RESEARCH ARTICLE

Willingness-to-pay for river restoration: differences across time and scenarios

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Abstract   The European Water Framework Directive (WFD) includes an article on the mandatory provision for environmental and resource costs and benefits in pricing water services. Valuing water resources—e.g., regarding water quality, water availability, ecology, and biodiversity—is therefore an increasingly important topic for all water-related policies, such as the provision of drinking water, wastewater treatment, hydrological engineering, and ship transport. The current study provides empirical evidence on a specific river restoration project in the Danube National Park (Austria) combining improvements in water quality, the reduction of flood risks, and ecological benefits in terms of providing improved groundwater and flooding dynamics in the adjacent wetlands. Our study allows us to test whether willingness-to-pay (WTP) bids of respondents for such programs are different between two identical surveys employed in different years, and between two scenarios differing in scope. The results are encouraging regarding the (short-term) temporal stability of preferences for river restoration. Except for minor differences which are not statistically significant, we find empirical (econometric) indications that WTP bids were roughly in the same order of magnitude between the two surveys. The results of the paper suggest that from the viewpoint of temporal stability, WTP bids may be reasonably transferred over time.

Keywords   WTP (willingness-to-pay) · Contingent valuation · River restoration · Biodiversity · Ecosystem services

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1 Introduction and background

Valuing water-related environmental goods and services not traded on markets (e.g., ecosystem services of water bodies) has become a top priority for policy makers since the implementation of the European Union's Water Framework Directive (WFD 2000). Article 38 of the WFD refers to the polluter-pays principle, and the inclusion of environmental and resource costs in the pricing of water services. Several research projects since then have tried to come to grips with the valuation and inclusion of water-related environmental, and resource costs and benefits. For instance, the so-called Aquamoney project (see http://www.aquamoney.org) brought together research teams from more than 10 European countries to test practical guidelines for the assessment of environmental and resource costs and benefits (Brouwer et al. 2009).

The current paper is an outcome of this international project with the aim to present the results of the application of a contingent valuation of river restoration measures along the Austrian Danube in the federal states of Vienna and Lower Austria[1]. We employed an identical survey in two consecutive years, and also presented two scenarios differing in scope within each survey. Temporal stability and sensitivity to scale are therefore the two main methodological issues of the current paper in addition to presenting willingness-to-pay (WTP) figures for river restoration as a basis for water-related policy making.

Besides the academic interest in the temporal stability of environmental valuation results (cf. Cameron 1997; Brouwer and Bateman 2005; Kealy et al. 1988, 1990; McConnell et al. 1998; Carson et al. 1997; Brouwer 2006), many studies do not find statistically different WTP bids, or reach at inconclusive results. Richardson and Loomis (2009) compare WTP bids over time and also indicate whether concrete day-to-day policy decisions may be based on values elicited at a "study" site and transferred to a "policy" site. Therefore, benefit transfer (cf. recent overviews of Wilson and Hoehn 2006; Lindhjem and Navrud 2008) might be feasible at least over time given the temporal stability of WTP bids while it might, of course, be problematic given the other potentially significant determinants of WTP (e.g., context of valuation; income changes; institutional differences between regions and countries).

The stability of environmental valuation results may, on the one hand, rest on the stability of preferences of households. It may be said that economists in general search for other rapidly changing factors on demand (and WTP), such as income and prices, before they consider changing preferences as a major cause. Stability of valuation results therefore might be considered as good news in the sense that robust values can be transferred to policy sites. On the other hand, if preferences change over time, the valuation results should mirror these changes. However, it has to be

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[1] Bliem et al. (2012) present the results of a test on temporal stability of values for river restoration in a choice experiment setting.

questioned which changes are long-lasting, and which are only due to short-term effects like a "hot" public debate on a certain issue that might cool down fast. For instance, it is not a heroic assumption that a survey on the safety of nuclear reactors might reach at fundamentally different values before and after the current (2011) nuclear catastrophe in Japan.

Furthermore, stable values for environmental goods might also point to the "warm-glow" effect. Even if environmental preferences change over time, stable WTP bids can be argued on the basis of motives other than environmental ones. This is also true regarding the sensitivity to scale of a certain project.

The structure of the paper is the following: Section 2 presents the methodological approach of the current study, provides an overview of the two surveys employed in two consecutive years, and the concrete information and questions presented to respondents. Section 3.1 discusses the descriptive results of the WTP study, also with reference to the representativeness of the surveys. Section 3.2 presents the econometric results and finally Sect. 4 discusses the results, summarizes and concludes.

2 Valuing the benefits of river restoration: methodology

River restoration along the Danube can improve the connectivity between the main stream of the Danube River and adjacent wetlands in terms of dynamics of groundwater and flooding (Hein et al. 2006). Such measure can therefore fulfill three major objectives. First, water quality can be improved by increasing the regeneration and assimilation capacity both of the main stream and the water bodies along the river. Wetlands are more closely connected to the river and can therefore increase the waste treatment capacity of the whole system. Second, it has been estimated that even small river restoration measures can substantially reduce the risk of damaging floods by reducing the velocity of water run-off and by providing larger inundation areas (flood control). Third, a dynamic exchange of groundwater and floods between the river and wetlands increases the variability of water levels, leads to rapidly changing landscapes in terms of pioneer habitats, and provides the basis for increased biodiversity specific to wetlands in the Danube national park (Schabuss et al. 2006).

Figure 1 presents a brief overview of the technical measures and the visible outcomes of river restoration. Besides other measures such as deconstruction of roads, bridges and dams in the wetlands, and connecting the small surface water bodies within the wetlands, the removal of the stabilizing blocks of rock along the river bank is the most important technical instrument for river restoration. Figure 1a presents a typical situation along the Danube River. Figure 1b shows the situation after the removal of rocks, and Fig. 1c highlights the dynamic impacts of floods on the landscape.

In order to value the benefits stemming from river restoration, a questionnaire was designed and implemented in a representative survey of the population in two federal states of Austria, Vienna and Lower Austria. The regional classification was decided on the basis of the location of the Danube national park which is part of the "Vienna green belt" and the federal state of Lower Austria. Studies for river

Fig. 1 River restoration measures. **a** Typical river bank along the Danube River with huge blocks of rock preventing erosion and limiting groundwater and flood dynamics. **b** Situation with removed rocks after a medium-sized flood. **c** Situation after a severe flood with changing landscapes, flow of water through adjacent wetlands, and new pioneer habitats. Source: Danube national park administration 2007

(a)

(b)

(c)

restoration or other measures affecting open or ground water show that it is important to consider the "regionality" of water resources in terms of the river basin (catchment area; cf. Brouwer et al. 2009).

As mentioned above, the valuation of the economic benefits of river restoration was done with two different methodologies—a choice experiment described in the works of Brouwer et al. (2011) and Bliem et al. (2012) and the current contingent valuation setting. Both methods were implemented via a web-based survey by a certified Austrian survey institute, in November 2007 ($n = 532$) and December 2008 ($n = 410$). Respondents were selected based on the socio-economic attributes of the respective population concerning, among others, age, gender, income, profession, and education. The response rate to the e-mail call for participation in the surveys was 26%.

The questionnaire started with a descriptive map of Vienna and Lower Austria, a couple of "warm-up" questions regarding environmental issues (e.g., membership of environmental organizations) and the perception of water-related aspects (e.g., ownership of wells, personal experience with floods, estimation regarding the current water bill). After the choice experiment (cf. Brouwer et al. 2011), the sample of respondents was split into two subsamples each being asked to value a river restoration scenario differing in the size of the area affected. Taking the status quo of about 25% of wetlands in the Danube national park directly connected to the main stream of the river, respondents were asked for their WTP for one of the following scenarios:

–   Connection of 50% of wetlands to the Danube River (Fig. 2b);
–   Connection of 90% of wetlands to the Danube River (Fig. 2c).

From an ecological perspective, introducing hydrological dynamics on 50% of the area is already a very good state, but 90% would underline the characteristics of the national park as wetlands and floodplains park even more, but would certainly limit the use value of the park in terms of recreation since visitors would not be able to cross the wetlands.

Again, respondents were shown maps of the area. Figure 2a presents the current situation of the Danube National Park; dark gray shaded are areas of the national park. Light gray areas are those affected by already effective river restoration measures such as the one described above and presented in Fig. 1.

The following description and question was used for eliciting WTP bids (translated from German):

"As described before, the Danube River is heavily modified in many places. Today approximately a quarter of the river is still connected to the surrounding floodplains and wetlands and the river banks are still in a natural state (SHOW MAP OF THE CURRENT SITUATION).
Restoration measures would connect the river again to the floodplains and the wetlands as they originally were before the changes had been made to the river and river banks. As a result of river and floodplain restoration the landscape will look more natural, with water flowing also through adjacent creeks and ponds. This more natural state will have a positive effect on nature and the variety of plant and animal species found in the catchment. Plans exist to
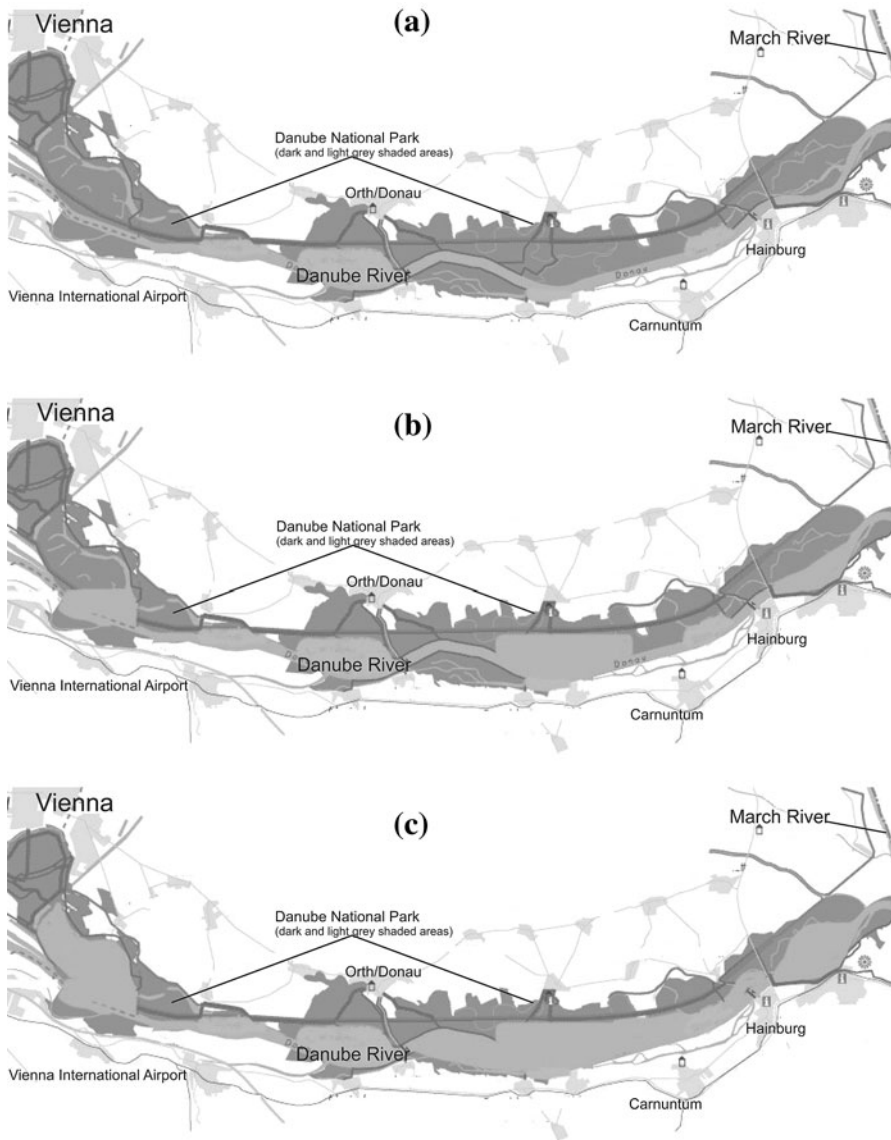
Fig. 2 Scenarios presented as maps to respondents. **a** Status quo with minor river restoration measures undertaken in the Danube national park, **b** Scenario 1 with about 50% of the area affected by river restoration; **c** Scenario 3 with about 90% of the area affected by river restoration. Source: Authors' draft based on maps of Danube national park administration

restore half (50%) (alternatively 90%) of the modified river banks in the Danube national park back to their original natural state as shown on the map (SHOW MAP), and connect the river again with the floodplains and wetlands. Can you tell me with the help of this card how much you are willing to pay MAXIMUM on top of your annual water bill over the next 5 years for

Table 1 Variables of the empirical estimations

Variable name	Description
Dependent variable	
WTP	Willingness-to-pay for river restoration (annual ear-marked contribution, ln EUR)
Socio-economic characteristics of respondents	
Income	Net monthly household income after taxes (ln EUR)
Age	Age of respondent (years, class mean)
Education	=1 for college/university degree
Perception and use of the Danube river	
Quality	=1 for water quality perceived as "good" or "very good"
Scenario	=1 for the sub-sample of scenario II (90% of total wetlands under influence by regular flooding due to river restoration
Vienna	=1 for respondents living in Vienna
Environmental preferences	
Preferences	=1 for respondents holding strong preferences towards nature conservation regardless the costs of conservation
Donation	=1 for respondents regularly donating to environmental organizations
Classification of respondents to surveys	
Group	=1 for respondents of the 2007 survey

the restoration of half (alternatively 90%) of the modified river banks in the Danube national park back to their original natural state as shown on the map?"

Respondents were explicitly told that they should state the maximum amount they would be willing to pay on top of their water bill in order to restore a certain stretch of the river bank. We used a payment card to elicit individuals' maximum WTP. The payment card showed 29 values ranging from € 1–250. In addition, the payment card offered the options "more than € 250, namely …", "other amount, namely…" and "I don't know". The range of bids—as well as all other questions—was tested in a pre-test implemented prior to the main survey (sample size of the pretest: 109 respondents). The WTP question was finally followed by a number of debriefing questions (e.g., eliciting protest bids and other environmental preferences), and by the statistical block referring to socio-economic attributes of respondents.

3 Empirical results[2]

3.1 Selected descriptive survey results

For an overview of all variables used in the current paper, see Table 1. Besides socio-economic characteristics, we include variables denoting the respondent's experience with the Danube River (visits to the wetlands, floods, water quality), and

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[2] All data and empirical assessments including econometric estimations can be sent by the authors on request.

Table 2 Socio-economics of respondents

	Austrian average	2007 survey		2008 survey		Differences 2007/2008
		Mean	SD	Mean	SD	t-Statistic
Age (years)	41.34	40.55	14.73	40.80	14.71	−0.26
Income (household income, EUR, net of taxes)	1,657.22[a]	1,862.59	1,007.47	1,848.72	963.39	0.19
Gender (share of female respondents)	49.9%	49.6%		48.5%		0.33
Education (share of respondents with college/university education)	13.4%	8.7%		10.3%		−0.88
		n = 532		n = 410		

Source: Authors' calculations based on Statistik Austria (2011) and surveys

[a] Mean Austrian equivalent income per household (net of taxes and social security)

several preferences for environmental conservation and river restoration in general. These variables were also partially used in our econometric estimations presented in Sect. 3.2.

Table 2 presents the socio-economic attributes of respondents for both surveys. The age of respondents, income, gender distribution, and education of respondents broadly lie in the same order of magnitude in both surveys. In fact, no statistically significant differences between the two surveys could be detected (cf. t-statistics in Table 2). Compared to the Austrian average, both surveys are representative in terms of age and gender with no differences between the two samples and the Austrian population. Gender of respondents is very close to the Austrian average with about 52% of women and 48% men in the sample. The age structure of respondents lies well within the distribution of the population of Vienna and Lower Austria, with the largest share of respondents between 30 and 50 years. Mean age of respondents is 40.55, respectively, 40.80 years (SD 14.7). The age category ">60" years was proportionally low. An explanation might be that a web-based survey was chosen and elderly people have less access to the web or feel uncertain using an online survey.[3]

Slight differences to the Austrian average can be seen in the share of households with a university or college degree, and regarding income. Both differences are not substantial especially given the potentially different definitions of formal education and income in the Austrian statistics compared to the rather crude measure in the statistical block of the current surveys.

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[3] The slight differences between the two surveys and the Austrian average might play some role in using WTP data for cost-benefit analysis. On the one hand, the results may indicate that benefits of river restoration may be unevenly distributed between different social groups. On the other hand, this also raises the question of the robustness of eliciting WTP values by means of surveys. For instance, one might wonder whether certain social groups have higher (dis-) incentives to engage in surveys (e.g., lower/ higher opportunity costs). However, we think that the differences in the current survey are too small to argue for non-robust results since most surveys include some differences between sample and total population—differences, for which we try to control in our econometric estimations.

Table 3 presents a range of interesting results regarding the perception of respondents of environmental issues. The distribution of respondents for whom data is available are roughly equal between Vienna (Austria's capital and at the same time federal state of Austria) and the federal state Lower Austria. In general, there are basically no differences between the two surveys (2007, 2008) in terms of respondents' answers to these questions except for personal experience with floods ($t = -1.99$, $p = 0.1$ level of significance). Around 9% of respondents stated that they are members of environmental organizations; a larger share of respondents (roughly 37–40%) stated that they would regularly donate to environmental organizations.

After these introductory questions, the questionnaire concentrated on water-related issues of which we only present the most important ones. Based on the WFD water-quality classification, a majority of respondents perceived the water quality of the Danube River as being "good" or "very good" (around 58%) while the rest thought that water quality would be worse (cf. Table 3). On average, water quality was perceived as lying between "good" and "moderate". This result is rather interesting since water quality of the Danube River is—depending on the river section examined—roughly between "good" and "very good", on average closer to "good" (Aschauer et al. 2006). Respondents therefore stated a water quality worse than actual (scientifically reported) levels. About one-third of respondents admitted that water quality has improved during the recent years.

As both programs described above touch upon the frequency of damaging floods, the perception and personal experience of respondents were hypothesized to influence the WTP for river restoration—reducing the tides of floods—in a significant way. Between 15 and 20% of respondents stated that they had some personal experience with floods described by respondents in an open question as flooded basements and homes, traffic problems (flooded roads), broken dams, evacuation, and rescue by military forces.

Finally, the questionnaire also included a number of debriefing questions, among others, regarding the perception of river restoration as a primarily public task, and the strength of environmental preferences.

A slight majority of respondents (around 57%) thought that river restoration is not only a private task but should also depend on private contributions for financing. This result suggests that the question for private contributions to river restoration measures is not as far-fetched from the viewpoint of many respondents. This also correlates to the very low share of protest bids in the WTP question of the survey.

About 35–40% of respondents clearly held strong preferences towards environmental conservation since they stated that the environment should be conserved regardless the costs.

Mean WTP of respondents is presented in Table 4 (see also Fig. 3 for the distribution of WTP bids across scenarios and survey vintages). WTP of respondents for scenario 1 is around € 26–27 per person per year, and thus smaller than WTP for scenario 2 (€ 29–34 per person per year). In the pooled dataset, WTP amounts to about € 27–31 per person per year. While the differences in WTP comply with theoretical expectations—larger environmental programs should gain a higher WTP—the differences between the programs offered are insignificant both in

Table 3 Respondents' perception of environmental issues

	2007 survey		2008 survey		Sum	Differences 2007/2008
	Frequency	Percentage	Frequency	Percentage		t-Statistic
Respondents from						
Vienna	265	52.3	215	52.3	480	−0.13
Lower Austria	242	47.7	196	47.7	438	
n	507	100.0	411	100	918	
Member in a environmental organization						
Yes	43	8.5	36	8.8	79	−0.51
No	463	91.5	374	91.2	837	
n	506	100.0	410	100.0	916	
Donations to an environmental organization						
Yes	210	39.5	152	37.1	362	0.75
No	322	60.5	258	62.9	580	
n	532	100.0	410	100.0	942	
Water quality assessment						
Good or very good water quality	302	56.8	243	57.7	545	−0.30
Moderate or bad water quality	230	43.2	178	42.3	408	
n	532	100.0	421	100.0	953	
Water quality improvements						
Quality has improved	181	34.0	149	36.3	330	−0.74
Quality has not improved	351	66.0	261	63.7	612	
n	532	100.0	410	100.0	942	
Experience with floods						
Personally affected	79	14.8	81	19.8	160	−1.99*
No personal experience	453	85.2	329	80.2	782	
n	532	100.0	410	100.0	942	
River restoration as a public task						
Rather public task	230	43.2	181	44.1	411	−0.28
Rather private contributions to financing	302	56.8	229	55.9	531	
n	532	100.0	410	100.0	942	
Environmental conservation and costs						
Environment should be conserved regardless the cost	186	35.0	164	40.0	350	−1.59
Environmental conservation should depend on costs	346	65.0	246	60.0	592	
n	532	100.0	410	100.0	942	

* $p < 0.1$

Table 4 Annual willingness-to-pay for river restoration (EUR per respondent)

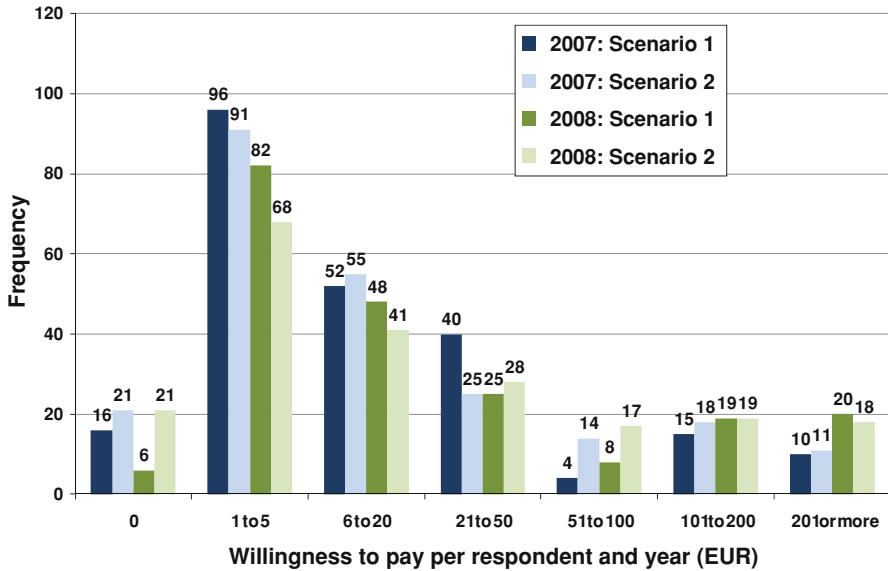|	2007 survey		2008 survey		2007 and 2008 survey (pooled)	
	Mean	SD	Mean	SD	Mean	SD
WTP (both scenarios)	30.20	56.16	28.04	50.79	28.95	53.46
WTP (scenario 1)	27.39	49.40	26.39	51.40	26.92	50.29
WTP (scenario 2)	28.55	52.39	33.59	60.49	30.99	56.45

Fig. 3 Distribution of willingness-to-pay bids for river restoration depending on scenarios presented to respondents (2007 and 2008 survey)

simple within-sample t-tests,[4] as well as in the econometric estimations presented below in Sect. 3.2 (this means that WTP of respondents is potentially insensitive to scope).

As Fig. 3 shows, most respondents (around 38% on average in the pooled dataset) ticked a WTP bid in the interval between € 1 and 5 (which might be considered only a symbolic contribution) while only about 7% of respondents on average refused to pay anything. In addition, there is also broad share of about 35% of respondents willing to pay from € 6 to 50 per year. About 19% of respondents in total would be willing to pay than € 50 (up to € 250 as the highest bid).

Regarding potentially different distributions of WTP bids between the two surveys, we employed a number of non-parametric tests. Kruskal–Wallis as well as Mann–Whitney U tests could not reject the null hypothesis of equal distributions across the two surveys ($p = 0.332$ and $p = 0.592$, respectively).

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[4] Details can be sent by authors on request.

3.2 Econometric results: testing for differences between surveys

As mentioned before, the descriptive analysis is complemented by econometric results for both surveys, and for a pooled dataset. In order to explore the determinants of respondents' WTP, a number of econometric approaches were tested regarding reliability and statistical fit. Based on the kind of question posed, and the elicitation instrument, Tobit estimation proved to achieve the most robust results.

Table 5 presents the details of several econometric estimations, while Table 6 displays the results for the pooled dataset. For the discussion below, we choose only the statistical best-fit models; Est. 1 and 4 in Table 5 and Est. 7 in Table 6 include socio-economic and water-quality related variables while the other estimations additionally account for the place of residence of the respondents and their preferences towards environmental policies. The estimation presenting the pooled dataset in Table 6 also includes a variable labeled "Group" classifying the two samples (under the equal distributional assumption). In addition, Est. 3 and 6 (Table 5) and Est. 7 (Table 6) include tests for the sensitivity of WTP to scope by including the scenario variable denoting the two programs offered to respondents. As will be discussed below, WTP seems to be insensitive to scope which in fact may be reasonable in the current context.

Table 5 shows that for the 2007 dataset, a number of theoretical assumptions for the validity of the WTP survey are fulfilled. Est. 1 indicates that WTP depends significantly on the household's income with the expected (positive) sign, while the age of the respondent correlates negatively with WTP—meaning that older respondents exhibit a significantly lower WTP. Higher education (in terms of a college or university degree) increases WTP; finally, Est. 1 also indicates that respondents are willing to pay more if they perceive the Danube River's water quality as good or very good.

Two variables a priori assumed to determine that WTP do not exhibit significant explanatory power (distance to the Danube; personal experience with floods) and are therefore not included in the estimations. This result, corroborated in the 2008 and pooled datasets, is rather surprising since earlier studies indicate some distance-decay effects leading to a smaller willingness to pay of respondents living farer away from the site dealt with in the survey.[5] Furthermore, as the proposed program of river restoration would also lower the probability of severe floods, we expected significantly higher WTP bids of respondents with a negative personal experience with floods. While the coefficient has the expected sign, it seems that the number of respondents with such experience is too small and therefore overlaid by other influences on WTP.

In comparison among the 2007, 2008, and the pooled datasets, it is interesting to see that even with the non-significant differences of mean WTP bids described above in Sect. 3.1, the coefficients vary substantially. For instance, the coefficient for the income variable is 0.21 for the 2007 dataset, and 0.28 for the 2008 dataset (Est. 1 and 4). However, this difference is not statistically different ($\chi^2 = 0.45$).

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[5] As the sample was not stratified with respect to distance to the Danube River, this result has to be treated with caution.

Table 5 Determinants of WTP – comparison between the 2007 and 2008 surveys

Variable	2007					
	Est. 1		Est. 2		Est. 3	
	Coefficient	z-Statistic	Coefficient	z-Statistic	Coefficient	z-Statistic
Constant	1.26	1.53	0.96	1.16	0.99	1.20
Income	0.21	1.81*	0.22	1.94*	0.23	1.99**
Age	−0.03	−4.46***	−0.03	−4.82***	−0.03	−4.86***
Education	0.63	2.37**	0.61	2.30**	0.62	2.35**
Quality	0.31	1.65*	0.29	1.43	0.29	1.53
Vienna			0.28	1.73*	0.28	1.76*
Preferences			0.14	0.86	0.13	0.79
Donation			0.30	1.81*	0.31	1.87*
Scenario					−0.18	−1.16
S.E. of regression	1.43		1.42		1.43	
Log likelihood	−665.24		−661.48		−660.81	
n	371		371		371	

Variable	2008					
	Est. 4		Est. 5		Est. 6	
	Coefficient	z-Statistic	Coefficient	z-Statistic	Coefficient	z-Statistic
Constant	0.05	0.04	−1.36	−1.24	−1.40	−1.28
Income	0.28	1.82*	0.42	2.77***	0.41	2.74***
Age	−0.01	−1.93*	−0.03	−3.47***	−0.02	−3.41***
Education	0.78	2.10**	0.44	1.22	0.44	1.21
Quality	0.67	3.03***	0.62	2.97***	0.62	2.97***
Vienna			0.65	3.14***	0.64	3.11***
Preferences			0.62	3.05***	0.62	3.05***
Donation			0.66	3.15***	0.68	3.21***
Scenario					0.13	0.64
S.E. of regression	1.58		1.52		1.52	
Log likelihood	−588.31		−572.69		−572.48	
n	313		313		313	

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$, Tobit estimation

The coefficient for the water quality variables, though, is different between these two estimations ($\chi^2 = 3.59$, $p < 0.05$) indicating that the influence of the perceived water quality on WTP bids is broadly larger in the 2008 survey.

As the distance and flood variables do not prove to be significant, we search for additional explanatory factors. Est. 2 and Est. 5 (Table 5; Est. 8 in Table 6) shows the results of additionally including variables denoting residents living in Vienna, the variable "Preferences" (denoting respondents stating that the environment

Table 6 Determinants of WTP—pooled dataset (2007 and 2008 surveys)

Variable	Pooled							
	Est. 7		Est. 8		Est. 9		Est. 10	
	Coefficient	z-Statistic	Coefficient	z-Statistic	Coefficient	z-Statistic	Coefficient	z-Statistic
Constant	0.74	1.12	0.04	0.06	0.05	0.08	0.02	0.02
Income	0.24	2.54**	0.29	3.13***	0.29	3.15***	0.24	2.43**
Age	−0.02	−4.50***	−0.03	−5.62***	−0.03	−5.64***	−0.02	−3.55***
Education	0.68	3.10***	0.56	2.59***	0.56	2.60***	0.47	1.35
Quality	0.48	3.36***	0.44	3.12***	0.44	3.14***	0.58	2.94***
Vienna			0.43	3.36***	0.43	3.38***	0.57	2.99***
Preferences			0.36	2.81***	0.36	2.79***	0.60	3.11***
Donation			0.44	3.37	0.44	3.35***	0.65	3.25***
Group	−0.02	−0.12	−0.01	−0.03	−0.01	−0.04		
Scenario					−0.06	−0.52		
Group × income							0.11	1.73*
Group × age							−0.01	−0.41
Group × education							0.10	0.22
Group × quality							−0.26	−0.96
Group × Vienna							−0.27	−1.07
Group × preferences							−0.44	−1.71*
Group × donation							−0.34	−1.28
S.E. of regression	1.50		1.47		1.47		1.47	
Log likelihood	−1,258.60		−1,241.85		−1,241.71		−1,237.35	
n	684		684		684		684	

* $p < 0.1$; ** $p < 0.05$ *** $p < 0.01$ Tobit estimation

should be protected regardless the costs), and the respondent's annual donation to environmental funds (variable "Donation").

While the distance variable is not a significant explaining variable, the variable Vienna proved to be significant in the 2008 and the pooled datasets. Of course, respondents living in Vienna are nearer to the Danube River; however, the positive sign of this variable does not only suggest that the river is closer but also that substitutes are not readily available since all open waters in Vienna are closely connected to the Danube River.

Regarding variable "Preferences" the 2007 survey does not exhibit a significant correlation with WTP (Est. 2 of Table 5) while the variable is significant for the 2008 and the pooled dataset (Est. 5 of Table 5).

The variable "Donation" again is significant in all estimations suggesting that respondents who regularly donate to environmental organizations seem to be willing to pay more for the river restoration program offered in the questionnaire. This might indicate that respondents who are familiar with private (individual) money contributions also state a higher individual WTP.

Table 6 also included an estimation using the pooled data set to explore whether a dummy variable labeled "Group" would be a significant explanatory variable. Est. 7–9 show that this variable does not add to the explanatory power of the model indicating that WTP does not differ between the two surveys.

Table 6 also includes Est. 10 again suggesting that the empirical models underlying the two samples are slightly different. The estimation excludes the dummy variable "Group" but explores whether the coefficients of the explanatory variable are different between the two samples. The results suggest that minor differences exist with respect to the strength of the income variable for respondents' WTP. As mentioned before, respondents of the 2008 survey broadly stated stronger environmental preferences which are also expressed in the coefficient for the variable "Preferences". However, both coefficients are only significant at the $p = 0.1$ level of significance.

As indicated in Table 1, we tested for a range of other variables hypothesized to be of significant importance. For instance, testing for the frequency of visits to the Danube floodplains shows that the visitor variable does not exhibit a strong influence on the WTP for river restoration, as well as including the stated willingness to visit the area in the future (variable "Futurevisit").

We also tested for the significance of a variable denoting the respondent's opinion that nature conservation and river restoration are public tasks that should be fulfilled even without private WTP. While a similar variable was found to bear significant explanatory power in other Austrian studies on nature conservation (cf. Friedl et al. 2009), the current study did not indicate such a relationship between individual WTP and the perception of environmental conservation as a merely public task.

3.3 Differences between estimated models: a comparison of actual and projected mean WTP

Comparing the estimations in Tables 5, 6 shows that—while mean WTP bids for both survey are quite similar (see Table 4)—the models for estimating the bid

function differ to some extent. While the socio-economic and water-related variables (income, age, education, water quality) are in the same order of magnitude—a Wald test revealed no significant differences—major differences between the survey results stem from the respondents' answers to debriefing questions such as the variable "Preferences". A Wald test indicated a significant difference between the coefficients at the $p = 0.05$ level of significance ($t = 2.36$).

Based on these comparisons, we tested for the robustness of our estimations by comparing mean WTP in each survey with the projected WTP by taking into account the two model specification (Est. 1 and 4, and 2 and 5, respectively; cf. Table 5). As Table 7 shows, none of the models could forecast mean WTP correctly. For instance, while mean WTP was € 27.25 in the 2008 survey, the model of 2007 applied to data of 2008 would forecast a WTP of € 11.25. However, as is usually the case with econometric models estimating bid curves, outliers distorting mean values cannot be forecast accordingly. Therefore, ignoring respondents stating a WTP equal or higher than € 100, leads to quite similar results of both the actual and the projected mean values of WTP. Testing for equality, however, results in the rejection of the H_0 (equality of mean WTP) at the $p = 0.01$ level of significance.

4 Discussion, summary, and conclusions

The current study deals with the temporal stability of WTP bids for river restoration. Two identical surveys—in the field in 2007 and 2008—were administered to samples similar in socio-economic characteristics. The elicited WTP bids exhibited a mean value broadly similar between the surveys and scenarios presented to respondents.

Exploring potential differences between the surveys further, estimated bid functions showed some quite substantial differences. While coefficients of socio-economic variables were broadly equal across surveys, perceptions of environmental policies by respondents were significantly different. Two different variables are worthwhile to be discussed in more detail. On the one hand, the perception of water quality—ceteris paribus—contributed to a different extent to the explanation of WTP bids. The assumed water quality of the Danube River—as one major effect of the proposed river restoration program—had a higher importance in explaining WTP bids in the 2008 survey than in 2007. On the other hand, the perception of environmental conservation as a merely public task was of significantly higher influence in 2008.

Applying the estimated 2007 model to the respective data of the 2008 survey (and vice versa) resulted in a broadly comparable order of magnitude of WTP bids. While actual WTP bids could only be reasonably explained for a "corrected" dataset with cutting off outliers, actual and projected mean WTP lie in the range of around € 9–12. It seems to be a robust result that WTP for the proposed river restoration program is in fact in this narrow range. However, it has to be stressed that from a merely statistical point of view, we can detect significant differences.

As discussed before, the survey also included two scenarios to be valued by respondents. The sample for both surveys was each divided into two (independent)

Table 7 Annual willingness-to-pay for river restoration (€ per respondent): transferring values between surveys and models

	Model 2007 → data 2008 (Est. 1)			Model 2008 → data 2007 (Est. 2)		
	Mean (actual, projected)	Comparison of means	n	Mean (actual, projected)	Comparison of means	n
WTP (unified data set)	27.25/11.25	6.91***	371	31.86/8.88	6.14***	313
WTP (cut off at € 100)	12.09/11.01	2.98***	331	11.33/8.57	1.81*	271
	Model 2007 → data 2008 (Est. 4)			Model 2008 → data 2007 (Est. 5)		
	Mean (actual, projected)	Comparison of means	n	Mean (actual, projected)	Comparison of means	n
WTP (unified data set)	27.25/11.30	6.86***	371	31.86/9.02	6.07***	313
WTP (cut off at € 100)	12.09/10.92	2.91***	331	11.33/8.61	1.75*	271

* $p < 0.1$; *** $p < 0.01$

subsamples confronted with two scenarios differing in the share of wetlands for which river restoration measures were proposed. A respective variable "Scenario" in the econometric estimations proved to bear no explanatory power while mean WTP is higher in the descriptive statistics presented in Table 4 (Est. 3, 6, and 9). This is an interesting result since theory suggests observing a higher WTP for larger programs. However, on the other hand, it seems that respondents do not take into account differences in such programs presumably due to the fact that they were not presented two programs differing in size within a joint sample (lack of possibility for intra-personal comparison). The results therefore suggest that the specific programs offered to respondents are broadly considered of equal importance. Furthermore, the program offering 90% of wetlands to be reconnected to the main stream limits recreation opportunities for visitors and therefore reduces the use value of the wetlands. This trade-off might also have been taken into account by respondents.

The results of the current study can, of course, be questioned on the basis of mainly two arguments: First, the sample was not spatially stratified with respect to the distance of the respondent's home to the Danube River. We tried to compensate for this shortcoming by including a variable denoting the distance to the Danube River. The inclusion of this variable did not add much explanatory power to our estimations. Second, it may seem that comparing WTP over time may be more adequately tested in a setting with a panel of households questioned two times in different years. We controlled for the socio-economic attributes of the respondents, e.g., by comparing age, income, education between samples and accounting for these attributes in our econometric estimations. However, the surveying of the same set of households may bear also problems in terms of aggravated self-selection bias and "survival rates" in the sample.

Concluding, we would like to interpret the results of our study cautiously in several directions. Notwithstanding the statistical differences or equalities between the surveys, the elicited WTP bids can be considered in the same order of magnitude. For concrete policy making, the figures may function as an important indication of environmental preferences in money terms and therefore may be included into a cost-benefit analysis of river restoration projects. As Kosz (1996) has shown in an earlier paper, the inclusion of a certain WTP bid into a cost-benefit assessment bears the risk that bids are always questionable based on the manifold biases in contingent valuation studies. The current study therefore shows that even the same survey with sample similar in socio-economic attributes, and without any extreme event, WTP bids are not equal. However, the important result of this paper is that they bear sufficient information in order to be included in a cost-benefit analysis.

Usually, a cost-benefit analysis would also include a broad range of sensitivity analyses highlighting the importance of determining costs and benefits on a project's efficiency. One potential option is to estimate all costs and benefits based on use-values, and then varying the non-use components (such as WTP bids like in the current surveys) to test for the switching values between project alternatives. For policy applications, the figures resulting from the current surveys are—from our viewpoint—robust enough to allow for benefit transfers over time since the order of

magnitude stays roughly the same. Still, there is need for further research regarding the differences in our empirical estimations. We do not have a ready explanation for the different size of the coefficients apart, of course, from potential differences in the empirical distribution of the data. For instance, it is hard to explain why—ceteris paribus—respondents in the 2008 survey apparently considered their perception regarding environmental policies more important in stating WTP bids than respondents in the 2007 survey. However, as said before, we believe that the differences between the surveys are too small to conclude that WTP bids elicited at different points in time are not stable, and thus, that benefit transfer over time is not an economical option to primary data collection.

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