased tax is always decreased. Categorical variables including protection structure, ASCs and facility are dummy coded and are supposed to follow uniform distribution (Hensher, Rose, and Greene, 2005). All models are estimated using gmnl package in R (Sarrias and Daziano, 2017) with 500 Halton draws.

Tax parameter in four segments of beach are all negative and significant, reflecting a rational preference trend that households dislike to pay for erosion tax. In segment A which is at the highest eroded rate, household favour a wider beach protected by sandbags and groynes, as parameters for width, groynes and sandbags are positive and significant. In segment B, households express their preference towards a wider, publicly accessible and facilitated beach with both restaurants and trees, protected by stair revetment and sandbags. Households incline to a wider and more accessible beach in the beach of segment C which is a popular beach in the past. In segment D which is a stable beach, households are more partial to an accessible and facilitated beach that is protected by either hard or soft structure than nothing.

Estimation results reflect a differences of households' preference towards coastal erosion policy in four segments. There is a preference tendency that households incline towards a wider beach in those segments where currently occur erosion (segment A, B and C) and are in favour of a publicly accessed beach in segments where sandy beach has up to now presented (segment C and D).

Table 3: Mixed Logit Estimations for Four Beach Segments

| | Beach A | Beach B | Beach C | Beach D |
|---|---|---|---|---|
| **Mean of Random Parameters** | | | | |
| Tax | -0.146(0.821)*** | -0.378(0.385)*** | -0.185(1.116)** | -0.255(0.388)*** |
| Restaurant | -0.02(0.342) | 0.521(0.327) | 0.444(0.36) | -0.017(0.3) |
| Restaurant-Tree | 0.328(0.29) | 1.011(0.283)*** | 0.267(0.405) | 1.275(0.461)** |
| Trees | 0.031(0.221) | 0.461(0.328) | -0.163(0.364) | 0.007(0.311) |
| Groynes | 0.859(0.231)*** | 0.392(0.429) | 0.19(0.472) | 1.481(0.401)*** |
| Stairs Revetment | -0.045(0.332) | 1.313(0.421)** | 0.523(0.451) | 0.828(0.415)* |
| Concrete Revetment | 0.076(0.333) | 0.66(0.466) | 0.559(0.404) | 1.212(0.455)** |
| Sand-bag | 0.727(0.296)* | 0.88(0.379)* | 0.151(0.421) | 0.756(0.45). |
| Access | 0.214(0.239) | 0.63(0.261)* | 1.917(0.517)*** | 1.533(0.561)** |
| Width | 5.123(1.699)** | 8.73(2.12)*** | 17.752(3.634)*** | 0.833(2.425) |
| ASCs | -0.293(0.471) | -0.262(0.471) | 0.825(0.557) | -0.801(0.623) |
| **Standard Deviation of Random Parameters** | | | | |
| sd.tax | 2.658(0.582)*** | 2.556(0.398)*** | 3.405(1.024)*** | 1.353(0.264)*** |
| sd.Restaurant | 0.863(1.434) | 1.574(0.588)** | 1.061(0.732) | 2.173(0.608)*** |
| sd.Restaurant-Tree | 0.998(0.782) | 0.595(0.564) | 2.457(0.525)*** | 2.953(0.634)*** |
| sd.Trees | 0.916(0.828) | 1.72(0.472)*** | 0.94(0.749) | 0.44(0.647) |
| sd.Groynes | 1.079(0.996) | 1.76(0.81)* | 3.711(1.121)*** | 0.865(0.636) |
| sd.Stairs Revetment | 1.062(0.869) | 2.926(0.673)*** | 3.908(1.071)*** | 2.234(0.792)** |
| sd.Concrete Revetment | 1.412(0.549)* | 3.973(0.662)*** | 2.616(0.866)** | 3.268(0.896)*** |
| sd.Sand-bag | 2.207(0.681)** | 1.403(0.493)** | 2.614(0.56)*** | 2.973(0.968)** |
| sd.access | 0.349(0.934) | 0.647(0.378). | 0.931(0.459)* | 3.41(0.588)*** |
| sd.width | 2.206(2.899) | 9.058(3.088)** | 1.434(3.405) | 7.412(3.226)* |
| sd.ASCs | -0.146(0.524)*** | -0.378(0.397)*** | -0.185(0.366)*** | -0.255(0.492)*** |
| Log-likelihood | -525.67 | -593.93 | -395.53 | -449.04 |
| AIC | 1095.34 | 1231.86 | 835.06 | 942.08 |
| BIC | 1192.72 | 1331.67 | 927.16 | 1038.82 |
| Observation | 1854 | 2070 | 1458 | 1800.00 |
| Respondents | 103 | 115 | 81 | 100 |

In order to examine whether choice behaviour for coastal erosion management policy in four beach segments are altered, the equality of parameters from four above models are tested. Table 4 presents results of the first stage of Swait-Louviere test. All combinations of two segments result in six pairs. The hypothesis which preferences for coastal erosion management policy across different beach segments stay the same cannot be rejected at 0.1% significant level and with 12 degrees of freedom (column 5 of Table 4). Because the first stage of the Swait-Louviere test strongly rejects the equality of preference parameter, it is needless to proceed the second stage of equality of scale parameter testing.

Table 4: Swait-Louviere test results for preference similarity between different segments of beach

| | Log Likelihood 1st sample | Log Likelihood 2nd sample | Log Likelihood ($\mu_1 \neq \mu_2$) | 1st LR test p-value | Scale Parameters 2nd sample |
|---|---|---|---|---|---|
| A vs B | -525.67 | -593.93 | -1140.89 | 0.00*** | 1.35 |
| A vs C | -525.67 | -395.53 | -933.48 | 0.00*** | 1.00 |
| A vs D | -525.67 | -449.04 | -994.26 | 0.00*** | 1.35 |
| B vs C | -593.93 | -395.53 | -1014.42 | 0.00*** | 1.14 |
| B vs D | -593.93 | -449.04 | -1070.14 | 0.00*** | 1.20 |
| C vs D | -395.53 | -449.04 | -870.46 | 0.00*** | 2.04 |

### 5.2 Geographical Scope and Magnitude of Erosion Effect

Length and magnitude of erosion in each beach segments and households' perception about erosion issue are included in pooled model of four beach segments in order to account for their influences on choice behaviour.Those variables are described in Table 6.

Table 5 presents estimation results. Result from estimation of Model I points out households' leaning to a publicly accessible and wider beach. Households are in favour of only facilitated beach with both restaurants and trees, and are partial to protected beach by either soft or hard structure. Groynes are the most preferred structure. On the other hand, households show their resistance to tax and the current situation of beach.

In order to assess to a favourable coastal erosion management policy is sensitive to the spatial scope of beach, *Length* is included in distribution of random parameters of desirable attributes, including *Access*, *Facility restaurant - tree*, *Protection Groynes* and *Width* (Part B in Model II). The second hypothesis states that preference for a preferred policy will increase with an expansion of length of beach. Estimation results identify that an increase in beach length enlarges preference for groynes; yet reduces preference for a wide beach. The second hypothesis cannot hence rejected.

Part C of table 5 accounts for effect of erosion on preferences. Erosion issues are represented into three aspects: 1, actual erosion rate or magnitude of erosion; 2, awareness of household about erosion problem and 3, Perspective of Household about Coastal Erosion or their ranking of severity of coastal erosion. The third hypothesis is tested by including these variables in distribution of variables *protection structure* and *width*. Estimation result indicates an insensitiveness of erosion size on preference for protection constructions and width of sandy beach, as parameters of actual erosion rate on the distribution of *protection structure* and *width* are insignificant. However, perspective of erosion problem has an influence on households' preferences. Households who consider "coastal

erosion" highly severe are more leaning to hard protection groynes, stairs revetment and concrete revetment. They have less desire to a wider beach and beach protected by sand-bag. Results confirm that household's preference for a coastal erosion management policy is insensitive with the actual magnitude of erosion but is reactive with their perspective about this issue. Thus, the third hypothesis cannot be rejected. It reflects a fact that households lean to a coastal erosion policy not because of the actual erosion problem but due to their viewpoint of severity of the issue.

Table 5: Estimated Mixed Logit Models for the pooled sample

| | Model I | Model II | Model III |
|---|---|---|---|
| **A: Random variables** | | | |
| Access | 0.805(0.16)*** | 0.649(0.416) | 0.756(0.161)*** |
| ASCs | -0.345(0.19). | -0.362(0.202). | -0.382(0.197). |
| Restaurant | 0.217(0.142) | 0.272(0.144). | 0.174(0.143) |
| Restaurant-Tree | 0.616(0.147)*** | 0.559(0.327). | 0.609(0.146)*** |
| Trees | 0.018(0.132) | 0.03(0.135) | 0.037(0.13) |
| Groynes | 0.843(0.162)*** | -0.035(0.399) | -0.622(0.663) |
| Concrete Revetment | 0.539(0.169)** | 0.566(0.178)** | -0.665(0.754) |
| Stairs Revetment | 0.573(0.179)** | 0.63(0.187)*** | -0.644(0.715) |
| Sand-bag | 0.656(0.166)*** | 0.678(0.17)*** | -0.914(0.723) |
| Tax | -0.332(0.218)*** | -0.134(0.224)*** | -0.132(0.211)*** |
| Width | 6.371(1.103)*** | 12.946(2.862)*** | 13.978(4.817)** |
| **B:Length** | | | |
| Access.length | | 0.1(0.209) | |
| Restaurant-Tree.length | | 0.067(0.163) | |
| Groynes.length | | 0.473(0.188)* | |
| Width.length | | -3.41(1.385)* | |
| **C: Erosion** | | | |
| *Actual Erosion Rate* | | | |
| Groynes.erosion | | | 0.009(0.024) |
| Concrete Revetment.erosion | | | -0.003(0.032) |
| Stairs Revetment.erosion | | | -0.027(0.031) |
| Sand-bag.erosion | | | 0.609(0.031) |
| Width.erosion | | | 0.127(0.183) |
| *Awareness of Erosion Problem* | | | |
| Groynes.Awareness | | | -0.006(0.007) |
| Concrete Revetment.Awareness | | | -0.018(0.009)* |
| Stairs Revetment.Awareness | | | -0.132(0.008) |
| Sand-bag.Awareness | | | 0.037(0.008) |
| Width.Awareness | | | -0.047(0.054) |
| *Perspective of Erosion* | | | |
| Groynes.Ranking | | | 1.598(0.634)* |
| Concrete Revetment.Ranking | | | 1.572(0.707)* |
| Stairs Revetment.Ranking | | | 0.174(0.675)* |
| Sand-bag.Ranking | | | -0.622(0.684)* |
| Width.Ranking | | | -8.488(4.521). |
| **Standard Deviation** | | | |
| sd.access | 1.294(0.271)*** | 0.559(0.271)*** | -8.488(0.262)*** |
| sd.ASCs | -0.332(0.315)*** | -0.035(0.315)*** | -0.006(0.222)*** |
| sd.Restaurant | 1.028(0.495)* | 0.925(0.547). | -0.665(0.498)* |
| sd.Restaurant-Tree | 1.782(0.344)*** | 1.848(0.368)*** | -0.914(0.345)*** |
| sd.Trees | 0.774(0.514) | 1.018(0.48)* | 0.756(0.597) |
| sd.Groynes | 1.248(0.508)* | 1.253(0.773) | 13.978(0.638) |
| sd.Concrete Revetment | 2.715(0.364)*** | -0.134(0.37)*** | 0.127(0.381)*** |
| sd.Stairs Revetment | 1.87(0.499)*** | 2.055(0.535)*** | -0.382(0.43)*** |
| sd.Sand-bag | 2.308(0.357)*** | 0.272(0.376)*** | -0.047(0.394)*** |
| sd.tax | 1.926(0.22)*** | 1.911(0.209)*** | -0.644(0.212)*** |
| sd.width | 7.454(2.116)*** | 0.03(2.336)** | 0.009(2.552)* |
| loglik | -2026.63 | -2021.76 | -2007.20 |
| AIC | 4097.25 | 4095.51 | 4088.40 |
| BIC | 4224.43 | 4245.81 | 4302.28 |

# 6 Discussion and Policy Implication

The paper reports results of four choice experiments about a same coastal erosion management policy conducting across four segments of beach. The purpose of our survey is to assess the scope sensitivity of households' preferences and how the actual erosion magnitude influences their preferences on a erosion management policy. The results points out a sensitiveness of households to length of beach, but not the scope of erosion. This differs from Matthews, Scarpa, and Marsh (2017) which found that households are indifferent with length of restored beach but is aligned with finding in Spencer-Cotton et al. (2016) that WTP for attributes increases with the an enlargement of geographical scope.

A scope sensitiveness implies that authorities might employ different coastal erosion management policy for different parts of beach based on its size and erosion rate. Hoian beach is a particular one in that it is located in the open-mouth of a big river, leading to a variation of erosion rate along the beach. Besides, the beach is separate to parts totally belonging to hotel and resorts, and parts publicly opened. Estimation results suggest that households are in favour of a wider beach in a beach facing with erosion but not the stable beach. Instead, for a stable beach where is a popular one for residents in Hoian to visit, they express their wish to have these beaches more protected by any structures, even though it has not eroded yet. It might infer a priority that a stable beach with no protection structure is in high need of a protection policy. For eroding beaches, households tend to prefer a particular protection structure for each parts. This might suggest that authorities should take a technical assessment on which typical protection structure suitable for each part of beaches.

Although erosion is a severe issue in Hoian which the erosion rate is about 12 meters per year, households preferences across beaches are insensitive with erosion magnitude. However, their perspective about the severity of this issue plays a role in their preferences toward coastal management policy. This might be an inference that public communication about coastal erosion through different channels could contribute to welfare changes of households toward coastal protection policy.

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# A Variables Definition

Table 6: Variables definition

| Variables | Description | Unit |
|---|---|---|
| Width | Average width of the beach<br>at high tide | Continuous variables<br>in kilometers |
| Access | Share of the beach that is public<br>with a free access to all people | Continuous variables<br>in percentage over 100 |
| Tax | Annual tax paid for<br>coastal erosion management | Continuous variables<br>In VND (make equivalent to USD) |
| Protection Structure | Type of hard or soft protection<br>structures built along the<br>coastline including:<br>1, Sandbags<br>2, Concrete Revetment<br>3, Stairs Revetment<br>4, Groynes | Four Dummy Variables<br>1: structure is chosen<br>0: structure is NOT chosen |
| Facility | Type of facilities presented in the<br>beach including:<br>1, Only Trees<br>2, Only Restaurants<br>3, Both restaurant & tree | Three Dummy Variables<br>1: a type of facilities is chosen,<br>0: a type of facilities is NOT chosen |
| Length | Length of a beach segment | Continuous variables<br>in kilometers |
| Erosion Rate | Erosion rate of beach segment<br>in last 13 years | Continuous variables<br>in meters per year |
| Severity Ranking | Respondent's ranking about<br>severity of coastal erosion issue | Continuous variables, Likert Scale<br>1(not severe at all),2,3,4,5 (highly severe) |
| Awareness of<br>Coastal Erosion Problem | If respondents think that Hoian is<br>facing aproblem due to coastal erosion | Dummy Variable,<br>1=Yes; 0= No or Dont' Know |