Southern Economic Journal 2007, 73(3), 659–676

Automobile Seatbelt Usage and the Value of Statistical Life

Jahn K. Hakes* and W. Kip Viscusi†

This article uses several within-sample tests to assess whether current seatbelt usage decisions are consistent with the stated preferences of survey respondents. The expressed survey values of statistical life are positively associated with the probability of seatbelt usage and are not statistically different from the values of statistical life implied by seatbelt usage decisions, which are in the $1.9 million to $8.4 million range. Seatbelt usage also varies in the expected manner with individual measures of heterogeneous attitudes toward risk, such as smoking status and education. Our evidence on seatbelt usage supports the view that consumers consistently balance expected safety benefits against the time and discomfort costs of seatbelt use.

JEL Classification: K13, I1, D80, L51

1. Introduction

The two principal ways by which people can reduce their health and safety risks are by choosing safer activities or by taking additional precautions while engaging in a risky activity. Seatbelt usage has been the most important natural experiment of individual self protection. A substantial economic literature has analyzed the efficacy of seatbelts in promoting safety,[1] the desirability of using seatbelts from a benefit-cost standpoint,[2] and the implications of seatbelt use for making inferences about an individual's willingness to bear health risks, or about the implicit value of a statistical life.[3] Most studies suggest that, on balance, wearing seatbelts is a safety precaution for which the benefits to the average individual exceed the costs. Whether there are overall safety benefits to society remains controversial, however, due to the effect of self-protection on the level of care the driver uses.[4]

It has long been a policy concern that some individuals fail to perceive the benefits of seatbelt usage. Informational campaigns can affect decision-making by helping people to more

* Department of Economics & Management, Albion College, Albion, MI 49224, USA; E-mail jhakes@albion.edu.

† Vanderbilt Law School, 131 21st Avenue South, Nashville, TN 37203, USA; E-mail kip.viscusi@vanderbilt.edu; corresponding author.

Thomas Kniesner provided valuable suggestions.

Received March 2005; accepted May 2006.

[1] See, among others, Peltzman (1975), Blomquist (1988), and Cohen and Einav (2003). Blomquist (2004) provides the most detailed survey of analyses of protective behavior.

[2] See Arnould and Grabowski (1981) and Levitt and Porter (2001).

[3] See Blomquist (1979), Winston (1987), Blomquist, Miller, and Levy (1996), and Viscusi (1998).

[4] Peltzman's (1975) offsetting behavior hypothesis acknowledges the theoretical possibility that safety innovations could be negated by more aggressive driving habits so that the overall effect on safety is diminished. Similar results have been found by Blomquist (1988) and others. However, Cohen and Einav (2003) found somewhat different results, as there was no significant evidence of offsetting behavior for seatbelts in their model after correcting for simultaneity.

accurately perceive the risk reduction achievable by using seatbelts. However, the informational campaign designed to foster seatbelt usage is perhaps the best documented failure of government information efforts to alter behavior.[5] The main lesson from this informational failure is that reminder warnings that do not provide new knowledge do not alter behavior. The results presented here also suggest that there may be no major information gap that should be filled.

The focus of this paper is on the implied value of statistical life (VSL) based on seatbelt usage and the consistency of those estimates with the VSL levels that the same sample reveals in a stated preference survey. In each instance, one computes the VSL based on the tradeoff rate between the change in costs and the change in the risk, or

$$\text{VSL} = \Delta\text{Cost}/\Delta\text{Risk}. \tag{1}$$

For the stated preference survey, the estimates of VSL are quite direct. Respondents consider a policy option with a well-defined risk reduction and indicate the maximum value of ΔCost that they are willing to incur to achieve that risk reduction.[6]

Our estimation of the VSL implied by seatbelt usage derives an imputed value using an approach introduced by Blomquist (1979). Government estimates of seatbelt efficacy provide the pertinent value for ΔRisk. The value of ΔCost consists of three components: the time cost of buckling up, the disutility cost of having one's range of motion restricted by the belt, and the reduction in expected legal penalties from not buckling up in the presence of mandatory seatbelt laws.[7] Rearranging Equation 1, a person will choose to wear seatbelts if

$$\Delta\text{Cost} < \text{VSL} \times \Delta\text{Risk}. \tag{2}$$

For continuous fatality risk choices, the VSL should be the same across various risk domains, as shown in Viscusi (1998).

Overall, more than 75% of drivers use seatbelts. That all people do not use seatbelts all the time, however, is not necessarily inconsistent with rational behavior. To determine the rationality of the decision to use seatbelts on a particular trip would require more information on the costs of precautions and the likely benefits, which will vary with contextual details such as the type of vehicle driven, where the vehicle is driven, and how the vehicle is driven.

Although the available data do not enable us to resolve the question of whether seatbelt usage decisions are rational, it is feasible to explore the consistency of these risk-taking decisions across different domains. Consistent risk takers should display the same threshold risk-cost tradeoff across different choices if these safety decisions are continuous. Because seatbelt usage decisions are discrete, there may be some observed VSL differences even if people are being consistent risk takers.

---

[5] See Adler and Pittle (1984) for documentation of the failure of the "buckle up for safety" campaign.

[6] Policymakers in the UK use stated preference VSLs, such as those developed by Jones-Lee (1989), to value traffic safety policies. Viscusi, Magat, and Huber (1991) develop stated preference values for traffic safety improvements in the U.S.

[7] Responses to these legal enforcement initiatives follow rational economic behavior. Cohen and Einav (2003) find that usage rates increase when laws are imposed, with greater effects for primary enforcement than secondary enforcement. Secondary enforcement means that citations for seatbelt nonuse are only issued after a motorist has been pulled over for another offense, while primary enforcement allows law enforcement officers to stop a vehicle for seatbelt nonuse even in the absence of another misdemeanor. In the revealed preference VSL calculations in Section 4, the legal penalty component will be assumed to be de minimis relative to the first two effects.

The first test of the consistency of seatbelt usage with risk-taking behavior is a comparison of the stated preference VSL amounts with the estimated VSL range implied by seatbelt usage. Meta-analyses such as Viscusi and Aldy (2003) and Blomquist (2004) have made comparisons across samples and across different studies, many of which involve different risk situations. The unique feature of this study is that in addition to making comparisons to VSL estimates in the literature, we also make within-sample tests that hold constant both the sample composition and the risk context. Although some previous studies have generated both stated preference VSL amounts and market-based estimates, these studies have not used this evidence as a test of the consistency of actual risk-taking decisions and stated preferences across individuals.[8]

The second consistency test that we report is the responsiveness of seatbelt usage rates to the individual's stated VSL. Are people who have higher stated VSL levels more likely to wear seatbelts, as theory predicts? This article reports the first tests in the literature linking stated preference values to self-protective behavior.

We also examine other economic determinants of seatbelt usage to test whether behavior is consistent with cost-risk balancing. For example, people who have revealed themselves to be risk takers by smoking cigarettes should be less likely to use seatbelts.[9] In contrast, members of demographic groups who more correctly perceive large health and safety risks, particularly women and those with college or advanced degrees, should be more likely to use seatbelts.[10]

This paper provides comparisons within-sample and with respect to other revealed preference estimates that focus primarily on traffic safety situations. As Dionne and Lanoie (2002) have suggested, the VSL for transportation risks could differ from the VSL for job fatality risks because the nature of the deaths may differ. These differences may not be substantial, however, as Blomquist concluded that the VSLs based on revealed preference consumption behavior and protective behavior "fall in the range of estimates based on averting behavior in the labor market" (2004, p. 104). Both revealed preference studies and stated preference studies have addressed traffic safety risks, but not with respect to the within-sample consistency of the estimates. Comparisons across studies in different risk contexts suggest that the VSL levels in the literature implied by seatbelt usage decisions are comparable to or perhaps a bit lower than the estimated VSLs in other contexts, such as labor market risks.[11]

There have also been several stated preference estimates of the VSL for traffic safety risks, such as those by Jones-Lee (1989) for the UK and Viscusi, Magat, and Huber (1991) for the United States. Whereas Miller (2000) concluded that the VSLs derived from stated preference approaches were higher than those from averting behavior, the survey in Viscusi (1993) found them to be similar in magnitude to the estimates implied by labor market studies. Our study

---

[8] Lanoie, Pedro, and Latour (1995) examined implied and stated VSL amounts as a test of the correspondence between the two methodologies rather than a test of market efficiency. In the same vein, Viscusi and O'Connor (1984) estimated the implicit value of statistical injuries using within-sample market data and survey data, but their concern was with respect to performance of chemical labels, not the efficiency of risk-taking choices. The Lanoie, Pedro, and Latour results for a Canadian sample indicated significant difference in VSL amounts using the two approaches. The results for hedonic labor market VSL amounts were only statistically significant for the manual unionized worker subsample, making broader comparisons infeasible.

[9] While this relationship has been documented previously by Hersch and Viscusi (1998) using a national sample, establishing a similar relationship for the sample analyzed here will provide a useful corroboration of both the relationship itself and the reasonableness of our sample results.

[10] See Hakes and Viscusi (2004) for a more detailed analysis of mortality risk perceptions by demographic group.

[11] Viscusi and Aldy (2003), Blomquist (2004), and Miller (2000) provide the most detailed reviews and comparisons of such studies.

employs this stated preference approach to construct a measure of individual risk preferences that can be incorporated in an empirical model of seatbelt usage decisions.

Subsequent sections explore the interrelationships among different VSL amounts and seatbelt usage. Section 2 presents an overview of the characteristics of our sample of 465 adults and presents their stated preference VSL amounts. The effect of these VSL levels and other variables on the probability of seatbelt usage is examined in section 3. In section 4, we derive measures of VSL implied by the self-protective seatbelt usage behavior, and section 5 concludes.

2. Sample Characteristics: Stated Preference VSLs and Seatbelt Usage

As Equation 2 indicates, seatbelt usage increases as a person's VSL increases and is greater if the person perceives a large reduction in risk. The focus of this section is on the probability that an individual uses seatbelts and whether that probability responds to a stated preference measure of VSL and other variables in the expected manner.

To explore these issues, we use an original survey of 465 respondents undertaken in 1998 in Phoenix, Arizona. The main advantage of this data set is that it has unique information on VSL amounts and risk beliefs that can be linked to seatbelt usage. Because only 90 people in the sample do not use seatbelts, the sample size is relatively small, but nevertheless we find significant effects for the key variables of concern. A marketing firm in Phoenix recruited subjects through random-digit dialing and paid each $40 to come to a central location to fill out a half-hour-long survey questionnaire pertaining to a series of risk issues.[12] Although one might expect that people with a low opportunity cost of time would be drawn to participate in the survey, the average education level of respondents is above the average for Phoenix and for Arizona generally.[13] The sample reflects a broad cross section of society, but not a random sample of the entire U.S. population, so it is important to control the estimates for differences in demographic characteristics. Because the whole sample is drawn from a single city, state differences in sanctions for failure to use seatbelts do not enter the analysis.

Table 1 provides the demographic characteristics and VSL amounts for three groups: the full sample, people who always use seatbelts, and those who never or only sometimes wear seatbelts.[14] On average, the sample is 44.3 years old, has 14.6 years of schooling, is 10% nonwhite, and is 69% female. Subsequent regression analysis controls for these personal characteristics so that we can use these estimates to make projections to a more representative population mix.

The VSL variable is calculated from respondents' expressed willingness to pay for a reduction in their risk one-year of death due to an automobile accident.[15] The wording of the question is as follows:

> Suppose you could reduce your annual risk of death in a car crash by 1/10,000. Thus, if there were 10,000 people just like you, there would be one less expected death per year in your group.

---

[12] Overall, 493 people were surveyed, but 10 respondents did not answer the seatbelt use question and 18 others did not give sufficient mortality risk perception responses, producing a sample size of 465.

[13] Unfortunately, the survey did not include a wage or income question, making it infeasible to address the role of these measures of opportunity cost.

[14] The three possible responses for wearing seatbelts were "always," "sometimes," or "never."

[15] The general approach of using a survey to elicit willingness to pay for safety is in the same vein as the stated preference approach to valuing traffic safety used by Jones-Lee (1989) and Viscusi, Magat, and Huber (1991).

Table 1. Summary Statistics, by Seatbelt Usage Group

	Mean (Standard Error of the Mean) [Standard Deviation]		
Variable	All Groups	People Who Always Use Seatbelts	People Who Sometimes or Never Wear Seatbelts
Age (in years)	44.3 (0.7) [15.3]	44.8 (0.8) [15.0]	42.5 (1.8) [16.6]
18–24	0.105 (0.014)	0.091 (0.015)	0.167 (0.040)
25–44	0.391 (0.023)	0.387 (0.025)	0.411 (0.052)
45–64	0.370 (0.022)	0.400 (0.025)	0.244 (0.046)
Female = 1	0.686 (0.022)	0.709 (0.023)	0.589 (0.052)
Education (in years)	14.64 (0.12) [2.5]	14.86 (0.13) [2.5]	13.70 (0.22) [2.1]
No high school diploma	0.037 (0.009)	0.032 (0.009)	0.056 (0.024)
High school diploma only	0.181 (0.018)	0.152 (0.019)	0.300 (0.049)
Some college	0.406 (0.023)	0.403 (0.025)	0.422 (0.052)
College degree (B.S, B.A)	0.269 (0.021)	0.288 (0.023)	0.189 (0.041)
Advanced degree	0.108 (0.014)	0.125 (0.017)	0.033 (0.019)
Nonwhite = 1	0.095 (0.014)	0.099 (0.015)	0.078 (0.028)
Current smoker = 1	0.226 (0.019)	0.189 (0.020)	0.378 (0.051)
Value of statistical life ($ millions)[a]	5.085 (0.244) [5.0]	5.345 (0.277) [5.1]	3.949 (0.484) [4.3]
Infinite VSL	0.090 (0.013)	0.083 (0.014)	0.122 (0.035)
Sample size	465	375	90

Numbers in parentheses report standard errors about the sample mean to describe the sampling distribution. The standard deviations of the continuous variables are in square brackets.
[a] Table 3 describes the distribution of this categorical variable.

> This risk reduction would cut your annual risk of death in a car crash in half.
>
> How much would you be willing to pay each year either for a safer car or for improved highway safety measures that would cut your motor-vehicle risks in half?

This question consequently gives respondents two ways to think about the hypothesized ΔRisk—the absolute probability reduction and the percentage risk reduction. Providing two such measures assists in eliciting meaningful responses given the difficulties posed by the low probabilities involved. Respondents chose from a range of responses: $0 to $50, $50 to $200, $200 to $500, $500 to $1000, and above $1000. A final possible option was that respondents could indicate that their willingness to pay is "infinite—all present and future resources." Such responses are inconsistent with private risk-taking behavior and suggest that the respondent refused to answer the question in the spirit in which it was asked. The 9% of the sample who indicate an infinite value do not appear to be extraordinarily safety conscious in other respects.

In other survey contexts, it is standard to treat such outliers as "protest" responses by people who did not understand the survey or were not engaged in the particular survey task. The evidence we present is consistent with this interpretation. To show the robustness of the results, we also analyze them as being meaningful responses. For the purposes of summarizing the sample characteristics in this section and the regression estimates in section 3, it is sufficient to treat the infinite response answers as a categorical dummy variable group that is analyzed separately.

The median respondent indicated a willingness to pay that implies a VSL of $2 million to $5 million. This value is unaffected by the inclusion or exclusion of the infinite responses. This VSL range is consistent with other stated preference results for motor-vehicle risks. For example, the survey by Jones-Lee (1989) found a VSL for traffic safety in the UK of $5 million, while the U.S. survey by Viscusi, Magat, and Huber (1991) found that people valued reduced risks of automobile fatality at a median value of $3.6 million.[16]

The overall relationship between stated VSL amounts and seatbelt usage is consistent with individual differences in stated VSL levels. As indicated in Table 1, the sample had an average stated VSL of $5.1 million, using the midpoints of the ranges for purposes of calculation.[17] Seatbelt users have a stated VSL of $5.3 million, as compared to $3.9 million for those who sometimes or never wear seatbelts. Seatbelt users are relatively less likely to express an infinite VSL than non- or sometime-users. Of those in the sample who always wear seatbelts, 70.9% are women, as compared to 58.9% of those who sometimes or never wear seatbelts. Seatbelt users are more likely to be better educated, and much less likely to smoke, as smoking rates are 18.9% among seatbelt users and 37.8% among those who sometimes or never use seatbelts.

Table 2 provides seatbelt usage rates conditional upon the demographic characteristics indicated in the first column. Whereas 80.6% of sample respondents overall report that they always use seatbelts, 83.4% of women always use seatbelts, as compared to only 74.7% of all men. The means in our sample are in line with national seatbelt usage at the time.[18] In a National Highway Transportation Safety Administration (NHTSA) survey in 2000, there was a 79% nationwide usage rate. Men reported using seatbelts 74% of the time, and women used seatbelts 84% of the time. These statistics are almost identical to our gender-specific usage rates. The mean seatbelt usage rate is higher in our sample than in some previous studies due to our oversampling of females and a positive time trend in usage, which is likely caused by increasing legal penalties for failure to buckle up.

Table 2 shows that there are few nonwhites in our sample. This small number of nonwhites is, no doubt, part of the reason why we find insignificant nonwhite coefficients in our regression results reported in Tables 4 and 5. Other patterns in Table 2 are that the rate of seatbelt use generally increases with age, and that people with more education use their seatbelts more often. The education effect on seatbelt usage is expected, as more human capital correlates with higher present values of lifetime wealth, which in turn increases willingness to pay for safety.

Two differences between those who always use seatbelts and those who never use seatbelts are most noteworthy. Seatbelt wearers are more likely to be female, which is consistent with gender differences in risk-taking behavior.[19] Second, current smokers are less likely to always wear seatbelts. Cigarette smoking is an extremely dangerous personal consumption activity that is strongly connected with a variety of risky behaviors.[20] Failure to use seatbelts consequently reflects consistent risk-taking behavior.

[16] All estimates are in year 1998 dollars unless otherwise indicated.

[17] These calculations treat the top-coded range of "above $1000" as having a VSL of $15 million.

[18] NHTSA (2000, at Table 4) reports survey results from 1998, which are based upon a question very similar to ours. See the report on http://www.nhtsa.dot.gov/people/injury/research/SafetySurvey/index.html#Part2. The usage rates in our sample do not differ statistically from the national averages reported by NHTSA, with *t*-tests for the equivalence of means for males and females yielding *t*-statistics of 0.18 and -0.29, respectively. Cohen and Einav (2003) use a different sampling strategy which results in lower reported seatbelt usage rates both in Arizona and nationally. Their estimated seatbelt usage rates in Arizona were three percentage points below the national average in 1998. They used several data sources, including state highway observational data on selected highways.

[19] See Hersch (1998) for a review of gender differences in willingness to incur health and safety risks. For a meta-analysis of gender and risk-taking behavior, see Byrnes, Miller, and Schafer (1999).

[20] See Hersch and Viscusi (1998) and Viscusi and Hersch (2001) for statistics on smokers' risk taking, including their use of seatbelts.

Table 2. Percentage of People Who Always Wear Seatbelts, by Demographic Group

Demographic Group	Observations	Always Use Belts Mean (Standard Error of Mean)
All respondents	465	0.806 (0.018)
Sex		
Male	146	0.747 (0.036)
Female	319	0.834 (0.021)
Race		
White	420	0.802 (0.019)
Nonwhite	44	0.841 (0.056)
Smoking status		
Current smoker	105	0.676 (0.046)
Former smoker or nonsmoker	360	0.844 (0.019)
Education level achieved		
No high school diploma	17	0.706 (0.114)
High school diploma	84	0.679 (0.051)
Some college	189	0.799 (0.029)
College degree	125	0.864 (0.031)
Advanced degree	50	0.940 (0.034)
Age		
18–24	49	0.694 (0.067)
25–44	182	0.797 (0.030)
45–64	172	0.872 (0.026)
65 and over	59	0.746 (0.057)

Table 3 presents the distribution of the VSL responses for this survey across the six possible categorical responses. We also draw attention to a sharp discontinuity in the responses by aggregating the quantifiable responses into two broad VSL ranges. Despite concerns in the contingent valuation literature that respondents may tend to overstate willingness-to-pay amounts

Table 3. Relationship of Value of a Statistical Life to Seatbelt Use

Respondent's Value of Statistical Life ($ millions)	Percentage of Sample in VSL Range	Percentage of Individuals in VSL Range Who Always Wear Seatbelts (Standard Error of Mean)	Percentage of Individuals in VSL Range Who Sometimes or Never Wear Seatbelts (Standard Error of Mean)
0 to 5.0	58.3	77.1 (2.6)	22.8 (2.6)
0.0 to 0.5	14.2	75.8 (5.3)	24.2 (5.3)
0.5 to 2.0	23.0	83.2 (3.6)	16.8 (3.6)
2.0 to 5.0	21.1	71.4 (4.6)	28.6 (4.6)
5.0 to 10.0 or higher	32.7	88.8 (2.6)	11.2 (2.6)
5.0 to 10.0	17.9	89.2 (3.4)	10.8 (3.4)
10.0 or higher	14.8	88.4 (3.9)	11.6 (3.9)
"Infinite—all present and future resources"	9.0	73.8 (6.9)	26.2 (6.9)

$N = 465$. Paired two-tailed t-tests of the equality of seatbelt use among individuals in the $0 to $5.0 M range; $5.0 M to $10.0 M range; and infinite value category gave the following results, assuming equal variances: $0 to $5.0 M vs. $5.0 M to $10.0 M: $t = 2.985$, $p = 0.003$; $5.0 M to $10.0 M vs. infinite value: $t = 2.476$, $p = 0.014$; $0 to $5.0 M vs. infinite value: $t = 0.471$, $p = 0.638$.

Table 4. Estimates of the Stated Value of Statistical Life (VSL) from Ordered Probit and Tobit Models

	Ordered Probit Coefficient—"Infinite" Omitted (Standard Error)		Ordered Probit Coefficient—"Infinite" Highest (Standard Error)		Tobit Model—"Infinite" Omitted (Standard Error)	
Age						
18–24	−0.045	(0.226)	0.240	(0.208)	−0.043	(0.876)
25–44	0.055	(0.162)	0.092	(0.155)	0.418	(0.632)
45–64	−0.012	(0.164)	0.072	(0.157)	0.232	(0.639)
Female	0.139	(0.112)	0.179*	(0.106)	0.378	(0.436)
Education level						
No high school diploma	0.429	(0.289)	0.205	(0.275)	0.796	(1.130)
Some college	0.207	(0.150)	0.175	(0.139)	0.640	(0.577)
College degree	0.484***	(0.162)	0.247*	(0.151)	1.800***	(0.623)
Advanced degree	0.502**	(0.207)	0.455**	(0.193)	1.477*	(0.807)
Nonwhite	−0.207	(0.182)	−0.156	(0.170)	−0.477	(0.702)
Current smoker	−0.096	(0.131)	−0.008	(0.119)	0.010	(0.506)
Tobit intercept					3.147	(0.709)
(Pseudo) R^2	0.01		0.01		0.01	

The VSL categories, in increasing dollar value, form the dependent variable for the ordered probit model. The Tobit model corrects for the 68 observations in the top finite response category with censoring at a VSL of $10 million or more. The Tobit coefficients presented indicate marginal changes in the latent variable.

* Significant at 90% confidence level; two-tailed test

** Significant at 95% confidence level, two-tailed test.

*** Significant at 99% confidence level, two-tailed test.

in surveys,[21] over half of the sample is in the $0 to $5 million range of VSL amounts. The percentage of respondents who always use seatbelts is nearly 12% higher for people with a VSL of $5 million or more than for people with a VSL of $5 million or less.[22] These results are consistent from the standpoint of costs and benefits of seatbelt use; seatbelts represent a highly cost-effective way of reducing mortality risks.[23] Whether seatbelt nonuse is rational has been a continuing concern in the literature,[24] but in this sample, at least from the standpoint of valuation, there is evidence of consistent risk-taking behavior, as higher VSLs are linked to greater seatbelt usage.

Note that the respondents who express an infinite VSL do not seem to reflect such a high value of safety in their personal protective decisions. Their seatbelt use rate of 73.8% is well below the sample mean and is statistically similar to respondents with low stated VSLs. This behavior suggests that this group of respondents either did not understand the VSL question or were not attending to the survey task.

The VSL amounts display an inverted U-shaped relationship over the life cycle. This age-related pattern is consistent with theoretical predictions, such as those presented in Shepard and Zeckhauser (1984). The mean VSL rises from $4.59 million for people aged 18 to 24 to $5.24 million for people aged 25 to 44, and $5.21 million for those aged 45 to 64, after which VSL declines to $4.41 million for those aged 65 and older.

[21] See Adams (1995) for a general critique of such surveys.

[22] The t-statistic for the difference in proportions test is 3.0, assuming equal variances.

[23] See Arnould and Grabowski (1981) and Levitt and Porter (2001).

[24] Blomquist (1991) provides evidence that is generally in support of rationality in terms of risk competence.

To identify the determinants of an individual's stated value of statistical life, Table 4 shows three sets of results. The first two equations are ordered probit regressions estimating the stated VSL category as a function of the demographic variables and smoking status. The first equation omits the infinite VSL respondents, while the second equation treats these as the highest value responses. The dependent variable in the ordered probit models ranks categories from highest to lowest willingness to pay, with "infinite value" as the highest ordered category in the second model. The estimated cut points for the ordered probit model are omitted from the regression output shown in Table 4, and the age category coefficients are estimated relative to the omitted age category, which is for individuals who are 65 or older.

While the VSL categories are fairly coarse, nevertheless there are two significant relationships with demographic variables in the ordered probit equation. Females state higher VSLs at the 90% confidence level for the second model, which is consistent with other studies on gender differences in risk taking. Also, the coefficients for the top two education categories are statistically significant at the 95% confidence level. The stated VSL of a holder of an advanced degree is expected to be higher than that of a four-year degree recipient, and the expected VSL of an advanced degree holder is estimated in the first model as $502,000 higher than the VSL of an otherwise similar high school graduate.

The third equation in Table 4 is a Tobit regression correcting for the 68 observations in the top finite response category with censoring at a VSL of $10 million. There are 353 responses with finite noncensored values, each of which is treated as being at the midpoint of its VSL range. The Tobit coefficients presented indicate marginal changes in the latent variable.[25]

In addition to confirming the qualitative results of the ordered probit models, the Tobit results make it possible to predict the mean estimated VSL for the sample, where this prediction is done on an individual basis and then averaged across the entire sample. This mean predicted VSL amount is $4.6 million and will serve as one of the benchmarks in assessing the consistency of seatbelt use with individual risk preferences.

3. Seatbelt Use Regression Estimates

Equation 2 indicates that seatbelt usage should be greater for people who express a high VSL and for those who believe that using seatbelts will greatly reduce risk. Although the survey did not include a direct measure of perceived risk reductions, it did include a series of questions eliciting a wide variety of mortality risk beliefs. The general approach follows that of Lichtenstein et al. (1978), which has been a well-established benchmark for exploring how people assess mortality risks.[26] The mortality risk perception component of the survey asked respondents to estimate the total numbers of people who died in a recent year in the United

[25] Alternatively, we tested a selection-corrected Tobit model which predicts the 42 responses of "infinite" VSL with a probit regression. Instruments used in the first stage include responses to two other damage compensation questions in the survey instrument, the current smoker indicator, and the intercept from the respondent's individual mortality risk perception equation. As the inverse Mills ratio selectivity bias term was not statistically significant, we do not report those results here. The results do not differ qualitatively.

[26] It should be emphasized that it may not be fully rational for people to invest the time and effort to become fully informed about risks of little pertinence to them, but the overall responsiveness of their risk beliefs to a wide variety of causes of death does provide a measure of the general accuracy of their risk beliefs.

States from each of 23 various causes of death.[27] To provide a reference point for the risk assessment, each respondent was told the total number of people—about 47,000—in the United States who had died in automobile accidents in that reference year, which is the standard anchor that previous studies of risk beliefs have given to respondents.

The measure that we use to characterize the responsiveness to risk beliefs is the elasticity of risk beliefs with respect to actual mortality risk levels. How much do perceived risks change in response to changes in the objective risks? People with more elastic risk perceptions should be more likely to use seatbelts than people with less elastic perceptions, since they will assess a greater ΔRisk in response to the reduction in actual risk levels associated with seatbelt usage. The empirical strategy for constructing these measures is based on estimations of individual mortality risk perception curves. For each respondent i we estimated a risk assessment equation of the form

$$\ln(\text{Perceived Risks}_i) = a_i + b_i \ln(\text{Actual Risks}_i). \tag{3}$$

The slope coefficient b_i is the estimate of the risk perception elasticity with respect to actual risks.[28]

These individual regressions are based on person-specific data sets of 23 data points, where each observation represents the respondent's assessed number of fatalities due to a particular ailment.[29] Due to the relatively large standard errors associated with regressions containing 21 or fewer degrees of freedom, the point estimates for the elasticity are imprecise. Rather than use the point estimates from the risk perception regressions directly, we have chosen to characterize each individual's mortality risk perceptions by quartile, using 0–1 variables to indicate whether the estimate of the risk perception elasticity was in the top quartile or bottom quartile of the sample, so as to isolate the qualitative effects of extreme values for that characteristic.

The binary elasticity variables will capture extremely high and low values of b_i, and will serve to indicate individuals in the top and bottom quartiles of elasticity of risk perceptions with respect to changes in actual risk. Individuals with larger values for b_i in Equation 1 will perceive a large ΔRisk and should accordingly be more willing to wear their seatbelts to reduce fatality risks. The opposite is the case for people with low risk perception elasticities.[30]

Table 5 presents the probit estimates for whether the respondent always uses seatbelts for four models. The coefficients reported have been transformed to correspond to the marginal probabilities of usage. Models 1 and 2 include only the VSL variables and the two constructed variables for the elasticity of risk perceptions. Models 3 and 4 also include a series of personal background variables. Models 1 and 3 include VSL as a continuous variable, whereas Models 2 and 4 include the categorical VSL values, omitting the lowest VSL group ($0 to $0.5 million) to serve as a baseline. Side by side, the four models show that our results are quite robust across the various specifications.

[27] For a list of these causes, see Hakes and Viscusi (2004), which details the correlation of mortality risk perceptions with demographic characteristics.

[28] The a_i intercept terms across individuals had a mean of 4.283 for those individuals used in our analysis, with an average standard deviation of 2.281. The mean b_i elasticity coefficient across individuals was 0.475, with a standard deviation of 0.201.

[29] A small number of respondents refused to estimate fatalities from one or more ailments, so that some of these individual regressions are based upon fewer than 23 observations. Individuals assessing fatalities from fewer than 10 ailments were dropped from the analysis.

[30] If, however, responses at these extremes reflect irrational responses to risk more generally, one would have somewhat different predictions. Assuming seatbelt use is rational, extreme responses that are irrational would tend to be correlated with failure to always use seatbelts.

Table 5. Probit Estimates for Whether Always Use Seatbelts

	Coefficient (Asymptotic Standard Error)			
	Model 1	Model 2	Model 3	Model 4
Value of Statistical Life (VSL)	0.009** (0.004)		0.008** (0.004)	
VSL range				
$ 0.5 M to 2.0 M		0.061 (0.052)		0.038 (0.052)
$ 2.0 M to 5.0 M		−0.039 (0.062)		−0.084 (0.066)
$ 5.0 M to 10.0 M		0.117** (0.046)		0.079 (0.049)
$ 10.0 M and up		0.107* (0.048)		0.090 (0.048)
Infinite VSL	−0.016 (0.065)	−0.009 (0.073)	−0.017 (0.063)	−0.038 (0.076)
Top 25% most elastic mortality perceptions	0.097** (0.039)	0.090** (0.040)	0.096** (0.038)	0.078* (0.039)
Bottom 25% least elastic mortality perceptions	−0.020 (0.044)	−0.026 (0.044)	−0.003 (0.042)	−0.007 (0.042)
Age			0.0007 (0.0012)	
18–24				−0.004 (0.070)
25–44				0.025 (0.053)
45–64				0.078 (0.052)
Female			0.113*** (0.042)	0.094** (0.042)
Education			0.028*** (0.008)	
No high school diploma				−0.021 (0.104)
Some college				0.060 (0.043)
College degree				0.100** (0.042)
Advanced degree				0.153*** (0.033)
Nonwhite			0.071 (0.048)	0.061 (0.049)
Current smoker			−0.121*** (0.049)	−0.135*** (0.050)
Observations	465	465	461	461
Pseudo R^2	0.03	0.05	0.10	0.13

Probit coefficients have been converted into slope coefficients, with an assumed 0–1 change for dummy variables.
* Significant at 90% confidence level; two-tailed test
** Significant at 95% confidence level, two-tailed test.
*** Significant at 99% confidence level, two-tailed test.

Models 1 through 3 in Table 5 show that, consistent with the central theoretical prediction, respondents who have higher stated VSLs are more likely to always wear seatbelts.[31] As an example, using the point estimate of the VSL coefficient from Model 3, people stating a VSL of between \$5 million and \$10 million have a 3.2% greater likelihood of always using seatbelts than people stating a VSL between \$2 million and \$5 million.[32] Interestingly, those who refused to name any finite price for being willing to bear fatality risks are not significantly more likely to use seatbelts. This result is consistent with the hypothesis that those responses reflect a failure to be engaged in the survey task rather than an underlying risk attitude.

The elasticity of perceived risks with respect to actual mortality risk levels indicates a constructive role of risk beliefs. Respondents for whom the slope of the relationship between ln(Perceived Risks) and ln(Actual Risks) is in the top quartile have a steeper risk belief curve and are more likely to assess the risk reduction effects of seatbelts as being substantial. Those in the top risk perception elasticity quartile are almost 10% more likely to always use seatbelts. The dummy variable indicating the bottom elasticity quartile is not statistically significant.

The demographic variables perform as expected. Females are more likely to use seatbelts, which is consistent with their lower rates of risk-taking behavior in other contexts. Better educated respondents will have higher levels of lifetime wealth, which should lead them to be more safety conscious, but this influence is captured in part by the VSL variable. Similarly, while better educated people are more knowledgeable about risk, this effect is reflected at least in part by the series of risk belief variables. Better educated people also have a higher opportunity cost of time, decreasing the incentive to use seatbelts. On balance, however, there is a positive effect of education on seatbelt usage.

The negative smoking status effects are of particular interest. Smokers incur considerable smoking-related fatality risks and engage in a wide variety of other risky behaviors.[33] That smokers are 12% less likely to always use seatbelts, controlling for all other factors, is reflective of these differences in attitudes toward health and safety risks.

4. VSLs as Revealed through Seatbelt Use

The preceding analysis used the respondents' stated risk premiums for automobile safety to examine whether the person's expressed VSL levels were consistent with seatbelt use. In contrast, the majority of the previous literature uses seatbelt use decisions to infer revealed-preference VSLs for some population. Here we will examine the VSL amounts implied by seatbelt use to see whether they are consistent with the stated preference values.

The Appendix details how we calculate the VSL derived from seatbelt usage decisions, using estimates of the risk reduction due to seatbelt use, the time and discomfort costs of seatbelt use, and information on the individual's seatbelt usage decision. These calculations follow the approach introduced in Blomquist (1979).

---

[31] Although the VSL category coefficients in Model 4 are not statistically significant, the point estimates follow the same pattern and approximate magnitudes as in Model 2. The insignificance is largely attributable to the larger standard errors resulting from reduced degrees of freedom in the regression.

[32] At first glance, this may not seem like a large increase, but given the high prior levels of seatbelt use, a 3 percentage point increase from 80% usage to 83% usage reduces the proportion of nonusers by 15%.

[33] See Hersch and Viscusi (1998) and Viscusi and Hersch (2001), who link smoking and seatbelt usage to the willingness to incur job risks.

Table 6. Estimated VSLs, Using Blomquist (1979) Method

Disutility Value Used	Mean	Low End of Range	High End of Range
$265 (Blomquist 1979)	$2.32 million	$1.91 million	$2.64 million
$1012 (Winston 1987)	$8.03 million	$7.62 million	$8.36 million

The mean stated VSL from the seatbelt use survey, conditional upon giving a finite response, was $5.03 million, with a 95% confidence interval for the mean ranging between $4.56 million and $5.51 million.

We generate two sets of estimates, based on whether we assume a high level of disutility costs of $1012 annually or a low level of disutility costs of $265. The implied VSL estimates, shown in Table 6, are well within the generally accepted ranges for VSL. Several reference points are useful in assessing the reasonableness of the VSLs implied by seatbelt usage. The first traffic safety study to estimate VSL from people's self-protection decisions was Blomquist (1979), who estimated a VSL of $0.9 million. Blomquist, Miller, and Levy (1996) made subsequent estimates using three different sets of assumptions, generating VSL amounts ranging from $2.0 million to $9.3 million. These estimated VSLs implied by seatbelt usage are broadly consistent with market evidence in a wide variety of contexts. The literature survey by Viscusi and Aldy (2003) found a median VSL in market situations of $6.6 million, with many estimates from the labor market and product market being similar to those implied by seatbelt usage.

Other revealed preference evidence for traffic safety risks can be derived from hedonic price equations relating automobile prices to their respective fatality risks. Based on that approach, Atkinson and Halvorsen (1990) derived VSL estimates of $4.8 million to $6.3 million, while Dreyfus and Viscusi (1995) estimated a range from $3.6 million to $5.1 million.

Purchases of child safety seats also reveal a motor-vehicle risk VSL. These deaths are not comparable to the risks to adults, but the estimates involve protective behavior and are based on estimation approaches similar to the seatbelt analysis. Carlin and Sandy (1991) estimated the VSL associated with child safety seats as $1.0 million, while Blomquist, Miller, and Levy (1996) estimated a range from $3.5 million to $6.2 million.

In addition to values from the literature, there are several instructive within-sample reference points. The median respondent has a stated VSL of $2 million to $5 million. The mean stated VSL is $5.1 million for the sample, excluding the infinite responses. The projected Tobit estimates controlling for the infinite values as a sample selection issue average $4.6 million. These sample-specific values are all consistent with the observed range of VSL estimates in meta-analyses of external market reference points.

Our estimates based on the lower level disutility costs of $265 per year from Blomquist (1979) yield a mean implied VSL of $2.32 million, with individual estimates ranging from $1.91 million to $2.65 million. These "low" estimates are very similar to the median stated VSL amounts. When Winston's (1987) high disutility cost estimate of $1012 per year is used instead, the mean implied VSL estimate is $8.03 million, with individual estimates ranging from $7.62 million to $8.36 million. These values are very similar to the median meta-analysis estimates. Roughly one-third of all respondents have stated VSL values in the high VSL range, as 18% have VSL amounts from $5 million to $10 million, and 15% have a stated VSL above $10 million.

Comparing the computed implied VSLs to the mean and confidence interval of the stated VSL also reveals strong similarities. In our survey sample, the mean stated VSL—conditional on giving a response other than "infinite value"—is $5.09 million, with a standard error of $0.24 million. The 95% confidence interval for the conditional mean level of stated VSL amounts, from \$4.56–\$5.51 million, lies entirely within the computed VSL range of \$1.91–\$8.36 million implied by seatbelt usage decisions.

5. Conclusion

Seatbelt usage decisions imply values of statistical life and provide evidence that these VSL levels are consistent with stated risk-cost tradeoffs. People with high VSLs should be more likely to use seatbelts. The VSL amounts obtained from stated preferences for one aspect of automobile safety are positively correlated with seatbelt usage and are comparable to this survey's estimate of the VSLs revealed through the respondents' observed behavior. The estimates for the revealed VSL amounts from seatbelt use bracket the stated preference VSL amounts for this sample. This result provides evidence of the mutual consistency that rational decision makers should have between stated willingness-to-pay values for safety and revealed preference values based on actual risk-taking decisions. The revealed preference VSL amounts are also similar to those derived in other market contexts.

Other determinants of seatbelt use are consistent with rational choice as well. People with risk beliefs that are very elastic with respect to actual risks will be more likely to use seatbelts, as theory predicts. Demographic variables such as education, gender, and current smoking status also perform in the expected manner.

Appendix: Calculating VSL Implied by Seatbelt Usage

The established framework for estimating VSL amounts from seatbelt usage decisions is articulated by Blomquist (1979) and Blomquist, Miller, and Levy (1996). We adapt this framework to introduce possible financial penalties imposed by law enforcement officials and insurance companies and to allow for subjective risk perceptions which differ from objective risk levels.

We formulate a person's expected utility level (Z) associated with precautionary behavior as

$$Z = f(V, I, S, D, M), \tag{A1}$$

where V = implicit value of life, I = implicit value of an accidental injury, S = the level of safety precaution taken (here a 0–1 decision to use seatbelts), D = the nonmonetary level of physical discomfort from wearing a seatbelt while driving, and M = the amount of monetary cost due to noncompliance with seatbelt laws through fines, and potentially through insurance rates.

The marginal expected utility with respect to seatbelt usage will depend upon the perceived reductions in mortality and injury risks from using seatbelts, the time and discomfort costs of seatbelt usage, and the likelihood of being caught while not wearing one's seatbelt. Based on the prior analyses, the first-order condition for undertaking a precautionary safety measure (that is, with respect to S), taken at the means of all variables, and after rearrangement of terms, is

$$\frac{P'V + R'I + LM - awt - (D'/\lambda)}{(at/\beta_w^*)} = B, \tag{A2}$$

where P' = the perceived marginal reduction in mortality risk, R' = the perceived marginal reduction in injury risk, L = the perceived likelihood of incurring financial cost F conditional upon seatbelt nonuse, a = a factor converting work-hour wages to monetary value of leisure hours, w = the wage rate, t = the time spent on the safety precaution, D' = the marginal nonpecuniary disutility of undertaking the safety precaution, λ = the marginal utility of money, β_w^* = the probit coefficient on wages, and B = the overall probit score where the probit results pertain to the probability of using seatbelts.

We have defined P' and R' as changes in perceived risks rather than changes in actual risk. How strongly risk perceptions P and R respond to the chosen level of precautions such as seatbelt use will affect the optimal level of precautions. If this relationship is weak and risk beliefs P and R are not greatly affected by greater safety-related efforts, precautions will appear to be ineffective, and a low level of precautions will be desired.

To facilitate the computations of VSL for the traditional range of disutility costs, and to maintain comparability to the previous literature, we also adapt several parameter estimates from Blomquist, Miller, and Levy (1996), who drew on several outside sources. For instance, they assume t is 4 seconds per trip times 1504 trips/year, or 1.67 hours/year, and that $a = 0.6$. They use federal highway survey data to estimate that $I = 0.0315V$, and that $R' = 12.145P'$. Using those statistical relationships, they collapse $P'V$ and $R'I$ into one term in two parameters while solving for V.

Blomquist (1979, p. 546) uses the parameter estimates from his probit model of observed seatbelt use to calculate the model at the hypothetical point where the probability of buckling up is near 1.00 ($P_{\text{buckle}} = 0.99$, so that $B = 2.326$), and assumes that at that point $U_s = 0$ so that the term will drop out. He is then able to solve for a lower bound on the average V using just the average wage rate and the β^*_w term from the probit regression.

The complete list of parameters used in the Blomquist model, and the assumptions we use to construct our VSL estimates, is presented in Appendix Table A. The modifications introduced are made so the model will be applicable to our survey context. For instance, using the context of the survey question on willingness to pay for risk reduction, wherein the probability of a fatal accident was reduced by 1 in 10,000, we set P' at 0.0001.

Nonetheless, we retain several of the original assumptions. For instance, we accept that the ratio of mortality risk reductions to nonfatal injury reductions has remained unchanged, and we use Blomquist's value of 0.382. Similarly, we use Blomquist's values of 0.6 for a and 1.67 hours/year for t.

A key component of the analysis is the annual disutility cost of using seatbelts. Estimates for disutility are on the order of hundreds of dollars. Blomquist (1979) estimated this value at \$265 (1998 dollars). Winston (1987) estimated disutility costs as \$1012 (CPI-adjusted into 1998 dollars), which seems high, as Blomquist (2004) noted. We use these estimates as hypothetical upper bounds and lower bounds on disutility costs. This method will, of course, abstract from some individual differences in VSL across the sample, since we are assuming the disutility costs to be identical for individuals, but still allows us to obtain a sense of the range of individual VSLs.

Since Blomquist's initial article, passage of mandatory seatbelt laws and primary enforcement laws has added an additional consideration in seatbelt use decisions. The expected penalties paid through failure to use seatbelts would appear as a positive term in the numerator of Equation 2, and would be equal to the average fine paid when caught times the expected number of tickets received per year. Our sample was drawn from Arizona in 1998. In that year Arizona had secondary enforcement laws in place. Cohen and Einav (2003) report that the implementation of secondary enforcement in 1991 temporarily raised seatbelt usage from 55% to 65%, but that by 1998, usage had fallen back to 62%, indicating that the law was not a significant deterrent to nonuse. Consequently, for ease of estimation we assume that LM is sufficiently near zero to disregard that term in the model.[34]

Although our survey did not collect wage or income data, it did obtain responses for age, education, gender, and race, all of which are significant determinants of wages. Using the values of those demographic characteristics, we impute wages for our sample respondents. To convert demographics into an estimated wage, we take wage and demographic data from the 1998 Current Population Survey's March Demographic supplement and run separate log-wage regressions for males and for females. We restrict each regression sample to full-time civilian workers living in metropolitan areas of the Mountain census region.[35] The coefficients from the wage regression are applied to our survey respondents to impute each person's wage level.

[34] A hypothetical average fine of \$50 and one expected ticket per year would decrease the marginal VSL required to decide to use seatbelts by about \$360,000. Estimating the perceived risk of being caught over an annual period, however, is problematic. Periods of heightened enforcement, such as "Click it or ticket" programs over holiday weekends, can temporarily raise the perceived number of tickets received *at an annual rate* by a significant amount, perhaps to higher than 1.0. It is thus possible to argue both that during "business-as-usual" periods of traffic enforcement, when the probability of being caught is very low, the expected penalties are not high enough to encourage universal seatbelt use and have negligible effects, and also that periods of heightened enforcement can be effective at temporarily increasing seatbelt usage.

[35] Sensitivity tests comparing the coefficients from the Mountain region sample to that of Arizonans find very similar coefficients, but much higher standard errors with the smaller group. The regression for males, based on a sample of 1964 observations, explains 29.84% of the variation in log-wages, with an F-statistic of 84.5. The estimated equation is LN(WAGE) = 0.540 + 0.087 AGE − 0.000836 AGE SQUARED − 0.263 BLACK − 0.202 HISPANIC − 0.122 ASIAN − 0.188 AMERICAN INDIAN OR PACIFIC ISLANDER − 0.353 HIGH SCHOOL DROPOUT + 0.129 SOME COLLEGE + 0.362 COLLEGE GRADUATE + 0.632 GRADUATE SCHOOL. The estimated equation for 1,454 females is LN(WAGE) = 0.410 + 0.077 AGE − 0.000789 AGE SQUARED − 0.210 BLACK − 0.226 HISPANIC − 0.116 ASIAN − 0.257 AMERICAN INDIAN OR PACIFIC ISLANDER − 0.280 HIGH SCHOOL DROPOUT + 0.129 SOME COLLEGE + 0.427 COLLEGE GRADUATE + 0.599 GRADUATE SCHOOL. Only the coefficients for ASIAN and AMERICAN INDIAN OR PACIFIC ISLANDER are statistically insignificant at the 95% confidence level. The omitted baseline group is white male high school graduates. Recent literature by Altonji and Blank (1999) and Jarrell and Stanley (2004) concludes that Heckman corrections for selection into the labor force do not greatly improve the quality of estimation in more recent labor market data.

In order to obtain an estimated slope coefficient for wage, the imputed wages were included in a probit regression model of seatbelt use alongside the female indicator and educational attainment variables and the respondent's risk perception indicators, resulting in a probit coefficient of 0.037.[36]

Gathering together the estimates into Equation 4 we solve for V_i:

$$\frac{0.0001382 V_{i,low} - \hat{w}_i - 265}{(1/\beta^*_w)} = \beta_i, \tag{A3}$$

and

$$V_{i,low} = \frac{\left[\left(\frac{\beta_i}{\beta^*_w}\right) + w_i + 265\right]}{0.0001382}. \tag{A4}$$

The equations for the $V_{i,\ high}$ estimates differ only in using the annual disutility cost of \$1012 instead of \$265 as the final term in the numerator. Both models are parameterized so that the predicted VSL increases by \$14,614 for each \$1 increase in estimated wages. Using the 10th and 90th percentiles of wages in the CPS March Demographic Supplement at \$5/hour and \$30/hour creates computed VSLs which vary by more than \$365,000, even when holding disutility costs constant. Finally, the responsiveness of stated VSLs to imputed wages is positive, with a point estimate of \$74,939, but given the large standard error associated with the wage estimation, this result is not statistically significant. As the stated VSL question asked for a categorical response, a traditional correlation coefficient between stated VSL and estimated wage is not appropriate, but an ordered logit regression resulted in a positive coefficient for estimated wage, although it is significant only at the 75% confidence level. This result is consistent with the regression estimates in Table 4, which show little correlation between the stated VSLs and the demographic variables.

[36] As the imputed wages are a linear combination of the demographic variables, the least statistically significant demographic variables, race and age, are omitted from the model. As a test of robustness, various combinations of the demographic variables were included in the probit regression, but the wage coefficient remained fairly stable in the range 0.28-0.48. The respondent's stated VSL was omitted from this model, as the point of this exercise is to test the reliability of those responses.

Table A. Values Used in Estimation of Revealed VSLs Using Blomquist (1979) Method

Variable	Description	Value used	Source
P'	Marginal reduction in mortality risk	0.0001	Survey question context
V	Value of statistical life		
R'	Marginal reduction in injury risk	$12.145P'$	Blomquist (1979)
I	Value of injury prevention	$0.0315V$	Blomquist (1979)
a	Fudge factor converting work hour value to leisure hour value	0.6	Blomquist (1979)
w	Wage rate	Individual specific, based on demographic variables	1998 Current Population Survey
t	Time spent on the safety precaution	1.67 hours/year	Blomquist (1979)
L	Perceived annual number of times caught for nonuse	Jointly considered de minimis, based on Arizona seatbelt usage before and after 1991 law, and small magnitude relative to D'	Cohen and Einav (2003)
M	Monetary penalty for seatbelt nonuse, conditional upon being caught		
D'	Marginal nonpecuniary disutility of undertaking the safety precaution	\$265 and \$1012 for ratio (D'/λ)	Blomquist (1979) and Winston (1987), respectively
λ	Marginal utility of money		
β^*_w	Probit coefficient on wages	0.0367	Auxiliary regression, using 1998 Current Population Survey and survey responses
B	Overall probit score	Individual specific, as estimated earlier	Survey responses

References

Adams, John. 1995. *Risk*. London: University College London Press.

Adler, Robert, and R. David Pittle. 1984. Cajolery or command: Are education campaigns an adequate substitute for regulation? *Yale Journal on Regulation* 2:159–94.

Altonji, Joseph, and Rebecca Blank. 1999. Race and gender in the labor market. In *Handbook of labor economics*, edited by Orley Ashenfelter and David Card. Amsterdam: Elsevier, pp. 3143–59.

Arnould, Richard, and Henry Grabowski. 1981. Auto safety regulation: An analysis of market failure. *Bell Journal of Economics* 12:27–45.

Atkinson, Scott E., and Robert Halvorsen. 1990. The valuation of risks to life: Evidence from the market for automobiles. *Review of Economics and Statistics* 72(1):133–6.

Blomquist, Glenn. 1979. Value of life saving: Implications from consumption activity. *Journal of Political Economy* 87(3):540–58.

Blomquist, Glenn. 1988. *The regulation of motor vehicle and traffic safety*. Boston: Kluwer Academic Publishers.

Blomquist, Glenn. 1991. Motorist use of safety equipment: Expected benefits or risk incompetence? *Journal of Risk and Uncertainty* 4:133–52.

Blomquist, Glenn. 2004. Self-protection and averting behavior, values of statistical lives, and benefit cost analysis of environmental policy. *Review of Economics of the Household* 2:89–110.

Blomquist, Glenn, Ted R. Miller, and David T. Levy. 1996. Values of risk reduction implied by motorist use of protection equipment: New evidence from different populations. *Journal of Transport, Economics, and Policy* 30(1):55–66.

Byrnes, James P., David C. Miller, and William D. Schafer. 1999. Gender differences in risk taking: A meta-analysis. *Psychological Bulletin* 125(3):367–83.

Carlin, Paul S., and Robert Sandy. 1991. Estimating the implicit value of a young child's life. *Southern Economic Journal* 58(1):186–202.

Cohen, Alma, and Liran Einav. 2003. The effects of mandatory seat belt laws on driving behavior and traffic fatalities. *Review of Economics and Statistics* 85(4):828–43.

Dionne, Georges, and Paul Lanoie. 2002. How to make a public choice about the value of a statistical life: The case of road safety. Working Paper 02-02, École des HEC Montreal.

Dreyfus, Mark K., and W. Kip Viscusi. 1995. Rates of time preference and consumer valuations of automobile safety and fuel efficiency. *Journal of Law and Economics* 38(1):79–105.

Hakes, Jahn K., and W. Kip Viscusi. 2004. Dead reckoning: Demographic determinants of the accuracy of mortality risk perceptions. *Risk Analysis* 24(3):651–64.

Hersch, Joni. 1998. Compensating differentials for gender-specific job risks. *American Economic Review* 88(3):598–627.

Hersch, Joni, and W. Kip Viscusi. 1998. Smoking and other risky behaviors. *Journal of Drug Issues* 28(3):645–61.

Jarrell, Stephen B., and T. D. Stanley. 2004. Declining bias and gender wage discrimination? A meta-regression analysis. *Journal of Human Resources* 39:828–38.

Jones-Lee, Michael W. 1989. *The economics of safety and physical risk.* Oxford: Basil Blackwell.

Lanoie, Paul, Carmen Pedro, and Robert Latour. 1995. The value of a statistical life: A comparison of two approaches. *Journal of Risk and Uncertainty* 10:235–57.

Levitt, Steven D., and Jack Porter. 2001. Sample selection in the estimation of air bag and seat belt effectiveness. *Review of Economics and Statistics* 93(4):603–15.

Lichtenstein, Sarah, Paul Slovic, Baruch Fischhoff, Mark Layman, and Barbara Combs. 1978. Judged frequency of lethal events. *Journal of Experimental Psychology: Human Learning and Memory* 4(6):551–78.

Miller, Ted R. 2000. Variations between countries in values of statistical life. *Journal of Transport Economics and Policy* 34(2):169–88.

National Highway Traffic Safety Administration. 2000. Motor vehicle occupant safety survey: Volume 2, seat belt report., U.S. Department of Transportation.

Peltzman, Sam. 1975. The effects of automobile safety regulation. *Journal of Political Economy* 83(4):677–725.

Shepard, Donald, and Richard Zeckhauser. 1984. Survival versus consumption. *Management Science* 30(4):423–39.

Viscusi, W. Kip. 1993. The value of risks to life and health. *Journal of Economic Literature* 31:1912–46.

Viscusi, W. Kip. 1998. *Rational risk policy.* Oxford: Oxford University Press.

Viscusi, W. Kip, and Joseph Aldy. 2003. The value of a statistical life: A critical review of market estimates throughout the world. *Journal of Risk and Uncertainty* 27(1):5–76.

Viscusi, W. Kip, and Joni Hersch. 2001. Cigarette smokers as job risk takers. *Review of Economics and Statistics* 83(2):269–80.

Viscusi, W. Kip, Wesley A. Magat, and Joel Huber. 1991. Pricing environmental health risks: Survey assessments of risk-risk and risk-dollar tradeoffs. *Journal of Environmental Economics and Management* 201:32–51.

Viscusi, W. Kip, and Charles J. O'Connor. 1984. Adaptive responses to chemical labeling: Are workers Bayesian decision makers? *American Economic Review* 74(5):942–56.

Winston, Clifford, Associates. 1987. *Blind intersection: Policy and the automobile industry.* Washington, DC: The Brookings Institution.