NOTA DI LAVORO

085.2010

What is the Value of Hazardous Weather Forecasts? Evidence from a Survey of Backcountry Skiers

By **Anna Alberini** , AREC, University of Maryland, College Park, USA

Christoph M. Rheinberger, WSL Institute for Snow and Avalanche Research SLF, Davos, Switzerland

Andrea Leiter, Faculty of Economics and Statistics, University of Innsbruck, Austria

Charles A. McCormick and **Andrew Mizrahi,** AREC, University of Maryland, College Park, USA

SUSTAINABLE DEVELOPMENT Series
Editor: Carlo Carraro

What is the Value of Hazardous Weather Forecasts? Evidence from a Survey of Backcountry Skiers

By Anna Alberini , AREC, University of Maryland, College Park, USA
Christoph M. Rheinberger, WSL Institute for Snow and Avalanche Research SLF, Davos, Switzerland
Andrea Leiter, Faculty of Economics and Statistics, University of Innsbruck, Austria
Charles A. McCormick and Andrew Mizrahi, AREC, University of Maryland, College Park, USA

Summary

What is the value of hazardous weather warnings? To answer this question, we focus on the avalanche bulletin for Switzerland issued by the WSL Institute for Snow and Avalanche Research (SLF). We take a survey-based, non-market valuation approach to estimating the value of hypothetical improvements in avalanche forecasting. We focus on backcountry skiers because (i) safety is arguably the most important type of benefit associated with the avalanche bulletin, (ii) they voluntarily undertake risks, and (iii) they perceive themselves and are generally perceived by others as skilled in avoiding risks. The respondents' willingness to pay (WTP) for the improved services ranges between CHF 42 to 46, implying a mean value of statistical life (VSL) of CHF 1.75 million. We find that WTP increases with income and is higher among Swiss nationals and those who rate the current bulletin "useful." Risk-tolerant individuals, persons who assessed their personal risk as lower than average, professional guides, and those who perceive themselves as proficient in using the existing bulletin report *lower* WTP figures. This suggests that the monetized value that people place on the enhanced bulletin reflects how productive these individuals are (or think they are) in using information to avoid avalanche risks.

Keywords: Avalanche Risk, Mortality, Value of Hazardous Weather Forecasts, Contingent Valuation, Value of a Statistical Life

JEL Classification: D81, J17, Q26

Address for correspondence:

Anna Alberini
AREC, 2200 Symons Hall
University of Maryland
College Park MD 20742
USA
E-mail: aalberini@arec.umd.edu

What is the Value of Hazardous Weather Forecasts? Evidence from a Survey of Backcountry Skiers

By

Anna Alberini,[1] Christoph M. Rheinberger,[2] Andrea Leiter,[3]
Charles A. McCormick[1] and Andrew Mizrahi[1]

June 2010

Abstract: What is the value of hazardous weather warnings? To answer this question, we focus on the avalanche bulletin for Switzerland issued by the WSL Institute for Snow and Avalanche Research (SLF). We take a survey-based, non-market valuation approach to estimating the value of hypothetical improvements in avalanche forecasting. We focus on backcountry skiers because (i) safety is arguably the most important type of benefit associated with the avalanche bulletin, (ii) they voluntarily undertake risks, and (iii) they perceive themselves and are generally perceived by others as skilled in avoiding risks. The respondents' willingness to pay (WTP) for the improved services ranges between CHF 42 to 46, implying a mean value of statistical life (VSL) of CHF 1.75 million. We find that WTP increases with income and is higher among Swiss nationals and those who rate the current bulletin "useful." Risk-tolerant individuals, persons who assessed their personal risk as lower than average, professional guides, and those who perceive themselves as proficient in using the existing bulletin report *lower* WTP figures. This suggests that the monetized value that people place on the enhanced bulletin reflects how productive these individuals are (or think they are) in using information to avoid avalanche risks.

Keywords: Avalanche risk, Mortality, Value of hazardous weather forecasts, Contingent valuation, Value of a Statistical Life.

JEL Classification: D81, J17, Q26.

[1] AREC, University of Maryland, College Park, USA.
[2] WSL Institute for Snow and Avalanche Research SLF, Davos, Switzerland.
[3] Faculty of Economics and Statistics, University of Innsbruck, Austria.

1. Background and Motivation

Announcements about hazardous weather are common in North America and most European countries. In the US, for example, the National Weather Service is responsible for severe weather watches and warnings, which cover thunderstorms, tornadoes, floods, excessive heat, tropical storms and hurricanes, tsunamis, and winter storms. Advisories are also issued about high winds, freeze, and dense fog as these conditions may pose a threat to human health, property, crops and livestock.

Weather warnings and advisories may have significant economic impact. The U.S. National Oceanic and Atmospheric Administration (NOAA) estimates the benefits of better snow and icing forecasting at US airports to be worth over $600 million per year. Considine et al. (2004) estimate the value of 24-hour hurricane forecasts to oil and gas producers in the Gulf of Mexico to be $10.5 million per year. Ebi et al. (2004) estimate the heat/watch warning system in Philadelphia to have generated reduced mortality benefits worth $468 million in its first three years.

What is the value of hazardous weather warnings? Economic theory suggests that the value of a forecast is mainly a problem of valuing imperfect information, in which individuals are offered forecast information to reduce their uncertainty in future decisions (Hirshleifer and Riley 1992). The amount they are willing to pay for receiving the information depends on whether, and by how much, they believe that this forecast will help them in making utility-maximizing decisions.

While many weather warning and advisory products are addressed to large groups of the population or to entire business sectors, this paper focuses on a specific type of hazardous weather warning—the avalanche bulletin for Switzerland issued by the avalanche warning service of the WSL Institute for Snow and Avalanche Research (SLF). This service was

established in 1945 to reduce the number of fatalities among the Swiss mountain troops. Since then, backcountry and out-of-bounds skiing have become popular sports in Europe (Holler 2007) and North America (Stethem et al. 2003). Since these activities usually take place in avalanche terrain, the number of people exposed to avalanche risk has been rising steadily.

Analyses of avalanche accidents indicate that 90% of the total avalanche death toll occurs in open terrain, i.e. while practicing activities such as skiing, snowboarding, snowshoe hiking or mountain climbing. In Switzerland, about 20 backcountry skiers die each year in avalanches, for a statistical mortality risk of about 10^{-4} per year (Waeger and Zweifel 2008). About 90% of the victims triggered the avalanche themselves or were buried in an avalanche released by another member of their group (McClung and Schaerer 2006).

Avalanche bulletins are issued to prevent such fatal accidents. The Swiss avalanche bulletin service is based on a standardized avalanche danger scale, which has been used throughout Europe and, in a slightly modified form, in Canada and the US (McClung and Schaerer 2006). Intended as a preventive warning, a national avalanche bulletin is issued every evening during the winter season. It is organized following a prescribed format and uses standardized terms providing (i) general information on the weather, snow conditions and snowpack during the past 24 hours in the Swiss Alps, (ii) the latest weather developments relevant to avalanche danger, (iii) the avalanche danger forecast for various regions, indicating the danger level for the following day, and (iv) a danger outlook for the next two days. This outlook is formulated as a forecast and remains valid for 24 hours under ordinary circumstances.

Avalanche forecasts convey information about the conditions in the terrain and rate the avalanche risk on a danger scale from 1 to 5, where 1 means generally safe conditions and 5 means very high avalanche risk. Forecasts are accessible to and used by a variety of users including ski resorts, mountain rescue teams, local avalanche warning services, road authorities,

the Swiss Army, and various individual users who use it to plan their backcountry activities and make decisions in avalanche terrain (Tremper 2001).

Feedback on the current bulletin service and the number of hits on the bulletin's webpage indicate that there is a growing demand for avalanche information. This is confirmed by a recent population survey, which found that the number of people who regularly go on backcountry trips doubled within the last eight years to approximately 200,000 individuals (Lamprecht et al. 2008), and an opinion survey which revealed that the majority of the users of the bulletin consider the avalanche bulletin an important information source for decision-making in avalanche terrain.

Producing the avalanche bulletin, however, costs money. The annual production cost of this program is about CHF 6 million (US$ 5.6 million), which is mainly covered through government subsidies. Since the users of the bulletin service are charged only a nominal price that covers transmission costs, it is not possible to infer the monetary value of the avalanche forecast from market transactions. Yet, it is important to estimate this value to assess how efficiently public monies are spent and how cost-effective this type of risk reduction is relative to the mitigation of other risks to life and limb (Ramsberg and Sjöberg 1997, Tengs et al. 1995).

To cast light on these questions, in early 2009 we developed a survey questionnaire and administered it online to a sample of skiers recruited among the visitors of the SLF avalanche bulletin web site. Respondents were asked to value a hypothetical, but realistic, enhanced bulletin that would provide more detailed local information and have a longer forecast range. Our best estimate of the WTP for the improved bulletin is in the range of 42 to 46 Swiss Francs (CHF). We find that risk tolerant skiers and skiers who perceived their risk as lower than average are willing to pay *less* for improved information, while those who judged the current bulletin useful for predicting conditions in the terrain, Swiss residents and people with higher income are willing to pay *more* for the enhanced bulletin service.

The remainder of the paper is organized as follows. Section 2 reviews earlier literature relevant to our study objectives. Section 3 presents methods, key concepts of our study, and discusses the population of backcountry skiers. Section 4 presents the survey questionnaire and describes the study design and execution. Section 5 presents the econometric model, section 6 the data, and section 7 the estimation results. We offer concluding remarks in section 8.

2. Earlier Literature

Many sectors of the economy, including transportation, aviation, agriculture, and construction, depend crucially on weather forecasts for planning and conducting business. As noted by Johnson and Holt (1997), the weather forecast meets the definition of a public good because it is non-excludable and non-rival in consumption. If left to private markets, weather forecast services would be either undersupplied or provided inefficiently. The development of new forecast products as well as the entry of private suppliers into the weather forecast market reinforces the need to place a monetary value on improved weather forecasts in general, and on specific weather warnings in particular.

Much empirical work to date has focused on eliciting the value of improvements in the accuracy of the weather forecast, rather than on the value of the forecast *per se*. Only few researchers have looked at the monetized value of hazardous weather warnings with most of this research been conducted on hurricanes (Hallstrom and Smith 2005, Whitehead 2003).

Letson et al. (2007) provide a taxonomy of the benefits of hurricane warnings that can be generalized to other severe weather warnings. These benefits include (i) avoided damage to property; (ii) avoided indirect costs including disruption of infrastructure, business losses and depreciation of property; (iii) reduction in casualties and deaths; and (iv) prevented false alarms

and unnecessary evacuations.[2] These benefits can be accrued by individuals, businesses, and society at large, and are correctly measured by the beneficiaries' willingness to pay (WTP) to avoid adverse extreme weather effects.

Some of the benefits can be monetized by employing market methods. Mortality and morbidity risks are, however, not traded in regular markets and require the use of non-market valuation methods (Bateman et al. 2002). Moreover, extreme weather events such as hurricanes cause considerable discomfort and anxiety, and so the WTP for benefits related to personal health and safety is likely to exceed the mere medical expenses or response costs (e.g., the out-of-pocket cost incurred in case of evacuation).

These considerations highlight the importance of non-market valuation methods to elicit the value of hazardous weather warnings. Yet, the majority of empirical studies on the value of weather forecasts have deployed the so-called indirect approach for valuation, which looks at how the value of the output commodity produced with information input changed (or would change) with the improved weather forecasts (see the review in Johnson and Holt 1997).[3]

3. Methods and Key Concepts

A. Approach

In contrast to earlier studies, we take a demand-based approach using stated preferences to place a monetary value on improved weather forecast information. Stated preference methods rely on surveys, and on what people *say* they will do under specified hypothetical situations. No market transactions, actual payments, or actual behavioral changes are observed. We use

[2] Letson et al. (2007) also note that improved weather forecasts could weaken incentives for other mitigation measures, and mitigation in turn reduces the need for, and value of, hazardous weather warnings.

[3] One exception is the study by Rollins and Shaykewich (2003) who take a demand-based approach to estimate the WTP for phone access to the weather forecast. They survey commercial, industrial and institutional entities in Canada, which were intercepted while calling in for the weather forecast. One problem with their approach, however, is that they do not hold quantity fixed when eliciting the actual demand for forecasting information.

contingent valuation, a method that asks people to report their WTP for a specified hypothetical good, public program or change in health risk.

Here, the good in question is a hypothetical improved variant of the Swiss avalanche bulletin, which is currently provided to users at a nominal charge. We survey an important category of users of the avalanche bulletin—backcountry and out-of-bounds skiers, including 73 professional guides who lead individual backcountry skiers or groups.[4] To frame a realistic scenario for our respondents, we ask them to consider a bulletin that would have more detailed local coverage and an extended forecast range.

B. Whose WTP? Respondent Selection

In February through April 2009, we posted an announcement on the SLF web site, soliciting users of the avalanche bulletin to participate in the survey. By clicking a link, they would be re-routed to a dedicated server, where the option was offered to start the questionnaire in any of four languages (German, French, English or Italian).

These users are of special interest to us for three reasons. First, in the event of an avalanche accident, they experience no property loss. Their risks are to life and limb, which allows us to focus on health risks and welfare effects not associated with property loss. Second, skiing in the backcountry is generally perceived as a strenuous and high-skill activity, and those who engage in backcountry skiing are thought of as persons with a strong sense of self-control (Adams 2005) and self-efficacy (Slanger and Rudestam 1997). Third, skiers bear the risks of avalanches *voluntarily* in exchange for highly positive, affective experiences associated with skiing. Earlier research on risk perception suggests that voluntariness in exposure does significantly lessen

[4] The term "skier" is widely used in the context of avalanches to refer not only to skiers, but to all those who engage in snow sports, including snowboarders, telemarkers, snowshoe hikers and others.

perceived risks (Slovic et al. 2000) and that perceived risks are inversely related to the perceived benefits (Alhakami and Slovic 1994, Gregory and Mendelsohn 1993).

Taken together, these points suggest that the way skiers process avalanche risk warnings may be different from how the general public processes hazardous weather warnings.[5] Hence, the value that skiers place on reducing avalanche risks may be different than that placed by the general population on reducing hazardous weather risks or environmental health risks such as air pollution, water contamination, or toxic emissions, to which people are exposed involuntarily (Alberini et al. 2007, Tsuge et al. 2005).

In earlier studies Atkins (2000) and McClung (2002) observed that avalanche information is often misperceived. Schwiersch et al. (2005) surveyed backcountry skiers to study their comprehension of information provided by avalanche bulletins. They found that while two-thirds of the surveyed skiers were able to correctly assess the prevailing level of avalanche danger, only one-third could recall information about danger spots. In a choice experiment about backcountry site selection, Haegeli et al. (2010) examined recreationists and professional guides in their understanding and use of avalanche relevant information. They found these groups to differ considerably with respect to safety concerns in site selection. Atkins and McCammon (2004) confirmed these differences by comparing avalanche experts and novices in terms of education and training, knowledge and rescue skills, and behavior in dangerous situations.

However, better avalanche education and experience does not necessarily result in reduced avalanche risk. McCammon (2004) identifies six heuristic traps that let even experienced backcountry skiers misjudge avalanche risks. These are (i) the familiarity heuristic: skiers make riskier decisions in familiar terrain than they would do in unfamiliar terrain; (ii) the consistency

[5] See Meyer (2006) and Browne and Hoyt (2000) for a more detailed discussion of various types of biases and heuristics in processing information and warnings about weather extremes and hazards.

heuristic: skiers take more risks once they have decided to enter into dangerous terrain; (iii) the acceptance heuristic: skiers risk more when they can receive acceptance and respect from peers; (iv) the expert halo: members of a skiing party ascribe skills in risk avoidance to the group leader, which this person might not have; (v) the social facilitation heuristic: skiers take more risk in the presence of other people; and (vi) the scarcity heuristic: skiers take seemingly disproportionate risks to access untracked snow.

McCammon argues that the susceptibility to these heuristic traps is likely to increase with more advanced avalanche training and with skiers' experience. To avoid such traps, many backcountry skiers use rule-based decision aids. McCammon and Haegeli (2007) examine the effectiveness of the most common decision aids. They find much heterogeneity in individuals' understanding of avalanche risks and conclude that the more successful a decision tool or information strategy is in building awareness of potentially life threatening risks, the more likely it is to reduce these risks. For this reason, our survey includes a series of questions to gather information about the respondents' usual efforts to reduce avalanche risks.

C. Defining WTP

Valuing the avalanche bulletin means finding out how much better off a decision maker is with avalanche-specific information rather than without this information. Suppose that when the avalanche danger is high, the probability of dying in an avalanche accident is q_0. Further, suppose that the information in the bulletin would enable skiers to avoid danger spots, inform them about weak snow layers, or lead them to cancel a trip altogether. This reduces their risk of dying to q_1 (with $q_1 < q_0$).

The value of the avalanche bulletin to a skier corresponds to his WTP for the reduction in risk $\Delta q = q_1 - q_0$. WTP is defined as the maximum amount of money that can be subtracted from

the skier's income at risk q_1 for him to experience the same utility as with the initial level of income and risk q_0. Formally, WTP solves:

(1) $V(y - WTP, q_1, \mathbf{p}; \mathbf{X}) = V(y, q_0, \mathbf{p}; \mathbf{X})$,

where $V(\bullet)$ denotes the indirect utility function, y is income, $\mathbf{p}$ is the vector of all prices, and $\mathbf{X}$ is a vector of individual characteristics of the skier.

In sum, the value of hazardous weather warnings may be defined as the maximum amount that the decision makers would be willing to exchange for access to this information. In the case of avalanche information, this value depends on the perceived accuracy of avalanche forecasts and the skier's ability to make use of this information in the terrain to reduce risks (Adams 2005, Tremper 2001). Hence, it is important to understand how skiers perceive avalanche risks and how better information impacts their decision behavior in the terrain. To learn more about the perception of avalanche risk, our questionnaire (outlined below) collected detailed data on skiers' decision behavior, preferences, and self-reported skills.

4. Survey Questionnaire and Study Design

A. Survey Questionnaire

The questionnaire was comprised of five sections. In section A, we asked questions to find out about the respondent's proficiency as a backcountry or out-of-bounds skier, and whether he is a professional guide. Section B inquired about the use of the avalanche bulletin. Does the respondent look up the avalanche bulletin regularly before a backcountry trip? We also inquired about recent attendance of avalanche safety classes, use of avalanche safety equipment, expenditure on avalanche search-and-rescue equipment within the last 5 years, and frequency of rescue search practicing.

In section C, respondents appraised the avalanche bulletin and indicated whether they find it easy to use and interpret. We asked them if they had been in situations where the actual avalanche danger was different from the danger forecasted in the avalanche bulletin, and what they would do if they were on a backcountry skiing tour and the conditions were more dangerous than indicated. This naturally leads to the next question. Has the respondent ever been caught in an avalanche? If so, was he buried partially or completely? Subsequent questions inquired about avalanche accident prevention and responsibility regarding the occurrence of avalanches.

The question at the heart of the survey elicits the WTP for the improved avalanche bulletin. This question was included in section C of the questionnaire and is described in detail below. Immediately after the WTP question we told respondents that in Switzerland every year about 20 backcountry skiers die in avalanche accidents. Since approximately 200,000 people engage in backcountry activities, the statistical risk of dying in an avalanche accident is about 10^{-4} per year. Does the respondent believe his risk of dying in an avalanche accident is lower, the same as, or higher than that of the average backcountry skier?

In section D respondents were asked additional questions about risk tolerance. Finally, in section E we elicited socio-demographic information on gender, age, marital status, size and composition of the household, education, occupational status and income.

B. WTP Scenario and Treatments

We placed the contingent valuation questions roughly in the middle of the questionnaire. All respondents were told about a hypothetical, but realistic, enhanced avalanche bulletin service that would provide more detailed local information and an extended forecast range, which should aid trip and activity planning. Respondents were then randomly assigned to the “treatment” or “control” variant of the questionnaire.

"Control" respondents were not given additional information about the benefits of the enhanced bulletin service and moved on to the WTP questions. By contrast, the treatment group was explicitly told that every year on average 20 skiers die in avalanche accidents. The enhanced bulletin service would reduce the number of fatalities to either 16 in the first sub-variant (*LARGERRISKREDUCTION* = 0) or 14 in the second sub-variant (*LARGERRISKREDUCTION* =1). (See Appendix A for the exact wording of the treatment scenarios.) The assignment to these sub-variants was at random.

Respondents were queried about their WTP for the enhanced service using two dichotomous choice questions. Specifically, they were asked whether they would be willing to pay CHF *x* for a one-year subscription to this hypothetical service. If the respondent said that he would pay *x*, we questioned him again at the next higher amount. If he declined to pay, we asked if he would pay the next lower amount. Initial and follow-up amounts are displayed in Table 1. Those respondents who answered "no" to both payment questions were asked to report directly their maximum WTP.

Table 1. Bid Amounts (in CHF).

Initial bid amount	Follow-up bid if YES	Follow-up bid if NO
15	40	7
40	50	15
50	100	40
100	200	50
200	300	100

5. Econometric Model

A. Statistical Model of WTP

Since 218 out of 1189 respondents with valid WTP responses stated that they were not willing to pay anything at all for the enhanced avalanche bulletin, our sample is a mix of interval-data and exact (zero and positive) observations on WTP. The appropriate model for such a sample is a so-called spike model (Kristrom 1997).

Assuming that the latent WTP, denoted by *WTP**, is normally distributed with mean μ and variance σ^2, the spike model results in the following log likelihood function:

$$(2) \quad \sum_{i\in\Im_0} \ln \Phi\left(-\frac{\mu}{\sigma}\right) + \sum_{i\in\Im+} \ln \frac{1}{\sigma}\phi\left(\frac{WTP_i}{\sigma} - \frac{\mu}{\sigma}\right) + \sum_{i\in\Im++} \ln\left[\Phi\left(\frac{WTP_i^U}{\sigma} - \frac{\mu}{\sigma}\right) - \Phi\left(\frac{WTP_i^L}{\sigma} - \frac{\mu}{\sigma}\right)\right],$$

where $\Im_0$ is the set of respondents who announced zero WTP, $\Im_+$ is the set of respondent with exact and positive WTP amounts, $\Im_{++}$ is the set of respondents with interval-data WTP responses, and $\Phi(\cdot)$ and $\phi(\cdot)$ denote the standard normal cdf and pdf, respectively. WTP^U is the upper bound and WTP^L is the lower bound of the interval around the latent WTP.[6]

The spike model is estimated by the maximum likelihood method. Mean WTP in the sample is estimated as $\hat{\mu}\cdot[1-\Phi(-\hat{\mu}/\hat{\sigma})]$ with $\hat{\mu}$ and $\hat{\sigma}$ denoting the maximum likelihood estimates of μ and σ, respectively.

B. Basic Specification of the WTP Model and Tests of Hypotheses

If we replace μ with $\mu_i = \mathbf{x}_i\boldsymbol{\beta}$, where $\mathbf{x}_i$ is a vector of covariates and $\boldsymbol{\beta}$ a vector of coefficients, we allow for systematic differences in WTP depending on individual characteristics of the respondents and/or on the treatment. The vector $\mathbf{x}_i$ always includes a minimum of two

[6] Consider a respondent who answered "yes" to the first WTP question and "no" to the follow-up question. For this respondent, WTP^L is the initial bid and WTP^U is the bid offered in the follow-up. For someone who answered "no" to the first payment question and "yes" to the follow-up, WTP^L is the amount in the follow-up question and WTP^U is the amount offered in the initial WTP question. Finally, we assign a WTP^L amount equal to the follow-up bid and a WTP^U equal to infinity to those who answered "yes"-"yes."

covariates to account for the experimental treatment the respondent was assigned to. These two regressors are *TREATMENT*, which is equal to one if the respondent was assigned to the "treatment" variant of the questionnaire and zero otherwise, and *LARGERRISKREDUCTION*, which is equal to one when the hypothetical avalanche bulletin description mentions that avalanche-related fatalities could be reduced from 20 to 14. In other words, we assume that latent WTP is:

$$(3) \quad WTP_i^* = \beta_0 + \beta_1 \cdot TREATMENT_i + \beta_2 \cdot LARGERRISKREDUCTION_i + \varepsilon_i ,$$

where ε_i is an i.i.d. normal error term with mean zero and constant variance σ^2.

We do not have clear expectations on the sign and significance of β_1. If reminding respondents about lives saved provides new information, and this is valued by the respondent, then β_1 is positive. We would then also expect β_2 to be positive, as WTP should be higher when more lives are saved due to the improved bulletin service. If the statement that the improved bulletin saves lives is not regarded as new information, respondents in the control and treatment groups may have similar WTP values, implying that β_1 is insignificant.

C. Hypotheses about Other Regressors

Since we expect heterogeneity in our respondents' valuation of the improved avalanche bulletin, we include individual characteristics and subjective risk perceptions in the right-hand side of Eq. (3). Possible determinants of the WTP include attitudes and beliefs about avalanche risks, ability to avoid or reduce risks, familiarity with them, and ease of use of the bulletin. To capture these factors, we enter dummies indicating whether the respondent (i) is a professional guide, (ii) leads groups of skiers, (iii) has attended an avalanche safety class, (iv) considers himself as an experienced backcountry or out-of-bounds skier, and (v) has been caught in an

avalanche before. We also control for the number of backcountry trips the respondent went on in the previous winter.

What signs do we expect on the coefficients of these variables? Regarding guides, we do not have unambiguous predictions. On the one hand, they may be willing to pay more for an enhanced avalanche bulletin because they are responsible for the lives of others. On the other hand, they may feel that they are capable of quickly assessing local conditions. If this is the case, an improved bulletin would not be of much additional value.

We reason that people who take avalanche safety classes are likely to be attuned to avalanche risks, and might be willing to pay more to receive more accurate avalanche information. Likewise, if someone has been buried in an avalanche before, the risk of a serious avalanche accident would be particularly salient to him, and he would be willing to pay more for improved information to help prevent another accident. We expect higher WTP for those respondents who frequently go on backcountry trips, as they presumably use the bulletin service more often.

The next group of regressors attempt to capture perceived risk, risk tolerance, and the respondent's beliefs about the entity responsible for the prevention of avalanche-related deaths. To measure perceived risk, we enter two dummies denoting whether the respondent considers himself at a higher or lower risk of dying in an avalanche than the average backcountry skier. We would expect persons who believe to be at greater risk than the average backcountry skier to place a higher value on the enhanced forecast.

As a proxy for risk tolerance, we enter a dummy indicating whether a respondent would choose a faster but riskier route to drive home on a hypothetical winter night. A preference for the descent part of a backcountry trip serves as another indicator for risk tolerance. We reason that more risk-tolerant people should be willing to pay less for an improved avalanche bulletin.

Regarding responsibility for avoiding avalanche accidents, we enter two dummies. The first takes on a value of one if the respondent agrees that the government should protect people from avalanches, whereas the second takes on a value of one (zero) if the respondent believes that backcountry skiers are (not) responsible for their own actions. The *a priori* signs of the coefficients on these variables are unclear, because either belief could imply trust of and reliance on the avalanche bulletin.

It seems reasonable to assume that WTP for improved avalanche danger information should depend on how satisfied one is with the format and ease of interpretation of the current avalanche bulletin. Therefore, we also include a dummy denoting whether the bulletin allows the respondent to estimate avalanche conditions "often" or "all the time or almost all the time."

WTP may also depend on gender, education, age, income, family status of the respondent, whether he has children and whether he is a Swiss national. In general, earlier research points to the fact that males tend to be more avalanche risk-tolerant than women (Sole and Emery 2008). This may imply, all else the same, that they are willing to pay less for an improved avalanche bulletin. Respondents who are married or have children are responsible for financial and non-financial support of their family members. It is likely that these respondents would be willing to pay more for information that could possibly save their life.

Economic theory suggests that the WTP for the improved bulletin should increase with income. We do not have clear expectations about the effect of age on the WTP.

6. The Data

A. Respondent Characteristics

A total of 1210 skiers participated in the survey. We deleted records with invalid e-mail or IP addresses or complete item non-response, and were left with a usable sample of 1189

observations. We further excluded respondents whom we suspected to work for weather forecast agencies, which left us with 1157 valid responses.

Descriptive statistics of the sample are reported in Table 2. Males account for over 86% of the sample. The average age is 40. Two-thirds of the respondents are married and about 40% have children. Most people are well-educated, with 60% having received university degrees and an average of 16 years of formal schooling. Almost 70% reside in Switzerland. Mean net household income is CHF 7689 a month.

Professional or candidate professional guides account for a little over 6% of the sample, and slightly less than half of the respondents lead groups during the winter. Regarding backcountry and out-of-bounds skiing, most people report that they are moderately experienced with these activities (60 and 65%, respectively). Self-assessed "professional/advanced" persons account for about one quarter of the sample. Only 12 and 13% of the respondents state that they are beginner backcountry and out-of-bounds skiers, respectively.

B. Avoidance of and Response to Avalanche Risks

What are the respondents' safety precautions with respect to avalanches? Given the nature of our sample, it is no surprise that almost all respondents (99%) check the avalanche bulletin before entering the backcountry. Over 50% of the subjects told us that they are able to estimate the avalanche danger "always or most of the time," another 40% "often," and 4% "some of the time."

Three-quarters of the respondents have taken an avalanche safety course. When asked about the money spent for avalanche safety training and rescue equipment in the last 5 years, 28% reported that these expenses were below CHF 500, 40% spent CHF 500 to 1000, 17% spent CHF 1001 to 1500, 8% spent CHF 1501 to 2000, and 5% more than CHF 2000. Using the

midpoint of the intervals for the first four categories and 2500 CHF for the last category (more than 2000 CHF), we calculate the average expense for safety training and equipment to be about 865 CHF. As shown in Figure 1, people who took avalanche education courses generally spent more money on rescue training and equipment than those who did not attend such classes.

About 20% of the respondents were previously caught in an avalanche. A majority of these people (56%) did not get buried. The others were buried either partially (33%) or completely (11%). In sum, these statistics suggest that subjects are well aware of avalanche risks, have sometimes experienced them first-hand, have been educated and trained in the prevention of and response to avalanche accidents, and use the avalanche bulletin consistently to avoid such risks.

Figure 1. Distribution of safety equipment and training expenditures over the last 5 years by avalanche course attendance.

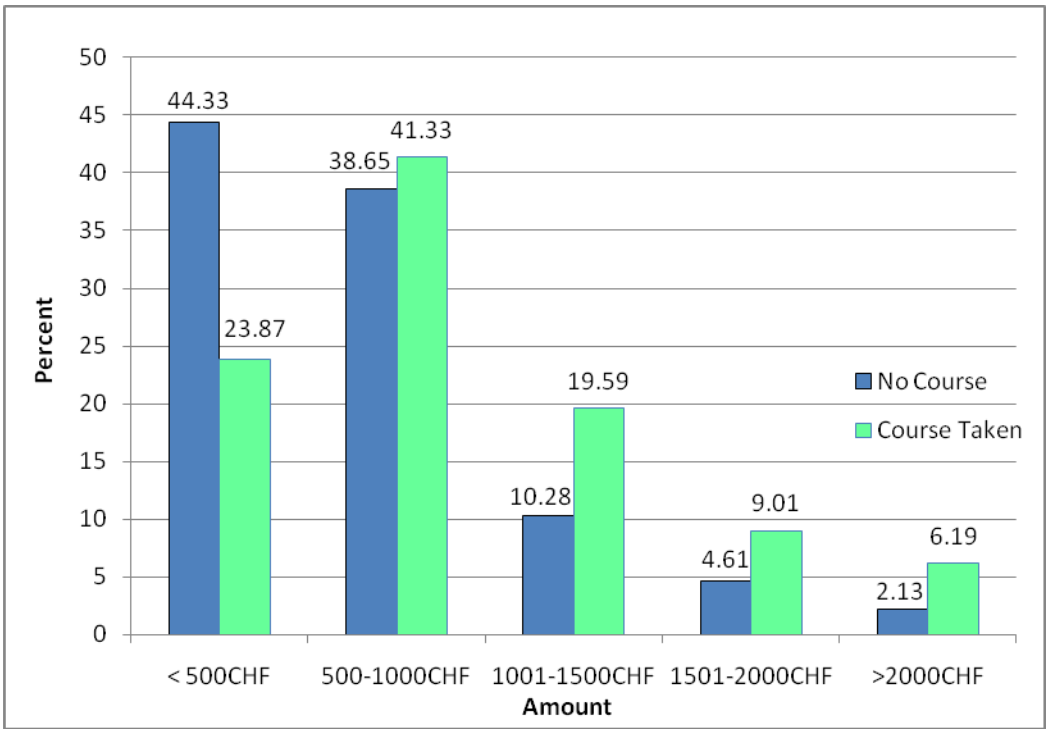

Table 2. Descriptive Statistics.

Variable	Obs	Percentage or Mean	Min	Max
Treatment group (*TREATMENT*=1)	1157	50.22	0	1
Larger risk reduction (*LARGERRISKREDUCTION*=1)	1157	24.72	0	1
Member of alpine club	1157	71.74	0	1
Professional guide	1157	6.14	0	1
BC/OOB professional	1157	29.04	0	1
Avalanche course	1157	74.94	0	1
Leader of a group	1157	48.83	0	1
Number of tours past winter	1119	12.65	0	25
Understand bulletin always	1157	52.29	0	1
Understand bulletin often	1157	40.28	0	1
Understand bulletin some	1157	4.41	0	1
Bulletin useful to estimate conditions	1157	90.75	0	1
Caught in avalanche	1157	19.53	0	1
Buried in avalanche	1157	8.73	0	1
Personal risk lower than average	1157	41.49	0	1
Personal risk higher than average	1157	8.04	0	1
Would take riskier road	1157	20.74	0	1
Avalanche prevention is the Government's responsibility	1157	19.36	0	1
One is responsible for himself in the backcountry	1157	85.91	0	1
Preference for the descent	1157	35.44	0	1
Male	1157	85.65	0	1
Years of education	1135	16.01	4	21
Age	1134	40.44	14	76
Monthly household income in CHF	1076	7689	2500	13000
Married	1157	65.60	0	1
Have children	1157	40.54	0	1
French	1157	9.25	0	1
German	1157	74.68	0	1
Italian	1157	12.10	0	1
Swiss	1157	68.54	0	1

C. Attitudes towards Avalanche Risks and Risk Mitigation

This section describes risk perceptions and behavior under hypothetical risky conditions. For example, how does the respondent view his own risk of dying in an avalanche compared to

that of the average backcountry skier? Half of our survey respondents think that their risk is about the same as the average backcountry skier, while 42% think that it is lower.

When queried about the choice between driving at night on an icy road A and taking a slower but safer road B, 21% of the sample would choose road A. Regarding specific aspects of background skiing, 35% of the respondents consider the descent the best part of backcountry skiing. This suggests that, at least in this hypothetical setting, most of the respondents are rather risk averse.

We asked respondents to express their degree of agreement with statements about the entity that should be responsible for protecting people from avalanche risks. About 20% of the respondent indicated that government should be responsible, while an overwhelming majority (86%) agreed with the statement that people who go into the backcountry are responsible for themselves.

D. Comparisons of Control and Treatment Respondents

Since respondents were randomly assigned to the control and treatment groups, we expect these two groups to be similar in terms of demographics. It is, however, possible that mentioning avalanche deaths (as we did to the treatment groups) altered people's perceptions of avalanche mortality risk, and that this was reflected in their answers to the questions about risks placed after the WTP scenario. For these reasons, we conducted a series of t-tests (see Appendix C) to check if the means of selected variables are statistically different across respondents in the control group (no mention of lives saved) and the treatment group (mention of lives saved).

We found virtually no difference with regard to socio-demographics. Respondents of the control group were somewhat more likely to consider themselves at higher risk than the average backcountry skiers (9.7% vs. 6.4% in the treatment group; t-statistic = 2.00, p-value = 0.022). We

also examined answers to the remaining questions posed after the WTP question. The t-tests find no evidence that the "treatment" had an effect on later responses. We conclude that, with minor exceptions, there are no statistically significant differences in the characteristics of the control and treatment respondents. Should we find any differences in WTP, they must hence be attributed to the treatment.

E. Comparison with the Universe of Backcountry Skiers

Since our survey questionnaire was posted online, we cannot claim that our sample is representative of the universe of backcountry skiers in the Swiss Alps. Comparison to a large survey of the Swiss population on sports behavior, however, suggests that for age and number of backcountry skiing days our sample is similar to the Swiss population (Lamprecht et al. 2008). The only exception is the share of males, which is higher in our sample (86% vs. 60%).

Self-selection is a possible concern in our survey. Since respondents were recruited among the visitors to the SLF web site, our sample might over-represent those who care about safety. If our sample is comprised of individuals who are highly concerned about safety, one would expect the WTP for the improved bulletin to be higher than that of the general population of backcountry skiers. If such a bias exists, however, it is difficult to say what its magnitude might be.

F. Willingness to Pay Responses

We check the validity of the 1189 usable WTP responses by examining whether the percentage of "yes" responses declines monotonically with the initial bid amount. Table 3 shows that this is indeed the case. The percentage of "yes" is almost 71% when the bid amount is CHF 15, declines monotonically in the initial bid level, and is 23% at the highest bid level of CHF 200. The figures in Table 3 suggest that median WTP is slightly less than CHF 50.

The frequency of the pairs of responses to the initial and follow-up payment questions indicates that the sample is generally well distributed among all pairs. NN sequences account for 36.7% of the sample, NY for 14.9%, YN for 28.9% and YY for 19.6%. A total of 436 people provided an exact WTP figure, and of these, a total of 218 (or 18% of the entire sample) reported zero WTP. We found no evidence of an association between the tendency to report zero WTP and the initial bid amount.[7]

Finally, we looked at the distribution of the WTP responses across the treatment and control groups. We found no significant differences in the proportion of "yes" responses by initial bids across the treatments. Zero WTP responses accounted for 18.7% of the responses from the control subsample and for 18.0% of the treatment subsample. Again, these proportions are not significantly different from each other (t-statistic = 0.31, p-value = 0.38).

These analyses hint at the fact that mentioning lives lost in avalanche accidents had little, if any, effect on the WTP for the enhanced bulletin service. We now turn to the statistical modeling to 1) obtain estimates of the WTP for the hypothetical enhanced bulletin service, 2) formally test whether explicit mentioning of risk reduction affects WTP, and 3) explore which factors drive WTP and the probability of zero WTP responses.

[7] The percentages of zero WTP responses in the groups of respondents who received initial bids of CHF 15, 40, 50, 100 and 200 are, in order, 17.0%, 20.3%, 17.4%, 18.5% and 18.6%.

Table 3. Frequency and percentage of "yes" responses to the initial payment questions.

Initial bid (CHF)	N	N valid	YES responses	% YES responses
15	271	271	192	70.8%
40	241	241	136	56.4%
50	230	230	118	51.3%
100	234	232	80	34.5%
200	216	215	50	23.3%

7. Results

A. Spike Model

Our simplest spike model (with *TREATMENT* and *LARGERRISKREDUCTION*) indicates that WTP is not significantly different across the control and treatment subsamples. WTP is not affected by the mention of a larger or smaller number of lives lost within the treatment sample. Mean WTP is CHF 43.58 (with a standard error of 2.71) in the control group, CHF 41.61 (with a standard error of 3.75) for the hypothetical bulletin that reduces lives lost from 20 to 16, and CHF 46.05 (with a standard error of 3.92) for the enhanced service that would reduce lives lost from 20 to 14.

One limitation of this model is that it overpredicts the proportion of zero WTP responses (24% versus the actually observed 18%). To remedy this problem, we re-estimate a modified spike model that includes additional regressors. This modified spike model predicts individual-specific probabilities of a zero (or positive) WTP response as a function of respondent characteristics and attitudes. Table 4 displays results of these augmented spike regressions.

In addition to the dummies for treatment and size of risk reduction, in Specification (A) we include professional guide status, whether the respondent leads a group, was ever buried in an avalanche, considers himself at lower or higher risk than the average skier, and chooses the riskier road in the question about risky behavior. We also include dummies for government and

personal responsibilities, and one dummy denoting that the respondent is capable of estimating the conditions always or most of the time by the use of the avalanche bulletin.

Specification (B) is similar to Specification (A), but replaces professional guide information with variables that proxy for skills, avalanche-specific education, taste for specific aspects of the backcountry experience, and frequency of tours. The final specification is given by Specification (C), which adds demographic and economic characteristics of the respondents.

The results are remarkably robust across the specifications. As with the simplest specification of the spike model, treatment status and number of lives saved do not affect WTP for the enhanced bulletin.

Professional guides have systematically lower WTP amounts. People at a lower risk level than the average skier are willing to pay significantly less than the average skier. A similar, but statistically insignificant, effect is observed for those persons who feel their risk is *higher* than that of the average backcountry skier. We conjecture that these persons either doubt the risk reduction, $\Delta q = q_0 - q_1$, that would be achieved by the new bulletin system, or feel that their better skills mitigate the higher risks—and hence do not have a great demand for the enhanced bulletin.

As expected, persons with a higher risk tolerance (i.e., those who prefer the riskier road over the safer but longer one) are willing to pay significantly less for the enhanced avalanche bulletin. The usefulness of the bulletin (*ESTBULLETIN*) enters positively and significantly. Specifically, WTP is about CHF 30 higher if the bulletin is judged useful in estimating the prevalent conditions.

Table 4. Interval data spike model.

Variable	Specification (A)		Specification (B)		Specification (C)	
	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
TREATMENT	-5.494	-0.87	-5.842	-0.91	-4.286	-0.65
LARGERRISKREDUCTION	4.302	0.62	5.658	0.81	5.549	0.78
Professionalguide	-21.267 *	-1.77				
Leadagroup	3.698	0.7	-2.426	-0.42	-2.623	-0.43
Buriedaval	-7.384	-0.82	-8.933	-0.97	-5.183	-0.54
Risklower	-12.303 **	-2.32	-11.85 **	-2.18	-11.879 **	-2.1
Riskhigher	-6.744	-0.69	-1.393	-0.14	1.166	0.12
Roada	-13.601 **	-2.17	-12.34 *	-1.91	-16.748 **	-2.48
Governmentresponsib	-5.266	-0.91	-5.861	-1.01	-6.799	-1.13
Peopleresponsib	-1.006	-0.12	-0.844	-0.1	2.652	0.32
Estbulletin	29.570 ***	3.22	27.422 ***	2.93	29.491 ***	3.04
Bcoob_prof			-13.65	-1.18	-10.051	-0.89
Avc			8.139	1.15	8.323	1.12
Avc_prof			-5.657	-0.43	-4.654	-0.35
Descent			2.705	0.49	0.165	0.03
Numtours_pw			0.543	1.57	0.590	1.57
Genderm					-8.463	-0.97
Edyears					0.920	0.83
Age35b					14.704	1.63
Age35_50					10.679	1.41
Income					0.002 *	1.69
Married					10.934	1.54
Havekids					10.619	0.67
Markids					-21.724	-1.31
French					-20.524	-1.19
German					-9.296	-0.61
Italian					-14.679	-0.86
Swiss					14.050 **	2.21
Constant	42.551 ***	3.39	37.468 ***	2.75	0.381	0.01
Scale	79.8		79.6		78.8	
N		1151		1113		1030
Log L		-2710		-2634		-2398

WTP is not systematically different for those who believe that skiers should be responsible for themselves nor for those who feel that the government should be responsible. Yet, those respondents who feel that government has a duty to protect people from avalanche risks are willing to pay somewhat less.

We attempted to control for skier skill level and avalanche-specific skills by entering a dummy indicating a highly proficient skier, and one indicating attendance of an avalanche course (as well as an interaction between these two variables). As shown in specifications (B) and (C), highly skilled skiers are actually willing to pay about CHF 10-14 *less* for the enhanced bulletins, although the coefficient on this dummy is not statistically significant. By contrast, those who have taken an avalanche course are willing to pay about CHF 8 more, although, once again, this coefficient is not significant.

We constructed several dummies to capture the respondent's preferences for several aspects of a backcountry trip, but none was significant. In particular, specifications (B) and (C) look at people who stated that they favor descending over ascending (*DESCENT*), which has negligible impact on WTP. We also found only a weak association between WTP and trips in the previous winter. Among the socioeconomic characteristics of the respondents, income was weakly and positively associated with WTP, but the other demographic characteristics did not matter.[8] Swiss residents were willing to pay significantly more for the bulletin, but the language in which the survey was taken did not make a difference.

B. Robustness Checks

One limitation of the spike model is that it forces the underlying coefficients to be the same for people with zero WTP and for people with positive WTP (Greene 2008). For good measure, we estimated probit models where the dependent variable is a dummy denoting zero WTP. The specifications are the same as those for the spike model presented above. The results (shown in Table 5) confirm the qualitative findings of the spike model.

[8] We report a specification based on placing people in three main age groups—up to 35, 35-50, and older than 50. Those in the former two age groups appear to have higher WTP (by about CHF 10-14), but their figures are not significantly different from those for the oldest group (which are absorbed into the intercept).

As with the spike model, the results are robust across specifications. Professional guides are significantly more likely to announce a zero WTP, as are those who feel that they are at a lower risk level than that of the average backcountry skier, and those who select the riskier road in the risk aversion question. The coefficients on the latter two variables are roughly of the same magnitude, whereas the one on professional guide status is more than twice as large.

We also find that respondents who believe that backcountry skiers are ultimately responsible for their own actions are less likely to report a zero WTP amount. The ability to estimate the local conditions using the avalanche bulletin is another important predictor of a zero WTP response. Specifically, those who feel that the bulletin allows them to estimate the prevalent conditions are less likely to provide a zero WTP response. The magnitude of this effect is roughly the same in absolute value, but opposite in sign, than that on professional guide status. By contrast, those with more backcountry trips in the previous winter are more likely to report zero WTP. This effect, however, is significant only in specification (C).

Respondents who valued the larger risk reduction are less likely to announce a zero WTP response, while respondents who took the survey in French or Italian are more likely to announce a zero WTP. These associations, however, are statistically weak.

Table 5. Probit model of zero WTP.

	Specification (A)		Specification (B)		Specification (C)	
Variable	**Coeff.**	**t-stat**	**Coeff.**	**t-stat**	**Coeff.**	**t-stat**
TREATMENT	0.140	1.33	0.151	1.39	0.117	1.01
LARGERRISKREDUCTION	-0.211 *	-1.68	-0.236 *	-1.85	-0.252 *	-1.89
Professionalguide	0.514 ***	3.00				
Leadagroup	0.079	0.85	0.048	0.48	0.062	0.55
Buriedaval	0.151	0.99	0.120	0.80	0.083	0.52
Risklower	0.223 **	2.40	0.269 ***	2.84	0.251 **	2.47
Riskhigher	0.183	1.13	0.080	0.47	0.029	0.17
Roada	0.217 **	2.06	0.182 *	1.67	0.237 **	2.04
Governmentresponsib	-0.166	-1.44	-0.153	-1.30	-0.152	-1.21
Peopleresponsib	-0.199	-1.64	-0.180	-1.43	-0.227 *	-1.70
Estbulletin	-0.454 ***	-3.16	-0.506 ***	-3.35	-0.570 ***	-3.46
Bcoob_prof			0.170	0.74	0.132	0.56
Avc			-0.024	-0.18	-0.015	-0.11
Avc_prof			0.104	0.42	0.108	0.41
Descent			-0.066	-0.68	0.010	0.09
Numtours_pw			0.015 ***	2.66	0.013 **	2.10
Genderm					0.214	1.33
Edyears					-0.021	-1.11
Age35b					-0.263	-1.61
Age35_50					-0.201	-1.58
Income					5.7e-06	0.35
Married					-0.182	-1.34
Havekids					0.088	0.36
Markids					0.104	0.40
French					0.671 *	1.95
German					0.452	1.43
Italian					0.634 *	1.87
Swiss					-0.053	-0.45
Constant	-0.583 ***	-3.25	-0.753 ***	-3.67	-0.792	-1.47
N		1151		1113		1030
Log L		-522		-495		-442

8. Discussion and Conclusions

We have used contingent valuation to find out how much backcountry skiers are willing to pay for improved avalanche information. Our scenario is framed as a small improvement in the existing avalanche bulletin service (rather than attempting to value the full service *per se*). The

enhanced bulletin can be regarded as a quasi-public good.[9] Using dichotomous choice questions followed by open-ended questions, we have found that about 82% of our respondents would pay a positive amount of money for this hypothetical improvement. The remaining 18% of the sample were not willing to pay anything at all, so the mean WTP of the sample is about CHF 42 to 46, depending on model specification.

Regression analyses show that professional guides and skiers who consider themselves capable of using the current bulletin are willing to pay little or nothing at all for this hypothetical improvement. Those who judge the current bulletin useful to estimate conditions in the field are, however, willing to pay more for the hypothetical enhanced service.[10] Respondents who perceive themselves at lower risk than the average skier are willing to pay less for the improved service, as are persons with a higher tolerance for risk. Taken together, these findings suggest that WTP does depend on how useful to the respondent the bulletin enhancement is judged to be, based on perceived risk exposure and skills processing cues about avalanche risks.

Further analyses show that willingness to pay is positively correlated with income. Even more important, reminders about opportunities for saving lives and the number of lives that would be saved did not have an appreciable effect on the WTP.

When analyzing policies and programs that save lives, it is useful to summarize information about the WTP for mortality risk reductions into a metric dubbed "the value of a statistical life" (VSL) (Hammitt 2000). The VSL is the WTP for a marginal change in the risk of dying and can be approximated as mean WTP divided by the reduction in risk Δq.

[9] We interpret the enhanced bulletin as a quasi public good because it would possible to charge users for the bulletin but there is no rivalry in consumption.

[10] About 45% of the professional guides and 51% of the other respondents indicate that the current bulletin is useful for estimating conditions "always or most of the time."

If the mean WTP estimated in this study is divided by the average mortality risk reduction stated to the respondents in the questionnaire (5 in 200,000), *and* we assume that the only benefit of enhanced bulletin is a mortality risk reduction, the WTP responses imply a VSL of CHF 1.75 million.

Admittedly, this is a restrictive assumption since respondents may have been thinking about non-fatal accidents as well, which means that this figure should be interpreted as an upper bound for the VSL in the avalanche accident context. This figure is within the range of plausible VSL values, but is low compared with estimates from the Swiss labor market (10-15 million CHF, 1995 CHF; see Baranzini and Ferro-Luzzi, 2001).[11]

With this caveat, our estimate of the VSL could be used for evaluating past improvements in avalanche safety. For instance, in 1999 the Swiss avalanche bulletin was extended to cover regional aspects of avalanche danger and special regional bulletins were created. What is the economic value of this improved service?

To compute this value, one may approximate the number of averted avalanche fatalities using changes in relative risk in the years 2000 through 2008. The number of backcountry skiers increased by 227% during this period (Lamprecht et al. 2008), while the 10-year average of annual avalanche fatalities increased only from $D^{91–00} = 19.2$ to $D^{99–08} = 19.6$. Without the extension of the bulletin service, better rescue equipment, and improved avalanche education we would expect the annual risk of dying in an avalanche-related accident for backcountry skiers to be constant during that period. Under these assumptions, the expected number of avalanche fatalities in 2008 is $D^{91–00} * 2.27 = 43.6$ deaths. Yet, we observe only 19.6 deaths on average over the 10-year period, and so the number of averted avalanche fatalities in 2008 that can be

[11] Adjusted for inflation, these figures are equivalent to 10.8-16.2 million 2009 CHF (see Swiss Federal Statistical Office, http://www.portal-stat.admin.ch/lik_rechner/d/lik_rechner.htm, last accessed 6 May 2010).

attributed to improvements in avalanche safety is approximately 24. On multiplying this figure by the VSL estimate from our study, we get monetized benefits of CHF 42.0 million, which is about seven times the actual cost of producing the avalanche bulletin. While we do not know perfectly the share of the risk reduction attributable to improvements in the bulletin service alone, it seems reasonable to conclude that the benefits of the regional bulletins far exceed the extra costs incurred for their provision.[12]

Regarding the matter of other means of reducing risk, we know that our survey participants spent about CHF 865 for safety training and equipment in the last 5 years—or about CHF 170 a year. The annual mean WTP for the enhanced bulletin is thus about one-third of the annual expenditure for equipment, and about 65% the cost of a two-day avalanche safety training course. This suggests to us that skiers consider the information about risks worthwhile, although of course we do not know for sure the extent of the risk reduction that they ascribe to the one or the other measures. Based on evidence from our sample that respondents who took avalanche courses reported higher equipment and rescue training expenditures, we conjecture that information and equipment are complements, and are not viewed as substitutes for one another.[13]

As always, regression results should be interpreted with caution. Though we believe that our sample is representative of backcountry skiers who access the Swiss avalanche bulletin online, (some 90% of the universe of avalanche bulletin users), we cannot tell how our respondents differ from people who do not use the avalanche bulletin at all. One might conservatively assume that those persons have a zero WTP for improved avalanche information.

[12] We also calculated the 20-year average of annual avalanche fatalities: $D^{81–00} = 22.5$ and $D^{89–08} = 20.0$. Using these figures, the annual benefits of avalanche safety improvements amount are even larger (CHF 54.5 million).

[13] We did run a spike model that includes safety equipment and training expenditure, which we added to the right-hand side of specification (C) in table 4. The coefficient on this variable is positive and significant, and implies that WTP increases by CHF 2 for every CHF 100 spent on safety equipment or training. We interpret this to mean that those who care more about safety are willing to spend more on equipment and on an enhanced avalanche forecast system.

Second, we did not inquire about life-saving benefits of the hypothetical improved avalanche bulletin control respondents may have spontaneously thought of.

One might wonder whether respondents who reported positive WTP amounts were thinking about their own or others' risk reductions. The fact that professional guides and self-professed highly skilled people reported lower or zero WTP, and that the enhanced bulletin is essentially a quasi public good to be accessed via a one-year subscription, suggests that people were thinking primarily of themselves and their own risks when they answered the WTP questions.

Clearly, more research needs to be done regarding altruistic considerations. In future research, we also hope to inquire in more detail how exactly people process hazardous weather information and other inputs in their 'risk reducing' production function.

References

Adams L (2005) A Systems Approach to Human Factors and Expert Decision-Making within Canadian Avalanche Phenomena Royal Roads University, Victoria, BC, Victoria, BC, pp. 295

Alberini A, Tonin S, Turvani M, Chiabai A (2007) Paying for permanence: Public preferences for contaminated site cleanup. Journal of Risk and Uncertainty 34:155-178

Alhakami AS, Slovic P (1994) A Psychological-Study of the Inverse Relationship between Perceived Risk and Perceived Benefit. Risk Analysis 14:1085-1096

Atkins D (2000) Human factors in avalanche accidents. Int Snow Sci Workshop. Big Sky MT.

Atkins D, McCammon I (2004) Differences between avalanche experts and novices. Int Snow Sci Workshop. Jackson Hole WY.

Bateman IJ, Carson RT, Day B, et al. (2002) Economic Valuation with Stated Preference Techniques: A Manual. Edward Elgar, Cheltenham, UK

Browne MJ, Hoyt RE (2000) The demand for flood insurance: Empirical evidence. Journal of Risk and Uncertainty 20:291-306

Considine TJ, Jablonowski C, Posner B, Bishop CH (2004) The value of hurricane forecasts to oil and gas producers in the Gulf of Mexico. Journal of Applied Meteorology 43:1270-1281

Ebi KL, Tieisberg TJ, Kalkstein LS, Robinson L, Weiher RF (2004) Heat watch/warning systems save lives. Bulletin of the American Meteorological Society 85:1067-1073

Greene WH (2008) Econometric Analysis. Prentice Hall, Upper Saddle River, NJ

Gregory R, Mendelsohn R (1993) Perceived Risk, Dread, and Benefits. Risk Analysis 13:259-264

Haegeli P, Haider W, Longland M, Beardmore B (2010) Amateur decision-making in avalanche terrain with and without a decision aid: a stated choice survey. Natural Hazards 52:185-209

Hallstrom DG, Smith VK (2005) Market responses to hurricanes. Journal of Environmental Economics and Management 50:541-561

Hammitt JK (2000) Valuing mortality risk: Theory and practice. Environmental Science & Technology 34:1396-1400

Hirshleifer J, Riley JG (1992) The Analytics of Uncertainty and Information. Cambridge University Press, Cambridge, MA

Holler P (2007) Avalanche hazards and mitigation in Austria: a review. Natural Hazards 43:81-101

Johnson SR, Holt MT (1997) The value of weather information. In: Katz RW and Murphy AH (eds) Economic value of weather and climate forecasts. Cambridge University Press, Cambridge, pp. 75-107

Kristrom B (1997) Spike Models in Contingent Valuation. American Journal of Agricultural Economics 79:1013-1023

Lamprecht M, Fischer A, Stamm HP (2008) Sport Schweiz 2008: Das Sportverhalten der Schweizer Bevölkerung.

Letson D, Sutter DS, Lazo JK (2007) Economic Value of Hurricane Forecasts: An Overview and Research Needs. Natural Hazards Review 8:78-86

McCammon I (2004) Heuristic Traps in Recreational Avalanche Accidents: Evidence and Implications (Parts 1 & 2). Avalanche Review 22: Issues 2 & 3

McCammon I, Haegeli P (2007) An evaluation of rule-based decision tools for travel in avalanche terrain. Cold Regions Science and Technology 47:193-206

McClung DM (2002) The elements of applied avalanche forecasting - Part I: The human issues. Natural Hazards 26:111-129

McClung DM, Schaerer P (2006) The Avalanche Handbook. Mountaineers Books, Seattle, Wash.

Meyer RJ (2006) Why We Under-Prepare for Hazards. In: Daniels RJ, Kettl DF and Kunreuther H (eds) On Risk and Disasters Lessons from Hurricane. University of Pennsylvania Press, Philadelphia, PA,

Ramsberg JAL, Sjöberg L (1997) The Cost-Effectiveness of Lifesaving Interventions in Sweden. Risk Analysis 17:467-478

Rollins KS, Shaykewich J (2003) Using willingness-to-pay to assess the economic value of weather forecasts for multiple commercial sectors. Meteorological Applications 10:31-38

Schwiersch M, Stopper D, Bach T (2005) Verstehen Skitourengeher den Lawinenlagebericht? Ergebnisse einer Studie der DAV-Sicherheitsforschung bergundsteigen – Zeitschrift für Risikomanagement im Bergsport 4:30-33

Slanger E, Rudestam KE (1997) Motivation and disinhibition in high risk sports: Sensation seeking and self-efficacy. Journal of Research in Personality 31:355-374

Slovic P, Fischhoff B, Lichtenstein S (2000) Facts and Fears: Understanding Perceived Risk. In: Slovic P (ed) The Perception of Risk. Earthscan, London, pp. 137-154

Sole A, Emery C (2008) Human Risk Factors in Avalanche Incidents. Int Snow Sci Workshop. Whistler BC.

Stethem C, Jamieson B, Schaerer P, Liverman D, Germain D, Walker S (2003) Snow avalanche hazard in Canada - a review. Natural Hazards 28:487-515

Tengs TO, Adams ME, Pliskin JS, et al. (1995) 500 Lifesaving Interventions and Their Cost-Effectiveness. Risk Analysis 15:369-390

Tremper B (2001) Staying Alive in Avalanche Terrain. Mountaineers Books, Seattle, Wash.

Tsuge T, Kishimoto A, Takeuchi K (2005) A choice experiment approach to the valuation of mortality. Journal of Risk and Uncertainty 31:73-95

Waeger P, Zweifel B (2008) 10hochminus5. bergundsteigen – Z f Risikomanagement Bergsport 10:32-36

Whitehead JC (2003) One million dollars per mile? The opportunity costs of Hurricane evacuation. Ocean & Coastal Management 46:1069-1083

Appendix A. Exact wording of the scenario and WTP questions.

Treatment

The avalanche bulletin is currently provided free of charge to users of the WSL Institute for Snow and Avalanche Research SLF in Davos. The forecast for avalanche danger is valid for the next 24 hours.

Suppose it was possible to develop an enhanced bulletin service with 1) more detailed information on avalanche danger on a regional and local scale, and 2) forecasts for avalanche danger for the next 48 hours.

The improved avalanche information would support many backcountry and out of bound skiers/snowboarders in their decision-making. Currently, about 20 fatalities occur every winter in avalanche-related accidents. It is estimated that the enhanced and extended avalanche bulletin would reduce the number of avalanche-related fatalities to 16 (14) per winter.

Suppose that to help defray the cost of developing and providing these enhanced bulletin services, it was necessary to charge users for accessing them on the SLF web site, via phone, MMS, WAP, and Teletext. You would still have access to the basic 24 hour forecast for free.
Would you be willing to pay X CHF for a one-year subscription with unlimited access to this enhanced avalanche bulletin with more detailed local conditions and forecasts extended to 48 hours?

Control

The avalanche bulletin is currently provided free of charge to users of the WSL Institute for Snow and Avalanche Research SLF in Davos. The forecast for avalanche danger is valid for the next 24 hours.

Suppose it was possible to develop an enhanced bulletin service with 1) more detailed information on avalanche danger on a regional and local scale, and 2) forecasts for avalanche danger for the next 48 hours.

Suppose that to help defray the cost of developing and providing these enhanced bulletin services, it was necessary to charge users for accessing them on the SLF web site, via phone, MMS, WAP, and Teletext. You would still have access to the basic 24 hour forecast for free.

Would you be willing to pay X CHF for a one-year subscription with unlimited access to this enhanced avalanche bulletin with more detailed local conditions and forecasts extended to 48 hours?

Appendix B. Explanatory Variables

Variable	Description
age35b; age35_50	Dummy=1 if the respondent is younger than 35 or between 35–50 years old, respectively.
Avc	Dummy=1 if the respondent attended a course or seminar about avalanches.
Avc_prof	Interaction of the two dummies avc and bcoob_prof.
Bcoob_prof	Dummy=1 if the respondent considers himself an experienced (professional level) backcountry or out-of-bound skier.
Buriedaval	Dummy=1 if the respondent has been (completely or partly) buried in an avalanche.
Treatment	Dummy=1 if the respondent is assigned to the treatment group.
Descent	Dummy=1 if the respondent considers the descent as best part of backcountry skiing.
Edyears	Years of education.
Estbulletin	Dummy=1 if the respondent states that the avalanche bulletin always, almost always or often allows estimating avalanche danger and route conditions.
French; German; Italian	Dummies that indicate the language the survey was taken.
Genderm	Dummy=1 if the respondent is a male.
Governmentresponsib	Dummy=1 if the respondent agrees that the government is responsible for protecting people from avalanches.
Havekids	Dummy=1 1 if the respondent has children.
Income	Respondent monthly household income (categories ranging from 2,500 to 13,000 CHF).
Largerriskreduction	Dummy=1 if the respondent was assigned to the treatment that mentions lives saved and to the program that reduces avalanche-related fatalities from 20 to 14 a year.
Leadagroup	Dummy=1 if the respondent currently leads groups during the winter.
Markids	Interaction of the two dummies married and havekids.
Married	Dummy=1 if the respondent is married.
Numtours_pw	Number of tours the respondent went past winter (categories ranging from 0 to 25).
Peopleresponsib	Dummy=1 if the respondent agrees that individuals themselves are responsible for protecting them from avalanches.
Professionalguide	Dummy=1 if the respondent is a professional guide.
Riskhigher	Dummy=1 if the respondent considers himself at higher risk of dying in an avalanche than the average (backcountry skier).
Risklower	Dummy=1 if the respondent considers himself at lower risk of dying in an avalanche than the average (backcountry skier).
Roada	Dummy=1 if the respondent would opt for the faster but riskier route to drive home in a winter night (proxy for risk tolerance).
Swiss	Dummy=1 if the respondent lives in Switzerland.

Appendix C. T-tests of differences in means across the control and treatment groups.

Variable	Control			Treatment			Stat. Diff.
	N	Perc/Mean	Std. Dev.	N	Mean	Std. Dev.	
Alpine club	576	0.715	0.452	581	0.719	0.450	not sign.
Professional guide	576	0.069	0.254	581	0.053	0.225	not sign.
Bc/oob professional	576	0.302	0.460	581	0.279	0.449	not sign.
Avalanche course	576	0.736	0.441	581	0.762	0.426	not sign.
Lead a group	576	0.500	0.500	581	0.477	0.500	not sign.
Number tours past winter	557	12.564	9.049	562	12.731	8.861	not sign.
Ustand bulletin always	576	0.535	0.499	581	0.511	0.500	not sign.
Ustand bulletin often	576	0.378	0.485	581	0.427	0.495	10 % level
Ustand bulletin some	576	0.056	0.229	581	0.033	0.178	10 % level
Estimate conditions	576	0.903	0.297	581	0.912	0.283	not sign.
Caught in avalanche	576	0.184	0.388	581	0.207	0.405	not sign.
Buried in avalance	576	0.090	0.287	581	0.084	0.278	not sign.
Lower personal risk	576	0.427	0.495	581	0.403	0.491	not sign.
Higher personal risk	576	0.097	0.297	581	0.064	0.244	5 % level
Road a	576	0.215	0.411	581	0.200	0.400	not sign.
Government's responsibility	576	0.193	0.395	581	0.194	0.396	not sign.
People's responsibility	576	0.854	0.353	581	0.864	0.343	not sign.
Descent	576	0.391	0.488	581	0.318	0.466	5 % level
Male	576	0.845	0.362	581	0.867	0.339	not sign.
Years of education	565	15.961	2.674	570	16.049	2.530	not sign.
Age	561	40.242	12.220	573	40.630	11.849	not sign.
Income (in CHF)	531	7660.55	3386.12	545	7716.51	3337.68	not sign.
Married	576	0.646	0.479	581	0.666	0.472	not sign.
Have kids	576	0.401	0.491	581	0.410	0.492	not sign.
French	576	0.092	0.289	581	0.093	0.291	not sign.
German	576	0.733	0.443	581	0.761	0.427	not sign.
Italian	576	0.127	0.333	581	0.115	0.320	not sign.
Swiss	576	0.677	0.468	581	0.694	0.461	not sign.

NOTE DI LAVORO DELLA FONDAZIONE ENI ENRICO MATTEI

Fondazione Eni Enrico Mattei Working Paper Series

Our Note di Lavoro are available on the Internet at the following addresses:

http://www.feem.it/getpage.aspx?id=73&sez=Publications&padre=20&tab=1
http://papers.ssrn.com/sol3/JELJOUR_Results.cfm?form_name=journalbrowse&journal_id=266659
http://ideas.repec.org/s/fem/femwpa.html
http://www.econis.eu/LNG=EN/FAM?PPN=505954494
http://ageconsearch.umn.edu/handle/35978
http://www.bepress.com/feem/

NOTE DI LAVORO PUBLISHED IN 2010

GC	1.2010	Cristina Cattaneo: Migrants' International Transfers and Educational Expenditure: Empirical Evidence from Albania
SD	2.2010	Fabio Antoniou, Panos Hatzipanayotou and Phoebe Koundouri: Tradable Permits vs Ecological Dumping
SD	3.2010	Fabio Antoniou, Panos Hatzipanayotou and Phoebe Koundouri: Second Best Environmental Policies under Uncertainty
SD	4.2010	Carlo Carraro, Enrica De Cian and Lea Nicita: Modeling Biased Technical Change. Implications for Climate Policy
IM	5.2010	Luca Di Corato: Profit Sharing under the threat of Nationalization
SD	6.2010	Masako Ikefuji, Jun-ichi Itaya and Makoto Okamura: Optimal Emission Tax with Endogenous Location Choice of Duopolistic Firms
SD	7.2010	Michela Catenacci and Carlo Giupponi: Potentials and Limits of Bayesian Networks to Deal with Uncertainty in the Assessment of Climate Change Adaptation Policies
GC	8.2010	Paul Sarfo-Mensah and William Oduro: Changes in Beliefs and Perceptions about the Natural Environment in the Forest-Savanna Transitional Zone of Ghana: The Influence of Religion
IM	9.2010	Andrea Boitani, Marcella Nicolini and Carlo Scarpa: Do Competition and Ownership Matter? Evidence from Local Public Transport in Europe
SD	10.2010	Helen Ding and Paulo A.L.D. Nunes and Sonja Teelucksingh: European Forests and Carbon Sequestration Services : An Economic Assessment of Climate Change Impacts
GC	11.2010	Enrico Bertacchini, Walter Santagata and Giovanni Signorello: Loving Cultural Heritage Private Individual Giving and Prosocial Behavior
SD	12.2010	Antoine Dechezleprêtre, Matthieu Glachant and Yann Ménière: What Drives the International Transfer of Climate Change Mitigation Technologies? Empirical Evidence from Patent Data
SD	13.2010	Andrea Bastianin, Alice Favero and Emanuele Massetti: Investments and Financial Flows Induced by Climate Mitigation Policies
SD	14.2010	Reyer Gerlagh: Too Much Oil
IM	15.2010	Chiara Fumagalli and Massimo Motta: A Simple Theory of Predation
GC	16.2010	Rinaldo Brau, Adriana Di Liberto and Francesco Pigliaru: Tourism and Development: A Recent Phenomenon Built on Old (Institutional) Roots?
SD	17.2010	Lucia Vergano, Georg Umgiesser and Paulo A.L.D. Nunes: An Economic Assessment of the Impacts of the MOSE Barriers on Venice Port Activities
SD	18.2010	ZhongXiang Zhang: Climate Change Meets Trade in Promoting Green Growth: Potential Conflicts and Synergies
SD	19.2010	Elisa Lanzi and Ian Sue Wing: Capital Malleability and the Macroeconomic Costs of Climate Policy
IM	20.2010	Alberto Petrucci: Second-Best Optimal Taxation of Oil and Capital in a Small Open Economy
SD	21.2010	Enrica De Cian and Alice Favero: Fairness, Credibility and Effectiveness in the Copenhagen Accord: An Economic Assessment
SD	22.2010	Francesco Bosello: Adaptation, Mitigation and "Green" R&D to Combat Global Climate Change. Insights From an Empirical Integrated Assessment Exercise
IM	23.2010	Jean Tirole and Roland Bénabou: Individual and Corporate Social Responsibility
IM	24.2010	Cesare Dosi and Michele Moretto: Licences, "Use or Lose" Provisions and the Time of Investment
GC	25.2010	Andrés Rodríguez-Pose and Vassilis Tselios (lxxxvi): Returns to Migration, Education, and Externalities in the European Union
GC	26.2010	Klaus Desmet and Esteban Rossi-Hansberg (lxxxvi): Spatial Development
SD	27.2010	Massimiliano Mazzanti, Anna Montini and Francesco Nicolli: Waste Generation and Landfill Diversion Dynamics: Decentralised Management and Spatial Effects
SD	28.2010	Lucia Ceccato, Valentina Giannini and Carlo Gipponi: A Participatory Approach to Assess the Effectiveness of Responses to Cope with Flood Risk
SD	29.2010	Valentina Bosetti and David G. Victor: Politics and Economics of Second-Best Regulation of Greenhouse Gases: The Importance of Regulatory Credibility
IM	30.2010	Francesca Cornelli, Zbigniew Kominek and Alexander Ljungqvist: Monitoring Managers: Does it Matter?
GC	31.2010	Francesco D'Amuri and Juri Marcucci: "Google it!" Forecasting the US Unemployment Rate with a Google Job Search index
SD	32.2010	Francesco Bosello, Carlo Carraro and Enrica De Cian: Climate Policy and the Optimal Balance between Mitigation, Adaptation and Unavoided Damage

SD	33.2010	Enrica De Cian and Massimo Tavoni: The Role of International Carbon Offsets in a Second-best Climate Policy: A Numerical Evaluation
SD	34.2010	ZhongXiang Zhang: The U.S. Proposed Carbon Tariffs, WTO Scrutiny and China's Responses
IM	35.2010	Vincenzo Denicolò and Piercarlo Zanchettin: Leadership Cycles
SD	36.2010	Stéphanie Monjon and Philippe Quirion: How to Design a Border Adjustment for the European Union Emissions Trading System?
SD	37.2010	Meriem Hamdi-Cherif, Céline Guivarch and Philippe Quirion: Sectoral Targets for Developing Countries: Combining "Common but Differentiated Responsibilities" with "Meaningful participation"
IM	38.2010	G. Andrew Karolyi and Rose C. Liao: What is Different about Government-Controlled Acquirers in Cross-Border Acquisitions?
GC	39.2010	Kjetil Bjorvatn and Alireza Naghavi: Rent Seekers in Rentier States: When Greed Brings Peace
GC	40.2010	Andrea Mantovani and Alireza Naghavi: Parallel Imports and Innovation in an Emerging Economy
SD	41.2010	Luke Brander, Andrea Ghermandi, Onno Kuik, Anil Markandya, Paulo A.L.D. Nunes, Marije Schaafsma and Alfred Wagtendonk: Scaling up Ecosystem Services Values: Methodology, Applicability and a Case Study
SD	42.2010	Valentina Bosetti, Carlo Carraro, Romain Duval and Massimo Tavoni: What Should We Expect from Innovation? A Model-Based Assessment of the Environmental and Mitigation Cost Implications of Climate-Related R&D
SD	43.2010	Frank Vöhringer, Alain Haurie, Dabo Guan,Maryse Labriet, Richard Loulou, Valentina Bosetti, Pryadarshi R. Shukla and Philippe Thalmann: Reinforcing the EU Dialogue with Developing Countries on Climate Change Mitigation
GC	44.2010	Angelo Antoci, Pier Luigi Sacco and Mauro Sodini: Public Security vs. Private Self-Protection: Optimal Taxation and the Social Dynamics of Fear
IM	45.2010	Luca Enriques: European Takeover Law: The Case for a Neutral Approach
SD	46.2010	Maureen L. Cropper, Yi Jiang, Anna Alberini and Patrick Baur: Getting Cars Off the Road: The Cost-Effectiveness of an Episodic Pollution Control Program
IM	47.2010	Thomas Hellman and Enrico Perotti: The Circulation of Ideas in Firms and Markets
IM	48.2010	James Dow and Enrico Perotti: Resistance to Change
SD	49.2010	Jaromir Kovarik, Friederike Mengel and José Gabriel Romero: (Anti-) Coordination in Networks
SD	50.2010	Helen Ding, Silvia Silvestri, Aline Chiabai and Paulo A.L.D. Nunes: A Hybrid Approach to the Valuation of Climate Change Effects on Ecosystem Services: Evidence from the European Forests
GC	51.2010	Pauline Grosjean (lxxxvii): A History of Violence: Testing the 'Culture of Honor' in the US South
GC	52.2010	Paolo Buonanno and Matteo M. Galizzi (lxxxvii): Advocatus, et non latro? Testing the Supplier-Induced-Demand Hypothesis for Italian Courts of Justice
GC	53.2010	Gilat Levy and Ronny Razin (lxxxvii): Religious Organizations
GC	54.2010	Matteo Cervellati and Paolo Vanin (lxxxvii): "Thou shalt not covet ...": Prohibitions, Temptation and Moral Values
GC	55.2010	Sebastian Galiani, Martín A. Rossi and Ernesto Schargrodsky (lxxxvii): Conscription and Crime: Evidence from the Argentine Draft Lottery
GC	56.2010	Alberto Alesina, Yann Algan, Pierre Cahuc and Paola Giuliano (lxxxvii): Family Values and the Regulation of Labor
GC	57.2010	Raquel Fernández (lxxxvii): Women's Rights and Development
GC	58.2010	Tommaso Nannicini, Andrea Stella, Guido Tabellini, Ugo Troiano (lxxxvii): Social Capital and Political Accountability
GC	59.2010	Eleonora Patacchini and Yves Zenou (lxxxvii): Juvenile Delinquency and Conformism
GC	60.2010	Gani Aldashev, Imane Chaara, Jean-Philippe Platteau and Zaki Wahhaj (lxxxvii): Using the Law to Change the Custom
GC	61.2010	Jeffrey Butler, Paola Giuliano and Luigi Guiso (lxxxvii): The Right Amount of Trust
SD	62.2010	Valentina Bosetti, Carlo Carraio and Massimo Tavoni: Alternative Paths toward a Low Carbon World
SD	63.2010	Kelly C. de Bruin, Rob B. Dellink and Richard S.J. Tol: International Cooperation on Climate Change Adaptation from an Economic Perspective
IM	64.2010	Andrea Bigano, Ramon Arigoni Ortiz, Anil Markandya, Emanuela Menichetti and Roberta Pierfederici: The Linkages between Energy Efficiency and Security of Energy Supply in Europe
SD	65.2010	Anil Markandya and Wan-Jung Chou: Eastern Europe and the former Soviet Union since the fall of the Berlin Wall: Review of the Changes in the Environment and Natural Resources
SD	66.2010	Anna Alberini and Milan Ščasný: Context and the VSL: Evidence from a Stated Preference Study in Italy and the Czech Republic
SD	67.2010	Francesco Bosello, Ramiro Parrado and Renato Rosa: The Economic and Environmental Effects of an EU Ban on Illegal Logging Imports. Insights from a CGE Assessment
IM	68.2010	Alessandro Fedele, Paolo M. Panteghini and Sergio Vergalli: Optimal Investment and Financial Strategies under Tax Rate Uncertainty
IM	69.2010	Carlo Cambini, Laura Rondi: Regulatory Independence and Political Interference: Evidence from EU Mixed-Ownership Utilities' Investment and Debt
SD	70.2010	Xavier Pautrel: Environmental Policy, Education and Growth with Finite Lifetime: the Role of Abatement Technology
SD	71.2010	Antoine Leblois and Philippe Quirion: Agricultural Insurances Based on Meteorological Indices: Realizations, Methods and Research Agenda
IM	72.2010	Bin Dong and Benno Torgler: The Causes of Corruption: Evidence from China
IM	73.2010	Bin Dong and Benno Torgler: The Consequences of Corruption: Evidence from China

IM	74.2010	Fereydoun Verdinejad and Yasaman Gorji: The Oil-Based Economies International Research Project. The Case of Iran.
GC	75.2010	Stelios Michalopoulos, Alireza Naghavi and Giovanni Prarolo (lxxxvii): Trade and Geography in the Economic Origins of Islam: Theory and Evidence
SD	76.2010	ZhongXiang Zhang: China in the Transition to a Low-Carbon Economy
SD	77.2010	Valentina Iafolla, Massimiliano Mazzanti and Francesco Nicolli: Are You SURE You Want to Waste Policy Chances? Waste Generation, Landfill Diversion and Environmental Policy Effectiveness in the EU15
IM	78.2010	Jean Tirole: Illiquidity and all its Friends
SD	79.2010	Michael Finus and Pedro Pintassilgo: International Environmental Agreements under Uncertainty: Does the Veil of Uncertainty Help?
SD	80.2010	Robert W. Hahn and Robert N. Stavins: The Effect of Allowance Allocations on Cap-and-Trade System Performance
SD	81.2010	Francisco Alpizar, Fredrik Carlsson and Maria Naranjo (lxxxviii): The Effect of Risk, Ambiguity and Coordination on Farmers' Adaptation to Climate Change: A Framed Field Experiment
SD	82.2010	Shardul Agrawala and Maëlis Carraro (lxxxviii): Assessing the Role of Microfinance in Fostering Adaptation to Climate Change
SD	83.2010	Wolfgang Lutz (lxxxviii): Improving Education as Key to Enhancing Adaptive Capacity in Developing Countries
SD	84.2010	Rasmus Heltberg, Habiba Gitay and Radhika Prabhu (lxxxviii): Community-based Adaptation: Lessons from the Development Marketplace 2009 on Adaptation to Climate Change
SD	85.2010	Anna Alberini, Christoph M. Rheinberger, Andrea Leiter, Charles A. McCormick and Andrew Mizrahi: What is the Value of Hazardous Weather Forecasts? Evidence from a Survey of Backcountry Skiers

(lxxxvi) *This paper was presented at the Conference on "Urban and Regional Economics" organised by the Centre for Economic Policy Research (CEPR) and FEEM, held in Milan on 12-13 October 2009.*

(lxxxvii) *This paper was presented at the Conference on "Economics of Culture, Institutions and Crime" organised by SUS.DIV, FEEM, University of Padua and CEPR, held in Milan on 20-22 January 2010.*

(lxxxviii) *This paper was presented at the International Workshop on "The Social Dimension of Adaptation to Climate Change", jointly organized by the International Center for Climate Governance, Centro Euro-Mediterraneo per i Cambiamenti Climatici and Fondazione Eni Enrico Mattei, held in Venice, 18-19 February 2010.*