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TIMING EFFECTS IN HEALTH VALUATIONS

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SUMMARY

This paper analyzes the impact of external sources of information, conveyed by the frequency of risky events that vary across time, on the individual willingness to pay (WTP) for a reduction of mortality risk. We collected data from a contingent valuation (CV) exercise conducted in two waves (fall and winter) to examine whether individual WTP varied across periods that differed in the predominance of fatal accidents. Risk valuations were based on fatal snow avalanche accidents, that is, a type of risk with seasonal differences in occurrence. We found slightly lower but statistically significant mean WTP figures in the winter than in the fall sample because of time-varying individual risk attitudes and, therefore, recommend controlling for these factors in risk assessment CV surveys.

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1. INTRODUCTION

Given the complex nature of gathering and collecting information, it is frequently argued that risk assessment is dependent on provided information (Kahneman and Tversky, 1979; Johannesson and Johansson, 1997; Kahneman *et al*., 1999; Cookson, 2000) and may also be influenced by implicit information from external sources that cannot be controlled for in risk assessment studies. One external source of information that influences individual risk assessment is the frequency of life-threatening events (Slovic *et al*., 1982; Tversky and Kahneman, 1982). Consequently, availability of information is also likely to influence individual preferences and willingness to pay (WTP) for reducing specific mortality risks (for empirical evidence, see Liu *et al*., 2005).

In this paper, we have explicitly addressed this availability bias by examining the respondents' WTP for risk prevention at different points in time that vary in the occurrence of fatal events. Our focus is the seasonally varying mortality risk of dying in a snow avalanche. We estimated WTP figures for a reduction in deadly avalanche accidents in two subsequent periods (fall and winter) that differ in terms of the occurrence and frequency of health risks.

2. SURVEY DESIGN

Our empirical study was carried out in the Alpine Austrian province of Tyrol. In this region, natural hazards such as snow avalanches occur regularly, and residents are aware of the exposure of inhabited areas to such dangers. A randomized quota sample was drawn from among the population aged over 17 years. The quota

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applied to the subjects' district of residence and size of domicile. In personal interviews conducted at their permanent places of residence, respondents were asked about their WTP to prevent a doubling of the risk of dying in an avalanche. The data were collected in two waves: the first in September–October 2004 and the second in February 2005. We used a total of 1500 observations to examine the sensitivity of individual WTP for protective measures to external events such as avalanche occurrence. Respondents in both, the fall and winter, samples received a detailed and identical description of the good they were asked to evaluate:

> *Protective measures against avalanches on roads and in residential areas have been implemented in Tyrol. On average, 2.35 people out of 100,000 inhabitants are killed by avalanches at present. Assume that all public funds to maintain protective measures will be cut, and henceforth, servicing costs have to be paid exclusively by private funds. If aggregate private contributions are too small, maintenance is not carried out, and the probability of a fatal avalanche doubles. Then, on average, 4.7 people out of 100,000 inhabitants would die in the snow masses (see Figure 1). Would you—given your income constraints—be willing to pay a monthly insurance premium of € 2.5/5/10 to maintain the effect of previous protective measures to save human lives?*

Individual WTP was gathered via a double-bounded dichotomous choice format. We also identified the group of respondents who were not willing to pay any positive amount and estimated a spike model (Kriström, 1997) to account for the significant number of zero responses ($N = 764$). For positive WTP answers, we applied the Weibull distribution (Haab and McConnell, 1997; Alberini, 2005). Mean WTP was then calculated by weighting the conditional mean of the positive WTP statements with the probability of a positive WTP response (Cameron and Trivedi, 2005, p. 545).

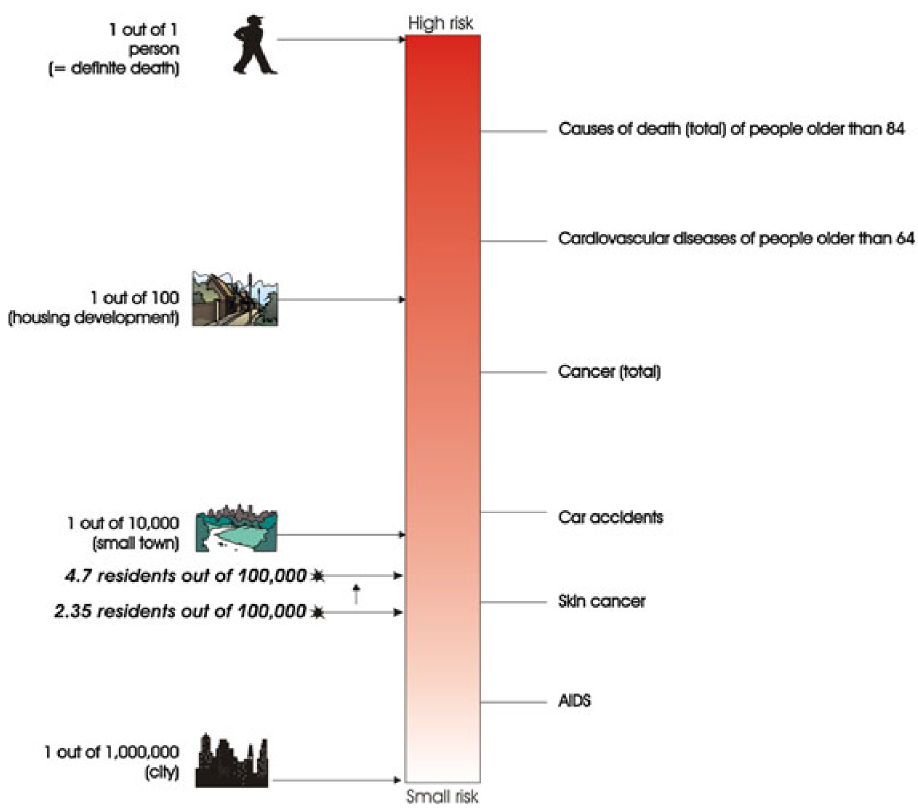

Figure 1. Causes of deaths in Tyrol in the year 2002. Graph analogous to that of Corso *et al*. (2001)

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Risk attitudes and other controls

Previous studies have found that the perception of risks and the changes in it (over time) from exploiting (external) information on current risks play a decisive role in the design of appropriate risk regulation (Slovic, 1987; Viscusi, 1992; Huang, 1993; Lesser *et al.*, 1997; Georgiou and Bateman, 1998; Slovic *et al.*, 2000; Lundborg and Lindgren, 2004; Liu *et al.*, 2005; Vassanadumrongdee and Matsuoka, 2005; Leiter, 2011). Several authors stressed that the ease with which an event can be brought to mind influences individual assessments (Tversky and Kahneman, 1982). As a consequence, frequent, familiar, salient, imaginable, and/or recent occurrences are more available and increase the perception of risks in general ('availability heuristic'). Further, important risk characteristics discussed in the literature and controlled for in our regression analysis are the individuals' perception of their own risk exposure (Slovic *et al.*, 1982; Shanteau and Ngui, 1989) and the perceived origin of risk (Slovic, 1987; Kahneman *et al.*, 1993; Lesser *et al.*, 1997; Sunstein, 1997; Walker *et al.*, 1999; Cookson, 2000; Slovic *et al.*, 2000). Consequently, we gathered information on the respondents' perception of the *average* risk of dying in an avalanche, how they assessed their *personal* risk of dying in an avalanche as compared with the average risk, and whether they regarded avalanches as anthropogenic, natural, or fateful events to perform the following: (i) test for internal validity of WTP statements; and (ii) examine possible changes in these variables over time.

The individuals' perception of the average risk (*perception*) was elicited via a risk ladder presented to the respondents (Figure 1) to help them visualize the avalanche risk. In this ladder, different mortality risks were plotted along a logarithmic scale to show the relative magnitudes of different risks. Respondents were asked to state their risk perception by drawing a line on the vertical scale to indicate where they thought the average risk of dying in an avalanche would be. The potential interval of *perception* ranged from 0 mm (lowest risk) to 131 mm (death). The average among respondents was 23.4 (26.4) mm in the fall (winter) sample, representing a risk of 0.0012% (0.0017%), that is, the probability that 1.2 (1.7) people out of 100,000 die. The difference between these figures was statistically significant ($t = -2.87$), and both figures were below the actual avalanche risk of 30 mm (i.e., a mortality risk of 0.00235%).

We further created four dummies, *low risk*, *anthropogenic* and *natural*, and *important alternative* to indicate whether respondents estimate their *personal* risk as below average, whether the respondents regarded avalanches as being anthropogenic at all times or occurring naturally at all times, respectively, and whether respondents favored alternative health risk-reducing programs (against car accidents and food poisoning). For the other controls, see Table I and Appendix A.

Table I reveals seasonal differences in the risk variables. One reason for the changes in risk characteristics over time may arise from the predominance of fatal avalanche accidents in winter. Particularly in winter, the media addresses the exposure to avalanche risks by reporting current avalanche accidents and by informing residents and tourists about the actual danger of avalanches so that they can take adequate precautions. The subsequent regression analysis identifies the determinants of individual WTP and examines whether external sources of information may have an influence on individuals' risk valuation. The variation over time was captured by including a dummy (*winter*) for the February 2005 sample and interaction terms of risk attitudes (*perception*, *low risk*, *anthropogenic*, *natural*, and *important alternatives*) with this dummy variable that control for their different impacts across periods.

3. RESULTS

Table II includes the estimation results of different specifications with the most parsimonious model only including a constant and the winter dummy presented in column (1). In addition, specification (2) controls for the set of socioeconomic individual characteristics, whereas columns (3) and (4) depict the influence of risk attitudes and their interaction with the winter dummy, respectively.

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Table I. Descriptive statistics

Variable	Fall		Winter		Total	
	Observations	Mean	Observations	Mean	Observations	Mean
Risk attitudes						
Perception	888	23.355	602	26.435	1490	24.599
Low risk	888	0.706	602	0.716	1490	0.710
Anthropogenic	888	0.313	602	0.369	1490	0.336
Natural	888	0.345	602	0.324	1490	0.336
Important alternative	888	0.194	602	0.140	1490	0.172
Socioeconomic controls						
Female	888	0.566	602	0.470	1490	0.528
Age	888	40.358	602	36.061	1490	38.622
Household members	888	2.650	602	2.875	1490	2.741
Income (€)	384	1052.083	414	1165.459	798	1110.902
Ln *income*	888	6.960	602	6.946	1490	6.955
Income missing	888	0.568	602	0.312	1490	0.464
A-level	888	0.316	602	0.296	1490	0.308
Volunteer	888	0.235	602	0.254	1490	0.243
Normal weight	888	0.579	602	0.653	1490	0.609
Nonsmoker	888	0.517	602	0.440	1490	0.486
Weekly sport	888	0.497	602	0.556	1490	0.521
Skiing	888	0.538	602	0.533	1490	0.536
Experience	888	0.236	602	0.214	1490	0.228

Note: Significant differences (at the 5% level) between the two samples are observable for the following variables: *perception*, *anthropogenic*, *important alternative*, *female*, *age*, *household members*, *income*, *income missing*, *normal weight*, *nonsmoker*, and *weekly sport*.

As can be seen from column (3), individuals who considered avalanches as natural events (*natural*) may have questioned the effective reduction of avalanche risks and therefore stated a lower WTP—an assumption that was strengthened by the positive (but insignificant) impact of *anthropogenic*. Respondents who were concerned about avalanche risks (*perception*) stated a higher WTP to prevent such a risk, and those who preferred alternative programs (*important alternative*) revealed a lower WTP for avalanche protection. The signs of these coefficients were reasonable and consistent with arguments in previous studies, with the exemption of the counterintuitive positive effect of *low risk*.[1]

The significantly negative winter dummy (*winter*) in columns (2) and (3) implies that individual risk assessment varies across the two waves. The interaction terms determine the factors that are responsible for the seasonal differences. In column (4), the interaction term *anthropogenic* × *winter* indicated a significantly lower WTP. In addition, we found a significantly negative effect for the interaction of the winter dummy with the variable indicating the respondents' preferences for alternative programs of risk reduction (*important alternative* × *winter*). As a consequence, the winter dummy became insignificant if the interaction terms were controlled for.[2]

Mean WTP was calculated from the estimates in Table II. It can be seen that the point estimates for the means in the winter sample (ranging from € 3.31 to € 3.54) were always slightly lower than those in the fall sample (varying between € 3.50 and € 3.82). Statistical tests for models (2)–(4) revealed significant differences (with p-values of <0.001, <0.001, and 0.011) between the fall and winter samples.

[1]Regarding the socioeconomic controls, we found that women (as compared with men), respondents of normal weight (*normal weight*), and those who refused to provide information about their personal income (*income missing*) stated a significantly lower WTP for risk prevention. On the contrary, respondents who have had previous personal experience with avalanches (*experience*) and those who regularly exercised (*weekly sport*) stated a significantly higher WTP. The impacts of these controls were stable over specifications (2)–(4).

[2]To test the independence assumption between the first and second votes (Silz Carson *et al*., 2009), a single-bounded dichotomous choice model based on the first set of bids was also estimated. The results confirm the double-bounded dichotomous choice findings.

Table II. Estimated coefficients for the double-bounded dichotomous choice model

	Total sample								Fall sample		Winter sample	
	(1)		(2)		(3)		(4)		(5)		(6)	
Winter	−0.077	(0.074)	−0.134*	(0.077)	−0.177**	(0.076)	−0.253	(0.175)				
Risk attitudes												
Perception					0.005***	(0.002)	0.004	(0.002)	0.004	(0.002)	0.008***	(0.003)
Low risk					0.272***	(0.079)	0.193*	(0.102)	0.241**	(0.104)	0.280**	(0.118)
Anthropogenic					0.016	(0.074)	0.159*	(0.096)	0.156	(0.098)	−0.184*	(0.111)
Natural					−0.195***	(0.076)	−0.231**	(0.096)	−0.229**	(0.097)	−0.127	(0.120)
Important alternative					−0.268***	(0.097)	−0.133	(0.128)	−0.151	(0.131)	−0.470***	(0.152)
Risk interactions												
Perception × winter							0.004	(0.004)				
Low risk × winter							0.156	(0.149)				
Anthropogenic × winter							−0.353**	(0.148)				
Natural × winter							0.088	(0.150)				
Important alternative × winter							−0.337*	(0.201)				
Socioeconomic controls												
Age			−0.003	(0.002)	−0.003	(0.002)	−0.003	(0.002)	−0.005	(0.003)	0.000	(0.004)
Female			−0.169**	(0.076)	−0.162**	(0.074)	−0.147**	(0.074)	−0.097	(0.100)	−0.206*	(0.112)
Ln *income*			0.050	(0.076)	0.053	(0.076)	0.067	(0.076)	0.080	(0.111)	0.036	(0.105)
Income missing			−0.152*	(0.080)	−0.160**	(0.079)	−0.174**	(0.079)	−0.220**	(0.103)	−0.087	(0.127)
A-level			−0.069	(0.083)	−0.075	(0.081)	−0.059	(0.081)	−0.025	(0.107)	−0.164	(0.127)
Household members			0.024	(0.023)	0.031	(0.023)	0.029	(0.022)	0.055	(0.037)	−0.002	(0.025)
Normal weight			−0.127*	(0.076)	−0.151**	(0.076)	−0.156**	(0.076)	−0.106	(0.101)	−0.257**	(0.119)
Nonsmoker			−0.066	(0.077)	−0.095	(0.076)	−0.095	(0.076)	−0.122	(0.099)	−0.058	(0.120)
Weekly sport			0.130*	(0.078)	0.150*	(0.076)	0.164**	(0.076)	0.168	(0.103)	0.167	(0.116)
Skiing			0.050	(0.082)	0.078	(0.081)	0.062	(0.080)	0.114	(0.109)	−0.021	(0.118)
Volunteer			0.100	(0.085)	0.094	(0.085)	0.098	(0.085)	0.183	(0.113)	−0.006	(0.130)
Experience			0.125	(0.088)	0.199**	(0.088)	0.188**	(0.088)	0.227*	(0.122)	0.132	(0.128)
Constant	2.118***	(0.048)	1.948***	(0.555)	1.690***	(0.560)	1.626***	(0.559)	1.394*	(0.803)	1.763**	(0.770)
γ (shape)	1.188***	(0.045)	1.224***	(0.047)	1.261***	(0.048)	1.274***	(0.049)	1.283***	(0.064)	1.298***	(0.078)
Observations	1490		1490		1490		1490		888		602	
Wald χ^2	1.082		30.840		65.411		78.479		45.120		43.676	
Log-LL	−2107		−2092		2076		−2071		−1226		−839	
Mean willingness to pay												
Fall	3.819	0.000	3.502	(0.592)	3.691	(1.187)	3.647	(1.089)	3.608	(1.289)		
Winter	3.536	0.000	3.305	(0.550)	3.475	(1.048)	3.492	(1.252)			3.530	(1.256)
Total	3.705	0.139	3.422	(0.583)	3.604	(1.137)	3.585	(1.160)				

[a]Dependent variable: bid interval.
*Statistical significance at the 10% level.
**Statistical significance at the 5% level.
and
***Statistical significance at the 1% level.

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By dividing the annual mean WTP of € 43.08 (3.59 × 12) for the total sample in specification (4) by the risk variation of 1/42,500, we arrived at a value of statistical life (VSL) of € 1.83 million. A cursory comparison showed that our estimates lay at the lower end of VSLs found in other European studies.[3]

4. DISCUSSION AND CONCLUSIONS

In our contingent valuation (CV) study, we did not find evidence that the availability of avalanches in the winter season (and their magnification by coverage in the media) would lead respondents to overestimate avalanche risks expressed in higher WTPs to avoid these risks. Avalanches are neither unusual nor unexpected. They occur every year, and it may be the case that respondents in the fall sample are as familiar with this natural phenomenon as their winter counterparts. On the contrary, we found slightly lower but statistically significant mean WTP figures in the winter than in the fall sample. There are at least two reasons for this result.

(1) The winter and fall samples are not perfectly identical as they differ significantly in several risk attitudes and individual characteristics.[4]
(2) We observed that the significant impact of risk attitudes on individual WTP figures had changed over time.

As a consequence, we controlled for socioeconomic characteristics and included interaction terms between the winter dummy and individual risk attitudes.

We found that the impact of alternative risk-reducing measures and of avalanche fatalities being classified as man-made had a strong and significantly negative impact on WTP in the winter sample only. This evidence is in accordance with the findings of Walker *et al*. (1999) who observed lower WTP to reduce damage if someone else can be made responsible for the loss. All fatal avalanche accidents in the winter of 2004–2005 happened to occur off-piste, a fact that was regularly reported by the media. Hence, respondents in the winter sample may have thought that the accidents could have been easily prevented by avoiding unsecured (ski) routes. It is likely that these respondents would be less willing to spend money on avalanche protection.

What are the implications of our findings for policymaking? If real preferences for risk-reducing measures change over time and WTP values differ, for example across seasons, ideally, a CV survey should be administered in waves rather than by a usual one-shot approach. Given our research design, we can report the estimates from the winter-only and fall-only samples (columns (5) and (6) in Table II) and compare them with the average WTP depicted in column (4). This allows some insight into whether the benefits of CV studies conducted in waves may outweigh the higher costs they incur. It can be seen from columns (5) and (6) that the risk attitude coefficients in the two samples are different. This mirrors the aforementioned change in the effects of risk characteristics over time. Mean WTP based on the fall-only (winter-only) sample amounted to € 3.61 (€ 3.53) per month. Statistical tests indicate that both figures are not significantly different (fall: $p = 0.651$; winter: $p = 0.344$) from the mean WTP of € 3.59 in the total sample as depicted in column (4). With respect to mean WTP, it would therefore not make a difference whether respondents are asked in a one-shot CV experiment (in either fall or winter) or in two separate waves that are then being used to calculate the theoretically correct average WTP across seasons as long as potential changes in risk characteristics are controlled for. From the evidence of this study, we would like to argue in favor of a one-shot CV experiment because of its lower administrative costs. However, it is crucial in CV surveys to control for risk attitudes and risk characteristics that have been shown to have a significant impact on WTP in risk assessment. In our survey, the different WTPs across seasons occurred not least from the varying impacts of specific risk attitudes in the two waves.

[3]See, for example Andersson (2005), Hultkrantz *et al*. (2006), Krüger and Svensson (2009), Svensson (2009), Weiss *et al*. (1986), and Maier *et al*. (1989).
[4]This may be true for unobservables as well.

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APPENDIX A: EXPLANATORY VARIABLES

Variable	Description
Age	Age of respondent in years
A-level	Dummy = 1 if the respondent has a university entrance diploma; 0 otherwise
Anthropogenic	Dummy = 1 if the respondent always regards avalanches as an anthropogenic event; 0 otherwise
Experience	Dummy = 1 if the respondent has had personal experience with avalanches; 0 otherwise
Female	Dummy = 1 if the respondent is female; 0 otherwise
Household members	Number of persons in the respondent's household
Important alternative	Dummy = 1 if the respondent prefers other health risk-reducing programs; 0 otherwise
Income missing	Dummy = 1 if income is missing; 0 otherwise
Ln *income*	Logarithm of personal monthly take-home income; missing observations replaced by mean income
Low risk	Dummy = 1 if the respondent assesses his or her personal risk of dying in an avalanche as below average
Natural	Dummy = 1 if the respondent always regards avalanches as a natural event; 0 otherwise
Normal weight	Dummy = 1 if the respondent is of normal weight; 0 otherwise
Nonsmoker	Dummy = 1 if the respondent does not smoke; 0 otherwise
Perception	Respondent's perception of deadly avalanche risks; ranges between 0 (no risk) and 131 (death)
Skiing	Dummy = 1 if the respondent is a skier; 0 otherwise
Volunteer	Dummy = 1 if the respondent volunteers; 0 otherwise
Weekly sport	Dummy = 1 if the respondent goes in for a sport at least once a week; 0 otherwise
Winter	Dummy = 1 if the survey took place in February 2005; 0 otherwise
Anthropogenic × *winter*	
Important alternative × *winter*	
Low risk × *winter*	Interaction terms: risk characteristics and the period dummy
Natural × *winter*	
Perception × *winter*	

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