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Economic and social demands for coastal protection

P. Polomé [a,*], S. Marzetti [b], A. van der Veen [a]

[a] CTW–WEM, University of Twente, P.O. Box 217, 7500AE, The Netherlands
[b] Department of Economics, University of Bologna, Italy

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Abstract

The purpose of this paper is to present methods and examples of economic valuation in the framework of cost–benefit analysis of coastal defense schemes. We summarize the concepts of value in economics and their application to coastal erosion defense. We describe the results of an original benefit transfer exercise on beach recreation, that is, whether and how values known for some sites can be used to assess the value of some other sites. We present six original case studies on the valuation of the benefits of coastal erosion defense; four of them focus on beach recreation in Italy, one focuses on the conservation of the Venice heritage, and one on biodiversity in The Netherlands. The results of the case studies are illustrative of the diversity of values for the many types of non-marketed assets that may be protected from sea erosion.

Keywords: Economic valuation; Coastal erosion; Non-market benefits; Benefit transfer

1. Introduction

The purpose of this paper is to present methods and examples of economic valuation in the framework of cost–benefit analysis (CBA) of coastal defense schemes. The paper is intended for a broad scientific audience without prior knowledge of economics. The introduction of the paper presents the principles of CBA, summarizes the main notions of economic value, the most well-known valuation methods and the main potential costs and benefits of coastal defense schemes. The following three sections are intended as illustrations of the variety of coastal defense benefits and their valuation. Section 2 presents the results of original studies on the valuation of recreational benefits of coastal defense for four Italian beaches. These case studies should be fairly representative of coastal defense schemes for Northern Mediterranean beaches. Section 3 presents the very special case of the defense of the Venice lagoon. Section 4 is radically different since it is about a small unused natural area in the Northern Sea. Section 5 introduces the technique of benefit transfer that is whether and how economic values known at some sites can be used to infer in some way the value of an original site. This technique, when it can be applied, is very economical because an economic valuation study can be quite expensive. The results of an original benefit

* Corresponding author.
E-mail address: polome@ecru.ucl.ac.be (P. Polomé).

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transfer exercise are presented. We do not claim that the valuation studies presented in the present paper are representative of all the possible valuation cases of coastal defense; yet we trust that, as a result of this paper, the reader will have a general idea of what can be done regarding cost–benefit analysis of defense schemes and will have enough examples to draw upon to build his own valuation exercise, be it a transfer exercise or an original study. That is the main purpose of our paper.

CBA is a process intended to measure whether the sum of all the positive impacts of a project outweighs the sum of its negative impacts once they are converted in a single unit, often money; for a thorough review of CBA in the case of environmental changes, see Hanley and Spash (1993). In this introduction, we will review briefly the economic notion of value, the valuation methods, the types of value, and the types of asset that can be found at the coastline. The economic concept of value that is most often used in a CBA is the Willingness to Pay (WTP) defined as the maximum amount of money a person is willing to exchange to acquire a (public or market) good or service. The economic value does not refer to an exchange of money or to a price; the goal is to convert "individual utility" into money to match it against monetary costs such as those of building a coastal defense scheme. The WTP is used, and not market prices, because the coastal defense scheme changes the supply of non-marketed goods: a government provides the defense scheme, but cannot charge the consumers for it; CBA addresses this issue by converting the change of well-being into money, and compares it to the actual money that has been spent on providing the good. The conversion should be based on individual preferences; that is the case in the present paper. That definition of economic value makes clear that a broad class of benefits should be considered in CBA. Yet, economic value is not the only criterion for deciding on public projects; equity considerations, precautionary environmental standards, and regional economic constraints can be seen as complements to CBA.

One purpose of this introduction is to make clear the diversity of value categories and assets at the coast. The value of a coastal defense scheme is composed of the sum of the values of the consequences of that scheme on the seafront, avoiding double-counting. Often different types of values will require different valuation methods. Classical typologies of values adapted from Turner et al. (1992), and Bower and Turner (1998) are presented in Table 1.1. The third column indicates the valuation methods that would be most suitable for estimating each value. This is not an indication that it has been estimated. An overview of the valuation methods is given in the sequel.

We now turn to a brief introduction of the economic valuation methods. The necessary data are generally too specific to exist in any publicly available database and it is often necessary to use surveys to collect the data or to resort to benefit transfer (Section 5). The valuation methods are divided into "stated preferences" and "revealed preferences"; a detailed description can be found in Haab and McConnell (2002). Revealed preferences methods rely on actions that individuals have taken in the past; one can distinguish between "direct" and "indirect" revealed preferences methods. Direct methods refer to changes that directly affect marketed goods. A typical example in the case of coastal defense is the demand for hotel nights at a specific coastal resort. Indirect methods refer to changes in the provision of a non-marketed good that can be valued indirectly through estimation of the changes in the demand of an associated marketed good. A good example in the context of coastal defense is the recreation quality of a beach. Recreation is not in itself sold in a market; however, to enjoy recreation at the beach, visitors have to travel there. One can then estimate the demand for travel to the beach and proceed as in a case of direct methods.

Direct methods, or "market pricing" as indicated in Table 1.1 can be briefly described as follows (see Fig. 1.1; see also Lipton et al., 1995). First, the demand schedule of the market good is estimated. The schedule can be estimated at individual level (the price is the observed individual price) or at the market aggregated level. The area defined by the horizontal price line, the demand curve and the vertical axis is defined as the consumer surplus. The producer surplus is defined similarly, but is often not estimated in practice because supply is assumed completely inelastic (vertical schedule). Second, using the estimated demand schedule, we forecast the change in demand caused by the change that we want to value (e.g. an eroded beach versus a nourished beach); in Fig. 1.1, the demand schedule shifts up. The change in value is the change

Table 1.1
Coastal defense values

Use generated values		
Direct use values	Consumptive: fishing; agriculture; transport; construction and maintenance costs	Market pricing (possibly adjusted)
	Non-consumptive: recreation	Travel cost; stated preferences
Indirect use values	Flood control; storm protection; sedimentation; habitat loss reduction; landscape; human health	Market pricing; hedonic pricing; stated preferences
Non-use and option generated values		
Option values	Insurance value of preserving options for use	Stated preferences
Quasi-option values	Value of increased information in the future (biodiversity)	Stated preferences
Existence and bequest values	Knowing that a species or system is conserved; passing on natural/heritage assets intact to future generations; moral resource/non-human rights	Stated preferences

in consumer surplus, in most cases a good approximation to the WTP for the change.

The complete procedure of estimation of the supply and demand schedules, and forecasting their change, is often a complex task, especially if there exist goods that are substitute or complement to the market good of interest. Things may be simpler if the change can be said to be marginal. In that case, the price of a market good is sometimes equivalent to the marginal social benefit of a unit of that good; as an approximation, and if the market can be said to be competitive, the social benefit of a project that increases marginally the output of such a good can be taken as the product of price and quantity. For example, regarding the increase in the number of hotel nights caused by a (small) beach protection scheme, the marginal social benefit can be said to be equal to the number of additional nights times the price of the rooms on the ground that if the change is marginal, the supply of the additional nights has a zero (or very low) marginal cost. If the change is not marginal, for example if hotels have to be built to accommodate the additional nights, then costs have to be taken into account and the demand and supply schedules should be estimated.

Indirect revealed preferences methods are used for goods for which there is normally no observable demand but there is a complementary or substitute market good. The travel cost method is concerned with changes in the quality of a recreational site. The value of that site is estimated on the basis of the demand for travel to that site, travel being the market good complement to the recreational site. Hedonic pricing captures the WTP associated with variations in property values that result from the presence or absence of specific environmental attributes.

Stated preferences methods are used for changes in non marketed goods such as landscape, natural or

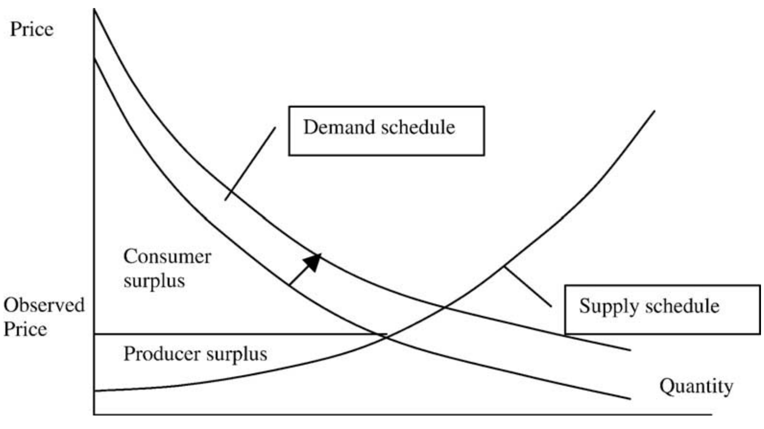


Fig. 1.1. Consumer and producer surplus.

cultural heritage that have no complementary or substitute market good. In that case, one can only resort to directly asking individuals (in a survey) how much they are willing to pay to obtain that change (or to avoid it). The precise way to ask that question is the subject of much debate and has given rise in practice to several methods. The contingent valuation (CV) is the most developed stated preferences method and is very well documented, see e.g. Bateman and Willis (1999). Several examples are presented in details in Sections 2, 3 and 4 of this paper.

We now turn to the question of what types of assets might be affected by a coastal defense scheme. We present here a summarized list; for a more detailed list, see Bower and Turner (1998), the "Yellow Manual" of Penning-Rowsell et al. (1992) and Polomé (2002).

Mitigation effects of coastal defense include the following categories: reduce damage to or prevent destruction of coastal properties and cultural and heritage assets from coastal storms and eroding shorelines; reduce salinity intrusion; reduce sedimentation; restore or preserve habitats or recreational opportunities (e.g. sand beach).

Buildings damage can be valued in two ways. Erosion can cause complete loss of the building (sinking); the literature (Mendelsohn and Neumann, 1999) suggests estimating the discounted value of the building from the current time until the expected sinking time, allowing for market adjustment of the building price (zero at the time of sinking). That produces in fact a lower bound on the value since the change is non-marginal (from the point of view of the individual house owner); a more appropriate measure is the WTP to prevent the loss, which may be difficult to measure due to the emotional nature of the good. An upper bound may be the discounted value of the building not allowing for market adjustment of the building price. The rationale would be that from a welfare point of view, what matters is that the people who would lose their house to the sea must find a replacement, that is, a house not threatened by the sea, for which the market does not adjust the price. Instead of a complete loss, erosion may only increase the probability of temporary flooding; the literature (see Dorfman et al., 1996) suggests valuing that loss of welfare through hedonic pricing.

Enhancement effects include: increased output of the seafront (e.g. creation of recreational fishing opportunities); water quality changes (eutrophication, red tides); conflicts among different types of recreation users of beach areas.

Preservation effects refer to natural areas. The benefits stemming from the preservation of a natural ecosystem are generally recreational use and non-use. An in-depth case is described in Goodman et al. (1996). Offshore sand and gravel mining (e.g. to find the sand for beach nourishment) may affect fisheries and habitats.

Indirect economic effects are "second round" effects, e.g. constructions in hazardous areas in relation to coastal storms that are built because of the protection granted by the defense scheme (resulting possibly in a stronger scheme being necessary in the future; see Cordes and Yezer, 1998).

2. Case studies on the use value of Italian beaches

In this section, we present the most significant results of four case-studies at Italian beaches. For the complete results, see Marzetti (2003, D28/A). Two small surveys were administered at the beach of Ostia near Rome (100 interviews on the beach, summer 2002) and on Pellestrina Island in the Lagoon of Venice (80 residents and 75 beach visitors, July 2002), respectively. Two larger surveys were administered at Lido di Dante near the town of Ravenna (an on-site sample of 600 interviews, August 2002) and at Trieste (a sample of 600 residents, November 2002).[1]

The purpose of the surveys was to value informal beach recreation (a non-marketable good); the value of the daily beach use was estimated per individual visitor. The methodology that was chosen is a version of the CV method implementing the Value Of Enjoyment (VOE) as described in the Yellow Manual of

[1] For the Lido di Dante survey, the tourists' characteristics may change depending on the months of the tourist season, since that site is mainly visited by foreigners and Italians from different regions. The other sites are visited by residents or people who live nearby, who generally visit the beach from May to September, but also in autumn–winter. Therefore, the results of the Lido di Dante survey likely describe only the preferences of the tourists present on the beach at the time of survey.

Penning-Rowsell et al. (1992). The valuation question has an open ended format: respondents are asked to state the value of enjoyment at the seafront in different scenarios. Alternative formats of CV (such as those implementing the WTP format for example) require the specification of a payment vehicle (such as a tax, entry fee or voluntary donation), while this is not required for the VOE version. At the Lido di Dante beach, Trieste (Barcola) seafront and Pellestrina beach, which are beaches with no admittance fee, at the time of the surveys any form of payment would have been unpopular, therefore the VOE format was found preferable for beach visitors and residents. Beach access is not free of charge on most of the beach at Ostia, but the VOE format was nevertheless applied to compare the results with those of the other Italian sites.

In CV surveys with the VOE format, each user is asked to estimate the value he/she attributes to the enjoyment obtained from a visit to the beach in different scenarios. At the heart of the CV approach is the questionnaire, presenting plausible scenarios in which the valuations can be made. To make those valuation exercises easier, the respondents are shown visual support such as pictures representing the various scenarios. For example, the visitors to a certain beach can be shown pictures of the beach in its current state and pictures of what the same beach would look like if erosion was allowed to take place. The basic VOE questionnaires used for the Italian case studies are those published in Penning-Rowsell et al. (Appendices 4.2(a) and (b)): the Standard site user questionnaire and the Standard resident questionnaire. The questionnaires were adapted to the Italian case studies by asking the beach use value not only in spring/summer but also in autumn/winter.

Since each of the four sites has distinctive characteristics, different questionnaires were used. The main characteristic of the Trieste (Barcola) questionnaire is the valuation of the beach use in two scenarios (status quo and a hypothetical artificial beach expansion). The Barcola seafront is defended from the sea by an artificial wall that protects the road and pedestrian paths, and there is currently a very narrow pebble beach. Composition 1 was presented to respondents, describing the project of building two artificial beaches at the Barcola seafront, each 400 m long and 40 m wide. The total cost of the project was estimated at about €17 million. The beach uses in the status quo and in the expansion scenarios were evaluated in two seasons: spring/summer and autumn/winter. In the Pellestrina survey only the value of the status quo (an already completely artificial beach as shown in Picture 1) is estimated.

Composition 1. Simulation of the Barcola seafront after the beach expansion.

In the Lido di Dante questionnaire, beach use is valued in three scenarios: status quo, hypothetical erosion and hypothetical expansion. Pictures 2 and 3, and Compositions 2–5 were presented to respondents. The Lido di Dante beach is divided into two parts: the developed and semi-developed area (where sunbathing buildings are on the beach — mainly in the developed part), and the undeveloped or natural area. These two beach areas were photographed in their current state at the survey time. Picture 2 describes the status quo of the developed and semi-developed area, while Compositions 2 and 3 describe the same area in the hypothetical situations of erosion and artificial expansion, respectively. Picture 3, instead, describes the status quo of the natural area, while Compositions 4 and 5 describe this area in the hypothetical situations of erosion and expansion, respectively.

Picture 1. Pellestrina Island beach.

In the Ostia survey, the status quo – already artificially protected – and the situation of erosion are valued; the status quo is described in Picture 4, while the situation of erosion is shown in Picture 5; both pictures were presented to the respondents.

Italian nationals were interviewed in Trieste, Pellestrina Island and Ostia, while in Lido di Dante, an international tourist site, foreign visitors were also interviewed. Most respondents favor the artificial protection of beaches from erosion. Composite intervention (groynes, nourishment and submerged breakwaters) and pure nourishment are the most preferred kinds of defense structures (see Marzetti et al., 2003). Regarding the time spent on the beach in the present state, in spring/summer the daily beach use of Italian beaches is generally intense: in Lido di Dante people stay about 5 h per day on average, 2.4 in Trieste, 4 in Ostia, and 4 (day visitors) and 3.2 (residents) in Pellestrina. In autumn/winter however, the time spent on the beach is about 1 h. The mean number of days spent on Italian beaches in spring/summer is fairly high: Lido di Dante about 12.4 days (tourists), 23 (day visitors) and 47 (residents); Trieste (residents) 15 days; Ostia (residents and day visitors) 89; and Pellestrina 70 days (residents) and 46 (day visitors). The number of visit days in autumn/winter is smaller than in spring/summer. In spring/summer a number of respondents visit the beach more than once per day.

The individual value of the beach recreational use changes according to the site characteristics. Table 2.1 shows the mean daily use values of the four Italian beaches according to the beach characteristics, scenarios, seasons, and population groups. Extreme values

Picture 2. Lido di Dante developed beach in its present state.

Picture 3. Lido di Dante undeveloped beach in its present state.

were excluded. Regarding the *beach characteristics* in the present state, the developed and semi-developed areas of the Lido di Dante beach (Picture 2) have a lower value than the undeveloped (natural and unprotected, see Picture 3) area, probably because the latter is a natural beach with dunes; very rare in the region (Marzetti and Zanuttigh, 2003). The undeveloped beach of Lido di Dante has a higher value than the undeveloped beach of Ostia (artificially expanded and less attractive). The developed Lido di Dante and Ostia beaches (very wide and long, with light sand, and artificially protected; Pictures 2 and 4) are given almost the same value by respondents, much higher than the Barcola seafront in Trieste (very small gravel beach), and Pellestrina (completely artificial, made of dark sand, Picture 1).

Table 2.1 also shows considerable variations in the daily use value in each scenario status quo (present state), erosion and expansion, as indicated above. The eroded beach value is lower than the current state beach value in Lido di Dante and Ostia (Compositions 2 and 4, and Picture 5). The lowest mean use value for an eroded beach is elicited at Ostia. The estimated value of the hypothetical artificially protected beach is

Composition 2. Lido di Dante developed beach in a hypothetical situation of erosion.

Composition 3. Lido di Dante developed beach in a hypothetical situation of expansion.

higher than the status quo value: in Lido di Dante the mean use value of the protected beach (Compositions 3 and 5) is 2.5% higher than the status quo value, while in Trieste it is 58.8% higher (Composition 1). This divergence may be explained by the difference in beach expansion with respect to the status quo.

Considering the mean use value according to the different *seasons*, as shown in Table 2.1, the value of the Barcola seafront in Trieste is slightly higher in autumn/winter than in spring/summer; the number of visitors is higher in autumn/winter, but the mean number of days and the daily mean hours are lower in autumn/winter. The values of the Lido di Dante and Pellestrina beaches are much higher in spring/summer than in autumn/winter. Not only did the respondents who visit the beach in autumn/winter state lower values (in summer they stay on the beach on average much longer than in winter), but the majority of respondents do not visit the beach in winter. In particular, as regards the Lido di Dante

Composition 4. Lido di Dante undeveloped beach in a hypothetical situation of erosion.

Composition 5. Lido di Dante undeveloped beach in the hypothetical situations of expansion.

beach, the mean use values in autumn/winter have been computed for the whole sample (people who do not visit the beach in autumn/winter have a zero value for the daily beach use) and for people who visit the beach in autumn/winter only. In spring/summer the main activities are sunbathing, relaxing and swimming, while in autumn/winter the majority of respondents only walk.

Finally, considering population groups Table 2.1 shows that at Lido di Dante, the highest mean use value in spring/summer was elicited from tourists, while in autumn/winter it was elicited from residents. This may be due to the fact that in spring/summer the tourists who travel to Lido di Dante on holiday value beach recreational activities highly; while the residents in spring/summer suffer a loss of enjoyment due to congestion, and attribute a greater value to daily beach use in autumn/winter because there is no congestion. On Pellestrina Island, the residents' average estimated value for the beach was higher than for day visitors. The daily use value also changes considerably according to nationalities. At Lido di

Picture 4. Ostia beach in the current state.

Picture 5. Ostia beach in an eroded state.

Dante, foreign visitors (except Dutch respondents) gave higher use values than Italian visitors.

The VOE is intended to measure the value of the recreational activities on a specific beach or destination; it should be interpreted as the cost of the most comparable activity. It is likely that respondents interpret the valuation question conditionally on being at or near the beach. Also, the visitors' trip usually has multiple destinations, and in practice it is not always possible to establish the share of this cost for one only destination. Consequently, the CV method with VOE format cannot be used to assess the influence of the

Table 2.1
Beach use values in Euros per person per day

Mean value	Spring/summer			Autumn/winter	
	Status quo	Eroded	Protected	Status quo	Expanded
Lido di Dante	27.67	13.26	28.37	4.10*	
North1 (developed)	25.41	11.47	27.43	16.38**	
North2 (semi-developed)	27.21	9.94	26.35	17.60**	
South (undeveloped)	32.44	21.49	33.39	19.62**	
Residents	10.25	9.33	23.14	27.89*	
Day visitors	23.21	10.76	24.91	4.32*	
Tourists	32.28	15.51	31.53	3.25*	
Nationals	26.45	12.49	17.99		
German	30.93	16.45	28.65		
French	30.00	14.04	33.36		
Swiss	53.33	28.70	36.38		
Dutch	22.50	5.50	25.00		
Other nationalities	39.33	14.08	31.73		
Trieste (residents)	5.24		8.32	5.25*	6.45
Ostia	17.91	2.05			
Developed area	23.28	2.47			
Undeveloped area	6.21	1.15			
Pellestrina	9.23			3.54*	
Residents	9.69			5.01*	
Non-residents	8.72			2.11*	

* Indicates the whole sample; ** indicates people who visit the beach in autumn/winter only.

travel cost on the elicited beach use value. Respondents who do not like the eroded or artificially protected beaches have the option of going to an alternative beach. In the hypothetical erosion situation, 16.4% of respondents would stop visiting the Lido di Dante beach, and 29.1% would visit it less or much less often, while as regards the Ostia beach 36% of respondents would stop visiting the beach and 39% would visit less often. In the situation of expansion, only a few respondents would reduce the number of visits (4.8% in Lido di Dante and 4.5% in Trieste) and would go to another beach.

Computation of the aggregate use values of the considered beaches meets the difficulty of measuring the number of day visitors. No official data about the total number of visits per year to these beaches exist; only data about tourists are available from local records. Nevertheless, if the sample is representative, using the CV survey, an estimate of the number of day visitors on the beach can be made. For example, at Lido di Dante, the CV survey shows that 44.8% of the respondents are day visitors and they visit the beach on average just under 23 days per year; using the VOE estimates from Table 2.1, it can then be shown that the estimated total loss of enjoyment due to beach erosion at Lido di Dante is more than €3 million per year (Zanuttigh et al., 2005). Trieste, on the other hand, is only visited by (about 235,000) residents; the beach expansion is important, and the aggregate annual value of the beach change has been estimated about €15 million per year.

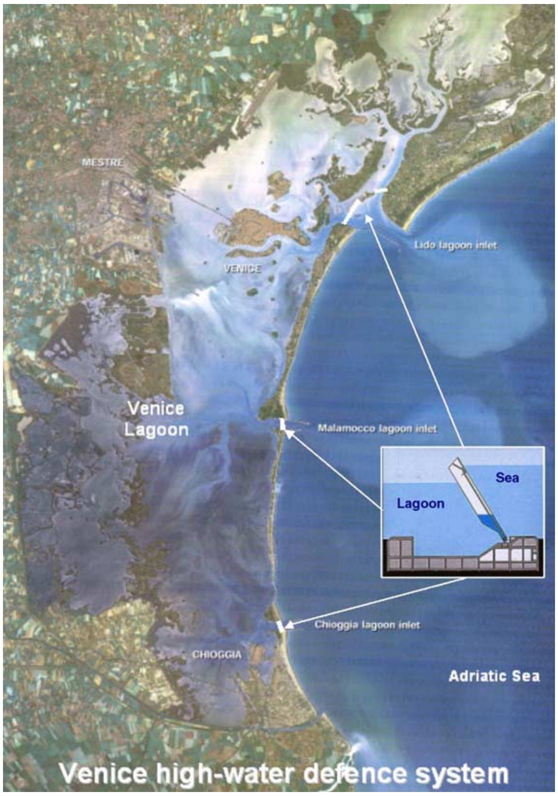
3. The Venice case study

This section illustrates the valuation of the coastal defense of a cultural and historical heritage site, the city of Venice, with a focus on option and non-use values (see Table 1.1). The aim is to estimate the willingness to pay (WTP) for the defense of Venice from sea flooding by means of a CV survey. In this section of the paper the main results are presented; for the complete results see Marzetti (2003, D28/B-I).

In 1987, Venice and its lagoon were designated World Heritage Site by the UNESCO. The town, with its architectural and historical characteristics, requires rational management and protection because it is affected by floods and high water phenomena which may take the nature of extreme flooding events. The coastal defense program of Venice consists of different kinds of interventions: (i) defense and rebalance of the morphological and hydrodynamic system of the lagoon, (ii) defense of the buildings, (iii) elevation of floors and pavements, (iv) protection of the natural barriers of Pellestrina and Lido islands from sea erosion by the building of artificial beaches protected by low crested structures, and (v) the temporary closure of the three inlets with mobile floodgates – the famous MO.S.E. – built inside the lagoon across each inlets. The amount of public funds involved is considerable. In particular, the Italian Government has allocated about €65 million in 15 years (more than €4 million per year) for the implementation of MO.S.E as from 2005. Because public funds are scarce, the implementation of a coastal defense project competes with that of other projects. Therefore, not only does the use value of Venice have to be included in the CBA, but also its option value and non-use values.

A CV survey was administered to assess the future use and non-use values of Venice and its lagoon. Depending on the relevant population, different kinds of surveys can be administered. Given the available funds and because Venice is visited by 10 million people of all nationalities per year, an on-site sampling of visitors (tourists and day visitors in the most crowded streets of Venice, national and foreign, aged 18 or over) was chosen. The main aims of the survey are: (i) to assess the amounts that the respondents are willing to pay to maintain or improve the existing quality level of Venice as cultural heritage; (ii) to investigate the donation and non-donation motives of the WTP; (iii) to collect information about the social characteristics of the respondents, and type and frequency of visits to Venice.

The questionnaire was drawn up considering the specific characteristics of the site, and the kind of survey chosen; a detailed version of it can be found in Marzetti (2003, D28/B-I). In particular, for the value elicitation questions, the “modified double-referendum” format was used (double dichotomous choice plus open-ended questions; see Shechter et al., 1998). The payment vehicle was one donation per year. Respondents were first reminded that there are many other worthy causes to contribute to, and presented with the high water defense program of Venice (they were shown Composition 6 below);



Composition 6. Venice Lagoon — The MO.S.E.

then they were asked (i) whether they were willing to pay €1 per year to a non profit agency for that program; if the reply was yes, (ii) they were asked whether they were willing to pay more; if the reply was again yes, (iii) the maximum WTP was asked. Given the hypothetical nature of the CV survey scenario, the elicited WTP could be different from the true WTP, therefore respondents were also asked how confident they were, on a scale from 1 to 100, that they would really donate the elicited amount (Champ et al., 1997). Before administering the main survey, a pilot survey was administered to test the questionnaire.

The sample consists of 1000 face-to-face interviews of 10–15 min each; 24.2% of interviewees were Italians and 75.8% non-Italians (European and non-European). A high percentage of the non-Italians were from Germany, Great Britain and the USA. There were 55.7% of tourists and 44.3% of day visitors. 58.4% of the respondents revealed their annual household income. The respondents' main recreational activity is walking around the streets, followed by visiting museums. A large proportion of respondents (93%) are in favor of the implementation of the protection program; of those against the project, just over 3% were Italians and 6% non-Italians.

In answering the value elicitation questions, 71.1% of the respondents stated that they would be willing to pay at least €1 to cover the cost of the flood and coastal defense program (77.7% of the Italians and 69% of the foreigners) and 40.9% would be willing to pay more than €1. Considering the whole sample, respondents indicate values from 0 to 100; the mean WTP for the defense of Venice is €4.85 per year (standard deviation 11.16). The day visitors' mean WTP is €3.95, while the tourists' mean WTP is €5.56 (Marzetti and Lamberti, 2003). As shown in Fig. 3.1, the mean WTP differs widely according to nationality: French and German respondents have the smallest mean values, while US and Italian respondents the greatest mean values.

In addition, 64.4% of the people claiming to be willing to pay at least €1 to cover the cost of the Venice defense program are 100% sure that they would indeed pay the stated amount if actually asked to; 1.3% of the respondents claim to be very uncertain. The mean subjective probability to pay is 0.88. Taking the probability of paying into account, the expected WTP is €4.39 (standard deviation 10.41). Considering only those respondents who are certain to pay (368 people), the mean WTP is €7.81 (median 5.00 and standard deviation 13.18). We highlight that, because Venice is a UNESCO World Heritage Site, the aggregation level is the entire world (King, 1995); we cannot estimate the aggregate value of Venice ascribed to option value and non-use values, but only the aggregate WTP of tourists and day visitors in Venice. Therefore, because Venice is visited by about 10 million people per year, the WTP of tourists and day visitors in Venice for option price and non-use values could be more than €40 million per year.

The respondents who were willing to pay at least €1 for the cost of the program were also asked their donation motives. Most of them were willing to pay for preserving Venice for future generations, just over 17% for visiting the city in the future, and 10.5% just for knowing that Venice exists. People who would not donate for the protection program (289 respondents) were also asked their motives. About 38% of these respondents think that paying for this project is the

State's duty; just over 18% said that the protection is not their problem because they do not live in Venice; and just under 12% thought that the money should be spent on some other projects.

4. The Normerven case study

Using a CV survey, we value a small restored marine natural area called Normerven in the Netherlands. Normerven was formerly a natural mudflat set along the dyke protecting the Netherlands from the Waddenzee (a huge shallow lagoon). Because of human action, Normerven was reduced to a thin band of land just in front of the dyke, but was later restored to a state comparable to the historical one. The restoration was achieved by filling up the area formerly occupied by the mudflat and defending it from sea erosion by constructing two low crested structures, one facing south and the other west, while the east was closed by the dyke. The structures were just low enough to be overtopped on a few winter tides but not more often; this had the purpose of maintaining suitable conditions for seabirds nesting. The restored area appears to be stable since 1995 and has seen a spectacular increase in the number of nesting pairs of birds, reaching for some species 2% to 3% of the Waddenzee population (based on computations from RIKZ, 1999).

Access is forbidden to Normerven and its location behind the dyke makes it invisible to all except those who are specifically searching it. Therefore, the site has virtually no recreation or tourist value. It has no value as a protective device either because it is so small comparatively with the dyke it is set against; at best it may reduce the maintenance cost of the dyke but in such a small scale that it can be considered negligible. There are, however, the classical non-use motives for value: altruism, care for future generations, duty towards the environment. . .

In a face-to-face CV survey, the respondents were presented (in their home) with hypothetical scenarios of valuation in which the site would be replicated at various locations along the coast of the South Waddenzee region. The respondents were told that the government of the Province (the relevant authority for that kind of project) intended to build from one to ten new sites similar to Normerven. After a description of Normerven and of the project in details, the respondents were shown three pairs of cards in sequence. Each card represented an alternative future described in terms of two characteristics: the cost of the project and the number of sites that would be built.

The so-called cost of the project is not in fact related to the actual cost of building the new sites; it is a hypothetical amount that varies among respondents. The purpose is to observe how the respondents react to the "cost" they are shown. For that reason, the "cost" is called a "bid" in the current context. The

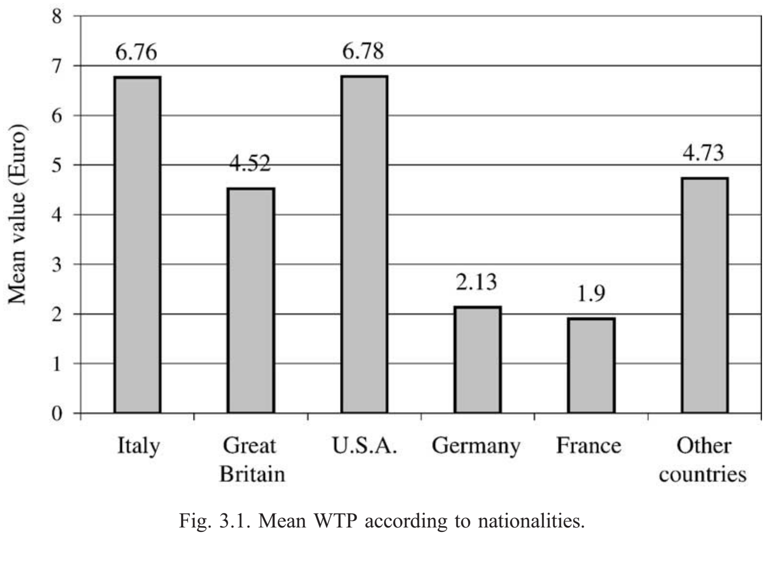


Fig. 3.1. Mean WTP according to nationalities.

exact location of the sites was shown on a map. The number of nesting pairs of birds that could be expected was also stated, in absolute values and in relative terms with respect to the total for the whole Waddenzee. In each pair of cards, one of the alternatives was always the do-nothing option, that is, Normerven is not replicated; that costs zero since maintenance of Normerven is negligible. The respondents knew in advance that they would be shown three alternative futures, but they were not told which characteristics they would have. For each pair of cards, the respondents were asked to indicate their preferred alternative. The payment vehicle was the real estate tax, paid by every household in the Netherlands, because it is the only one on which the government of the province has a substantial influence.

The sample was selected randomly from the census file of the North region of the North-Holland province, where Normerven is located. The survey was administered sequentially in rounds of about 100 questionnaires (see Hanemann and Kanninen, 1999, for a survey of sequential administration). After each round, a quick analysis of the answers made it possible to update the bids if needed. Only one bid update occurred, between the 2nd and 3rd rounds. Exactly 600 questionnaires were completed, out of which some 73 are excluded for this analysis. The two most typical reasons for exclusion are that the interviewer made some mistakes in the alternatives that had to be shown to the respondents and that the respondent chose not to answer (an option that he was explicitly given). Since the remaining 527 observations have each three valuation choices, there are 1581 lines of data. Table 4.1 shows the proportion of Yes answer for each pair (bid, site). A "Yes" answer indicates that the respondent prefers the do-something alternative to the do-nothing one. Empty cells are empty by design.

Table 4.1
Relative frequencies of yes

Bid	# Extra sites				# Observations
	1	3	5	10	
6	0.73	0.77			349
12	0.61	0.71	0.48		89
18	0.64	0.63	0.74		219
24	0.45	0.54	0.51	0.36	100
40	0.59	0.56	0.49	0.28	252
50		0.50	0.45	0.40	86
80		0.50	0.39	0.32	288
150			0.39	0.22	198

As expected, in most cases the frequency of Yes decreases when the bid increases. It was expected that the frequency would increase when the number of sites increased, but that turned out to be true only from 1 to 3 sites. From 3 to 5 sites the frequency is roughly stable, and then decreases sharply for 10 sites. In other words, the marginal utility of an additional site is actually zero after the third site and negative after the fifth site. The reason for that behavior may be that the new sites are competing with other uses and non uses of the coastline. Extra sites are not "other things equal" because they occupy space, thus the respondent's WTP for an extra site can actually be negative because his WTP includes the disutility of some lost space or increased nuisance. For example, some respondents stated that one of the sites would reduce the usage of a local sea port by partially blocking its entrance (each site location had in fact been planned with engineers and marine biologists). Too many birds may also generate a series of nuisances. This feeling of competing usages or that there is already enough nature or birds in the region, is the second motive (a little under 20%) for a No answer, after the cost of the alternative (42.4%).

Since the respondents had three valuation choices, the most flexible model to represent their choices is the trivariate probit. It can be shown that with our data, this model is observationally equivalent to a random effect panel data probit model in which the means are not equal to each other's in the three choices. The formulation of the model is described in Greene (1993). The estimation results confirm that the larger the bid, the less likely is a Yes answer. An increase in the number of sites corresponds to an increase in the probability of a "Yes" answer for low numbers of sites (1 to 3) but to a decrease for large numbers (5 to 10). Respondents tend to answer "Yes" more often when they are members of environmental organizations, when they work part or full time, when they spend a large part of their leisure outdoors, when they think that there are many threats to the environment and when they think that many aspects of the environment should be "helped." A larger proportion of "Yes" answers occurred in the first valuation question than the next two. A similar phenomenon occurs

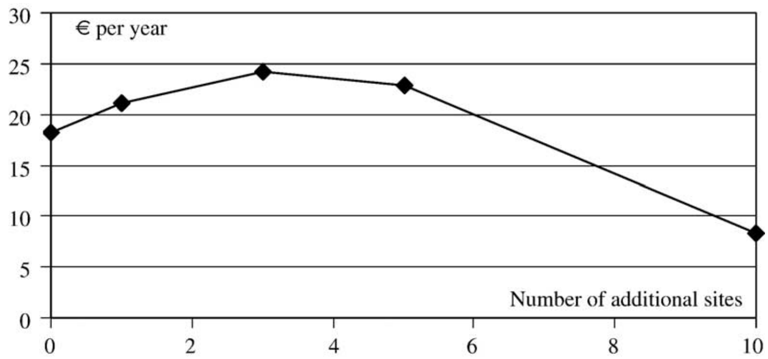


Fig. 4.1. Median WTP function.

in double-bounded CV; several explanations are possible, see Hanemann and Kanninen (1999) for an overview of that discussion.

The estimated model is a Random Utility Model. It is compatible with economic theory and can be used to extract a welfare measure in a manner similar to that of Hanemann (1984). The relevant welfare measure in this case is the WTP because the survey depicts a situation in which the respondents do not own the additional natural areas and may (collectively) decide whether to acquire them or not. The median of the WTP is the amount such that the probability of a Yes answer is .5. It is a more robust statistic than the expected WTP because it is less sensitive to the tails of the statistical distribution chosen for estimation. The main results of the estimation are shown in Fig. 4.1. The results shown correspond to the most conservative scenario; they constitute a lower bound.

The value of the original Normerven site can be extrapolated as shown in Fig. 4.1. It is apparent that it is this first site that generates most value. From there, the WTP follows a quadratic curve that culminates at 3 new sites and then starts decreasing (5 new sites are still worth more than one). As discussed already after Table 4.1, one should not be surprised of this phenomenon: the additional sites are competing with other uses in terms of space, thus respondents may consider that there are too many bird areas similar to Normerven.

This result has a direct bearing on benefit transfer (see the next section), namely that the value of two identical sites may differ accordingly with the order in which they are provided. If the conclusions of this chapter can be generalized, then the (marginal) value of each additional site decreases as the total number of sites increases. For a detailed version of these results, see Polomé et al. (2003).

5. Benefit transfer

This section presents an example of benefit transfer for coastal defense. The technique of benefit transfer is intended to assess whether and how economic values known at some sites can be used to infer the value at an original site, called the study site. Ideally, one would like to estimate a transfer function for each type of benefit present at a coastal defense site (Table 1.1); that is, for each type of benefit, a function linking the value to socio-economic and physical characteristics of the study site. However, for most types of benefit there are only a few studies or none at all. The only exception is a composite of several recreational activities at the coast, called "informal beach recreation" in some references. A transfer function for that category of benefit is estimated in this section. That is the same category of benefit as the one studied in the Italian case studies of Section 2.[2] A figure is also presented describing the probability that the transferred benefit fall within bounds of the value that would have been estimated with a new study. Such a figure lets the users of the transfer function decide what level of risk they are willing to take or whether they prefer instead to undertake a new study.

The data come from three sources. The first one is a library search of published and unpublished papers,

[2] Because of time constraints however, the results of those studies could not be included in the benefit transfer exercise.

including reports. It is important not to restrict the search to published papers; otherwise a selection bias could appear. The second source of data comes from unpublished British results collected by Professor C. Green (Flood Hazard Research Centre, Middlesex University). Those data are scarce regarding the description of each site being valued and the socio-economic characteristics of the local or visiting populations. Furthermore the value concept used in those data is the Value of Enjoyment (VOE) developed by Penning-Rowsell et al. (1992) instead of the more standard WTP. VOE is to be seen as an average of the prices of experiences similar to a visit to the beach; WTP is the maximum amount a person would pay to visit the beach or to preserve it, depending on what the researcher intends to estimate. The third source of data comes from studies by the US National Oceanic and Atmospheric Administration collected by Professor W. M. Hanemann (University of California at Berkeley). Those data are also scarce regarding the physical description of the beach and the socio-economic characteristics of the visitors, but they are based on more conventional value concepts.

In none of the data sources used in this exercise substitute sites were completely taken into account. This is a drawback (see Herriges and Kling, 1999) and it indicates that the estimated values in each study are to be taken as upper bounds because the loss of the site corresponds to the value of the site. If substitutes are taken into account, the loss of the site corresponds to the difference of values with the next best site. Another shortcoming of benefit transfer in this case relates to the number of visits to the beach. All the available values are per visit to the beach. To estimate the value of the beach itself, it is still necessary to know the total amount of visitors to the beach and their number of visits. That information was not available and is generally difficult to acquire. An estimation of the prospective visitors, who would appear following an improvement of the beach, was also absent. However most surveys are concerned about preserving the beach in its current state; hence prospective visitors are not an issue. An additional problem is the on-site sample bias. That bias is due to the fact that when visitors are randomly selected on-site on a beach, the frequent visitors are over-sampled (see Shaw, 1988). This will bias upward the estimate of the count and the effect on the estimation of the individual visitor's value is unclear.

The data set has 106 observations, but only 38 different sites. Some sites have been observed during more than one year, and for some sites there were hypothetical behavior questions such as "how much would you value this beach if it was eroded" (the actual phrasing of the question is unknown for most studies). Only three countries provided data: the UK, with 79 observations, the US with 22, and the Netherlands with 5.

In our data set, there is information on three categories of variables. A first category, X, is the site characteristics, containing two variables: site type and site quality. Sites are classified in 3 types: Coastal resort (101 observations), Beach (5) and Dune (2). A site can have three "quality levels": current state (64 observations), eroded (20) or defended (24). This measure of quality is very coarse. "Current" refers to the beach as it is at the moment of the study; as far as we can say on the basis of the present data set, this is in fact a wide range of qualities. It merely denotes a coastal site that is enjoyable under normal conditions. "Eroded" indicates a quality, usually hypothetical, in which only a narrow range of the beach remains in place, if any. "Defended" indicates that a coastal defense scheme, also usually hypothetical, is implemented that partially modifies the aspect of the beach and may enlarge it. We do not have information about the exact scheme that was used at each site; it is likely that nourishment was the main defense, possible accompanied at some sites by groynes or boulders. This is only a guess from the information that we have: a coastal site is usually the object of a study when it is already somewhat eroded; the defense scheme aims at restoring it to previous levels.

A second category of variables, Y, is the socio-economic variables. The only variable here is represented by means of 4 categories of respondents: the local visitors (16 observations), the non-local visitors among which those who stay a single day (15) and those who stay longer (15), and those observations for which this distinction is not made (60).

The last category of variables, Z, relates to the study itself. A first variable in this category is the year the study took place, ranging from 1975 to 1995, with most studies in the early nineties. A second variable is the concept of value that has been used:

VOE in 78 cases, WTP for use in 13 cases and consumer surplus in 15 cases.

The value itself is expressed per visit per person in Euro of 2001, adjusted by the consumer retail price index of the relevant countries up to 2001 and then converted to Euro using the average rate for 2001. The average of the values (across all sites and all qualities) is nearly 17, with standard deviation around 14, minimum 1, maximum nearly 92. Table 5.1 compares the data used in this report with the three other known references in which a value for transfer is suggested.

To formalise the analysis, we start with the prototype linear benefit transfer function from Brouwer (2000):

$$V_i = \alpha + \beta X_i + \gamma Y_i + \delta Z_i + \varepsilon_i, \quad (1)$$

where $\alpha, \beta, \gamma, \delta$ are parameters to estimate, V is the value per site per visit for a given policy, X, Y and Z have been defined above and i indexes the studies. Because we have no data on several variables that could explain the value, such as beach width and length or respondents' income, Ordinary Least Squares (OLS) estimation of the coefficients $\alpha, \beta, \gamma, \delta$ of Brouwer's model (1) is generally biased and inconsistent. This is a standard result about OLS: missing regressors lead to bias on the coefficient estimates unless there is no correlation between the missing variables and the included ones (an unlikely event). However, since in the current dataset, there is often more than one observation for a single site, an alternative benefit transfer function can be written as:

$$V_{it} = \alpha_i + \beta X_{it} + \gamma Y_{it} + \delta Z_{it} + \varepsilon_{it}, \quad (2)$$

where V_{it} is the value for site i in circumstance t. A circumstance can refer to a different point in time (a different year), or to some hypothetical situation (for example, the site is eroded). Model (2) is called a panel data model: for each site, there can be more than one observation. The main formal difference with Brouwer's model (1) is that the intercept term α_i is now specific to each site (it is indexed by i). The interesting feature of the site-specific intercept term of the panel data model (2) is to account for all the differences in values across sites not accounted for by the regressors. For example, although income is not observed, the effect of the average visitors' income on site i estimated value is captured by the intercept term α_i. Thus the OLS bias problem is avoided.

When the goal of the study is to estimate the marginal effect on the measure of value (V) of a change in some characteristic of the beach, the panel data model (2) is always to be preferred because it avoids the biases caused by the missing regressors. However, more regressors can be included in model (1) than in model (2) because all the variables that do not change over the year are captured by the individual specific constants α_i of the panel data model (2) and have therefore to be excluded from that model. For example, the country where the study took place is a variable in model (1) but not in the panel data model (2) because the site-specific intercepts represent not only the country but also the region and any variable which has no variation within one site. If we would try to insert dummies representing the country in the panel data model (2), there would be linear dependence between them and the site-specific intercepts α_i and that would preclude estimation. Therefore, when the goal of the study is to predict the value of one site given a series of characteristics, Brouwer's model (1) should be estimated using OLS. This is because biases in the estimated coefficients are not important for prediction. Of course, the estimated

Table 5.1
Average value per visit to a beach (Euro of 2001)

Source	Country	Current state	Eroded	Defended	Value concept
Average of available data	UK	17.7	9.1	20.6	VOE
	US	23.1	–	–	WTP for use or consumer surplus
Penning-Rowsell et al. (1992) "generic" beach	UK	15.6	8.2	18.7	VOE
US National Oceanic and Atmospheric Administration (informal communication, 1995) "standard" beach	US	13.9	–	–	WTP for use
Loomis and Crespi (1999)	US	22.4	–	–	WTP for use

Table 5.2
Panel data model "WTP"

Variable	Coefficient	*P*-value
Intercept	19.38	0.002
T	0.22	0.49
Category of visitor (default is "unspecified")		
Day	4.70	0.22
Local	1.55	0.69
Stay	4.12	0.29
Concept of value (default is VOE or CS)		
WTP	−15.67	0
Quality of the site (default is "current")		
Eroded	−8.37	0
Defended	3.30	0.02

coefficients of model (1) have no interpretation since they are biased. Below the estimates of both models are presented and we show that the panel data model (2) is not as good a tool as model (1) when it comes to predict the value of one site.

5.1. Marginal effect: panel data results

The date (*T*) of the study is a cardinal variable and is inserted in the regressions as a natural trend starting in 1975 (normalized to 1). The 4 categories of visitors (local residents, day visitors, stay visitors and unspecified type) are represented using three dichotomous variables (Local, Day, Stay), with the omitted category (the default) being the unspecified type. The 3 categories of quality of the site (eroded, current quality, defended) are represented using two dichotomous variables (Eroded, Defended); the omitted category is the current quality. Finally, the concepts of value (VOE, WTP for use, Consumer Surplus) have been represented by 2 dichotomous variables (WTP, CS), the omitted category being VOE. It turns out that the sum of WTP and CS is a vector of zeros and ones identical to the sum of certain site-specific constants; this is a direct consequence of the fact that in most cases the value of a site has been estimated using a single concept of value. Therefore, one of these 2 variables had to be removed to enable estimation (otherwise, perfect collinearity impedes estimation), but since the decision to remove is arbitrary, we present the 2 sets of results: in the first one (Table 5.2) the variable removed is CS, the dummy indicating the Consumer Surplus, in the second one (Table 5.3) it is WTP, the dummy indicating the WTP for use.

The first thing to remark from these tables is that they are quite similar with the exception of the intercept term. The intercept changes because of the two different dummies (WTP or CS), this is reasonable because these dummies indicate a change in the average value of the site (the default is different), and hence of the intercept. The coefficients of the regressors change little; this indicates that the effect of these variables on the value is similar whatever the concept of value that is used. The effect of time (*T*) is statistically negligible; that is, the value of sites for coastal informal recreation has not changed noticeably between 1975 and 1995 (in real terms since the value is expressed in Euros of 2001). The effect of the type of respondents (Local residents, Day visitors, Stay visitors or Unspecified) is not statistically significant either. The quality of the site (Current, Defended, Eroded) is unquestionably very significant.

Finally, the high significance of the concept of value used (VOE, WTP for use, Consumer Surplus) is worrisome. It is acceptable that different concepts of value yield different values, but the problem is that different valuation methods and designs have been used for the different concepts. Therefore, we cannot tell whether the differences in value are genuine or are led by the valuation method that has been used. If it is the former, we would still have to decide which concept of value is more appropriate. If it is the latter, then benefit transfer of informal beach recreation is partially flawed since different methods lead to differ-

Table 5.3
Panel data model "CS"

Variable	Coefficient	*P*-value
Intercept	10.22	0.08
T	0.22	0.48
Category of visitor (default is "unspecified")		
Day	6.26	0.11
Local	3.12	0.42
Stay	5.67	0.14
Concept of value (default is VOE or WTP)		
CS	15.90	0
Quality of the site (default is "current")		
Eroded	−8.32	0
Defended	3.30	0.01

Table 5.4
OLS estimate of model (1)

Variables	Coefficient	Number of cases
Intercept	−9.35	
T (1975=1, each year is one)	1.87	
Country of study (default is UK)		79
US	23.56	22
NL	1.39	5
Type of site (default is "coastal resort"; that is, an "equipped" beach)		99
Beach	−10.94	5
Dune	−10.47	2
Type of visitor (default is "unspecified")		60
Day	−7.82	15
Local	−9.78	16
Stay	−8.00	15
Concept of value (default is VOE)		78
WTP	−22.66	13
CS	−12.44	15
"Quality" of the beach (default is "current" state)		64
Eroded	−9.27	20
Unspecified defense	2.95	14
Defended by nourishment	−1.47	4
Defended by nourishment plus groynes	3.13	4

ent values for the same beach. For certain situations, the researcher was imposed the method (e.g. in the UK, only a specific CV format was admissible for claims of funding to the former Ministry of Agriculture, Fisheries and Food), but in general, this suggests a lack of standards in applying valuation methods to beach recreation. On the other hand, it is possible that the value concept variable is capturing some of the site or socio-economic characteristics because VOE is only used in the UK and CS is mostly used in the US. The average value is around 16 (of 2001) for the UK and 22 for the US sites.

5.2. Predicting values: ordinary least squares results

As stated above, because of missing regressors, the OLS estimator of the coefficients of model (1) is generally biased and inconsistent. It is therefore not worth trying to correct for other possible estimation problems. Yet, when the goal of estimation is prediction (that is, transfer), bias in the estimated coefficients is of no importance. Whether the coefficients are biased or not, the OLS estimator minimizes the prediction error by construction.

The estimation results are described in Table 5.4. As explained above, there are more variables in model (1) than in the panel data model (2), but the OLS estimator is inconsistent and therefore the estimates of the coefficients are not meaningful. For that reason, their significance is not shown. The overall fit (adjusted R^2) of the model is about 40%, but it is unclear whether it can be taken as a good measure of fit in the current context.

5.3. Benefit transfer

To transfer values to an entirely new site, that is, to predict the value of the new site, one would

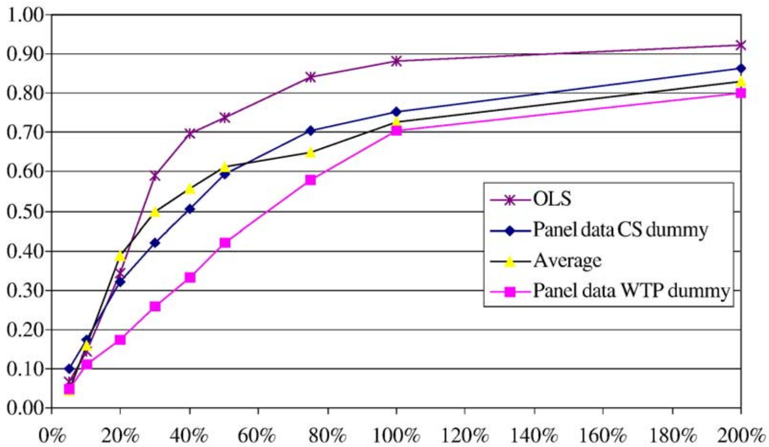


Fig. 5.1. Benefit transfer cumulative distribution of prediction errors.

simply substitute the new site's characteristics and the estimates of Table 5.4 into model (1). To estimate the size of the error that one could commit by proceeding in this way, we have devised the following exercise. For each site, we ran the panel data and OLS regressions without that site's observation(s) and predict its value. Then, to measure the gain of precision obtained by carrying a new study, we compared the predicted value(s) with the one(s) obtained from the original study(ies). The measure of prediction error is the proportion of deviation from the value reported for the site in absolute term. In Fig. 5.1 below, the line referring to the "average" (triangles) represents the average-value prediction, that is, the value of one site is set equal to the average value of all the other sites, regardless of the sites characteristics.

Fig. 5.1 reports the proportion (on the vertical axis) of predictions that falls below the error level indicated on the horizontal axis. For example, the proportion of errors no larger than 40% in transferring a value is about 70% for OLS and 55% when the prediction is the average of the values of the other sites. In other words, when transferring value using model (1) estimated by OLS (Table 5.4), there is a 70% chance of making an error of 40% or less, and (approximately) a 90% chance of making an error of 100% or less. Fig. 5.1 is a truncation of the complete plot since there is a non-zero probability of making an error larger than 200% (about 5% chance with OLS).

We say that model A predicts better than model B when the cumulative distribution of prediction errors of model A is above that of model B. In that sense as can be seen in Fig. 5.1, the panel data model with WTP dummy (Table 5.2) performs worse than the simple average of values. That does not undermine the qualities of the panel data model (2) as an unbiased estimation of regression coefficients, but for prediction (that is, transfer) purposes, the best model is model (1) estimated by OLS. That is not to say that better estimators cannot be found, but we would have to resort to more sophisticated econometric estimators (e.g. Tobit models to take into account that values cannot be negative). Given the limitations of the data set on the one hand and, on the other hand, the fact that the transfer function should be easily usable by non-economists field practitioners, we have preferred the simplest models. More details can be found in Polomé (2002).

6. Conclusions

The contributions presented in this paper have shown the important diversity of coastal values – from informal enjoyment of a beach to heritage and nonuse values – and have provided examples and illustrations of estimation of these values. The focus has been on the valuation of non market benefits.

In Section 2, the Penning-Rowsell et al. (1992) value of enjoyment methodology has been adapted for the valuation of four Italian beaches. These surveys have shown mean values for informal recreation on a beach in its current state from €5 to €28 per visit. This is therefore of the same order of magnitude as the US and UK beaches, even though there are large variations across beaches, and some respondents sometimes express very large values. The Italian surveys have also shown that coastal visitors are sensitive to the protection of coastal sites from erosion and flooding and that they are generally in favor of defense projects. The value of enjoyment may also vary considerably accordingly with the season (spring/summer or autumn/winter) or the type of visitor (resident or tourist).

The contingent valuation methodology can be used to value other, very different, types of coastal assets. In this paper, two cases were illustrated. The Venice case study in Section 3 indicated values of an order between €4 and €5 per year per visitor for protecting Venice and its lagoon from erosion and recurrent flooding using a complex defense scheme. A large proportion of respondents expressed their certainty to pay the amount elicited if actually asked, though some did not. This confirms the usefulness of a 'certainty question' after the valuation questions in order to estimate the expected mean donation.

In the Normerven contingent valuation survey in Section 4, we estimated a value function for increasing the number of seabird nesting areas in a Dutch coastal province. It has been shown that even if the first area could have a rather large (purely non-use) value (close to €20 per year for 10 years), subsequent areas have strongly decreasing values. One implication of this result for the transfer of benefit is that replication of a defense scheme may not lead to a replication of its value.

In Section 5, a compilation of the existing (published and unpublished) evidence on coastal protection benefit estimates has made clear that it does not seem possible to estimate a function that would provide the total value of a coastal defense scheme for any single site. Instead, previous studies have concentrated on specific types of benefits. In particular, it appears that informal beach recreation has been studied more than any other type of activity at the beach, but even in this case most of the estimated values come from either the US or the UK. The reader should be cautious when using the results of the benefit transfer function presented in Section 2 outside those two countries. Even within these two countries, the probability that the transferred value is within 50% of the value from an original study is only 75% (see Fig. 5.1). The average value of informal recreation on a beach in its current state in these two countries, all methodologies together, is around €20 (of 2001) per visit. This value is within the bounds of the Italian case studies presented in Section 2.

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