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Traffic accident experience and subjective well-being

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Abstract

In this paper we aim to use a posteriori approach to estimate the monetary compensation that would keep the individual's subjective well-being unchanged after experiencing traffic accidents. The coefficients of the life satisfaction equation, estimated with Swedish data collected in May 2020, indicated no statistically significant association between accident experience and life satisfaction. This result is in line with the extensive empirical research on hedonic adaptation that suggests individuals' tendency to adapt relatively fast to new life circumstances and highlights the importance of knowing the time of the accident in order to draw conclusions about when and what monetary compensation might be needed to keep the individuals' life satisfaction unchanged when experiencing, directly or indirectly, a traffic accident.

Keywords: subjective well-being; life satisfaction; well-being valuation method; traffic accident; direct and indirect experience.

JEL Codes: D46; D62; I31; R41.

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1 Introduction

Despite technical and juridical progress on traffic safety, traffic-related fatalities are predicted as the fifth most common cause of death worldwide in 2030.[20] This makes clear that the management of traffic safety, including the establishment of a strong and safe infrastructure, safe vehicles and strict traffic regulations, must look more near to the individuals' behavior and their well-being. While earlier studies investigated the impacts of accident experiences on a host of revealed dimensions, few have considered the individuals' life satisfaction after an accident. Furthermore, traffic accidents experienced by a someone near, family or friends, can also affect the individual and the relationship functioning. Survivors, regardless of the severity of their injuries, report reduced utility along several aspects of life (e.g., time off work, sexual life etc.) one year after the accident [8].

In this paper, we explore the extent to which past accident experiences affect individuals' current life satisfaction. Our study relates to the extensive empirical research on hedonic adaptation; individuals' tendency to adapt to new life circumstances. When hedonic adaptation takes place, the intensity of some episode or event diminishes, making happy or adverse events merely transitory. For someone directly involved in an accident, the adaptation mechanism can take different forms, e.g., a physiological form; involving full or partial recovery from physical disability, and cognitive form; the coping of psychological distress and social consequences [11]. Earlier literature suggests that people recover rather rapidly in terms of well-being, taking perhaps as short as three months or even less [15]. Individuals with serious impairments, significant enough to keep them out of work, show signs of partial adaptation [21]. Furthermore, individuals who suffered from disabilities later in life were less satisfied with life than those who developed their disabilities at birth or in early life [18]. Adaptation also occurs after positive shocks to individuals' lives. Positive shocks to wealth, through lottery lump-sum payouts, produce sustained increase in overall life satisfaction, mainly driven by increased financial fulfillment [5]. Lottery fortune showed no signs of having long-term effects on mental health and happiness. For certain events, however,

physical and psychological pain do seem to drag on endlessly. The ability to bounce back from hardship seems particularly difficult following transition into unemployment [14] [7], and divorce [13].

From a policy perspective, knowing the monetary compensation that would keep the individual's well-being unchanged after experiencing a traffic accident is critical for any decision maker assigned with the complex task of prioritizing between appropriate measures and interventions. The value of monetary compensation for experiencing a traffic accident can be deduced from the implied trade-off between income and accident experience that keeps the individual's well-being unchanged. The theoretical understanding of the monetary compensation is the additional income needed to bring the individual's well-being back to the level as before the accident. This amount, which is unobserved and not revealed on a market, is sometimes referred to as the shadow price. Shadow prices of several goods that lacks a market in the traditional sense have estimated by previous studies, e.g., the cost of preventing depression [23], the price of friendship [22], the value of marriage [4], the value of air quality [16], and the value of avoiding chronic pain [19], but not the value of traffic safety. In this study, in addition to estimating the association between traffic accident experience and life satisfaction, we also attempt to estimate the shadow price of experiencing traffic accidents. To do this, we use Swedish data collected in 2020. Sweden is a relevant case given the high level of safety for drivers, cyclists or pedestrians reached due to strong governmental intervention. Since 1997, the government continuously renewed its commitment to transport safety work as to achieve Vision Zero; a long-term goal to prevent serious injuries and fatalities on Swedish roads. Despite continuous efforts, 2018 saw a spike in road fatalities after some years with a flat trend [1]. Even though motorists (e.g., drivers and passengers of cars, buses, motorcyclists, etc.) were most likely to be involved in accidents on Swedish roads, cyclists were most likely to suffer severe injuries, with the numbers rising annually since 2007. Most bicycle accidents are single-vehicle and typically cause open wounds, contusions and fractures. Bicycle accident victims tend to need specialized out-patient care [12], and

their injuries can result in lasting symptoms associated with psychiatric disorder and severe pain [17]. Therefore, it is relevant to analyze the association between the traffic accident experience and the life satisfaction of both individuals involved in a traffic accident and those who know someone near, family of friends who was involved in a traffic accident. The paper proceeds as follows; Section 2 presents the econometric framework and shortly presents how to estimate the monetary compensation for experiencing traffic accident using the well-being valuing method. Section 3 shortly describes the data with focus on the variables required to apply the well-being valuing method. Section 3Section 4 presents the regression results. The last section discusses and concludes.

2 Well-being equation and well-being valuing method

In recent years, the well-being valuation model (WVM) has gained acceptance amongst economists and the evaluation of so called non-market goods now extends over a host of contexts, some of which already mentioned. Following the WVM approach, we investigate how individuals' experiences with traffic accidents relates to their life satisfaction (LS) by estimating the following linear specification:

$$LS_i = \alpha_i + \beta_A AccidentExperience_i + \beta_M M_i + \beta_X X_i + \epsilon_i \tag{1}$$

where LS_i is individual i's general life satisfaction. $AccidentExperience_i$ is a dummy variable that takes value one if individual i has had direct or indirect traffic accident experience and zero otherwise. M_i represents the monthly equivalent household income, which in some previous studies was expressed in natural logarithm. X_i includes socio-demographic and other control variables related to traffic accident and ε_i a normally distributed error term. The natural logarithm takes into account diminishing marginal utility of income, which is a more realistic representation of how increases (or losses) in wealth affect individuals

differently depending on their initial level of wealth. If the estimated coefficients are to be economically meaningful, i.e., β_M in equation (1) is positive and statistically significant and β_A is negative and statistically significant, these two estimated parameters can be used to estimate the shadow price (SP), i.e., the monetary compensation for those who experienced traffic accidents that would keep their life satisfaction unchanged. The shadow price (SP) is worked out by reversing the logarithm with the exponent [19] in the following way:

$$SP = \bar{y}\Big[exp(-\frac{\beta_A}{\beta_M}) - 1\Big] \tag{2}$$

where β_A and β_M are the estimated parameters from equation (1). SP in equation (2) is regarded as equivalent to the marginal rate of substitution between β_A and β_M when the monthly equivalent household income is log-transformed. $\bar{y}$ is the average monthly equivalent household income in the sample. We condition for a set of demographic and socioeconomic variables that have been identified as being predictive of life satisfaction. In addition to the natural logarithm transformation of equivalent monthly household income, we control for gender, age, country of birth, marital status, education and labor market status. Other variables, as for example, helmet usage and being worried for experiencing traffic accidents in the future, are potential outcomes themselves and therefore should not be included as explanatory variables [3] [6] .

3 Data

3.1 Sample design

For the purpose of our study, we got access to a sample of 1026 individuals that is representative of the Swedish adult population with respect gender, age and geographical region. The respondents were selected in May 2020 from the Scandinavian web panel Userneeds, which

at the time had approximately 110,000 members aged between 18 and 80. The data contain information about the individuals' life satisfaction, income and their accident experiences, the three variables needed to use the well-being valuing method to compute the monetary compensation that would keep the individual's well-being unchanged when experiencing a traffic accident [2].

Given the Useerneeds' rules of rewarding the participation in the web survey only for the respondents who answered all questions, there are not missing values in our sample. However, due to ethical aspects, some of the survey's questions let the respondent chose to answer either "I don't want to answer" or "I don't know". For example, five respondents answered "I don't know" for all questions about their accident experience and 166 respondents answered "I don't want to answer" for the question about their monthly household income. Therefore, our final sample includes 857 (of 1027) respondents who answered all three questions required by the well-being valuing method. However, this seems to not affect the sample representativeness. Table A1 in the Appendix indicates that there are no statistically significant mean differences between the initial sample and the final samples used to produce the regression estimates reported in Section 4.

3.2 The necessary variables of the well-being valuing method

3.2.1 Life satisfaction

We elicit information about respondents' well-being from the life satisfaction question "How satisfied have you been with your life during the last 12 months?", which was answered using a 0-10 scale, where 0 means extremely unsatisfied and 10 means very satisfied. The mean life satisfaction of the initial sample is 6.55, which is only marginally lower than the mean life satisfaction of the four samples (i.e., 6.62-6.64) used to estimate the coefficients of the life satisfaction equation (Table A1 in the Appendix). We rely on the life satisfaction measure to capture variation in utility levels, which was for many years widely debated by happiness scholars due to measurement errors, such as situational influences; daily variations in mood,

the weather, etc. ([10]). We make the assumption that measurement errors are independent of the accident experience.

3.2.2 Accident experience

The accident experiences was assessed by respondents' answers to two questions about their own accidents: "In your life, how many times have you been involved in a traffic accident that resulted in hospital visit?", which was answered by choosing one of the following alternatives: never, once, twice, more than two times, and "I don't know". The question was asked twice to specifically distinguish between cyclist/pedestrian accidents and car accidents. Similarly, the respondents answered four questions about the accident experience of someone near, family or friends, accident experience. The question was stated as "In your life, do you know/knew someone (relative or friend) who has been involved in a traffic accident?". The question was asked four times to distinguish between cyclist/pedestrian accidents and car accidents, and whether the relative or friend was severely injured or deceased. Table 1 reports the share of respondents that have experienced different types of traffic accidents. Of 857 individuals in the analyzed sample, 31% reported that they have been hospitalized at least once as a result of a traffic accident (either by bike, walk or in a car). About 45% reported that they know or knew someone who was injured or died because of a traffic accident and 59% reported that they either been hospitalized themselves or know/knew someone that was hospitalized or died a result of a traffic accident.

Table 1: Traffic accident by type of experience, in percent

	Own injuries			Family/friends			Any
	Car	Bike/walk	Any	Deceased	Injured	Any	
Yes	19.3	18.4	31.3	20.1	36.7	45.3	58.7
No	79.9	80.8	68.1	77.8	59.1	51.4	38.4

Notes: n = 853.

Those who have experienced a bike or pedestrian accident themselves report significantly higher worry of similar recurring accidents (Figures A1 and A2 in the Appendix). This higher worry does however not affect the association between bike or pedestrian accident experience and life satisfaction (Figures A3 and A4 in the Appendix). As expected, individuals who use a helmet when riding a bicycle report significantly higher worry for an accident (4.398 on a 1-10 scale) compared to those who do not wear a helmet (3.617). However, the majority of helmet users are in fact irregular bicycle riders; 57% of them use their bicycle a few days a month, less frequently than so or not at all.[1] Interestingly, the life satisfaction of helmet users is on average 0.592 units higher than respondents who ride the bicycle without a helmet.

3.2.3 Income

All respondents in the final sample reported their monthly household income. We computed the monthly equivalent household income. We use uniform weights and assign all members weight=1. An alternative weight schedule is the modified OECD scale [19], where the first adult has weight=1, the second adult has weight=0.5, and where each child is assigned weight=0.3.

4 Results

Table 2 reports the OLS estimates for the life satisfaction equation defined in Equation (1). Columns 1 and 2 reports the estimated coefficients for direct accident experiences and Columns 3 and 4 for indirect accident experiences. Neither of the estimated coefficients are statistically significant at any of the conventional significance levels and one of the four estimates does not have the expected sign. This result might be explained by individuals' adaption to the new circumstances of their life. The estimate for the $\log(income$ (i.e., the natural logarithm of equivalent monthly household income) is positive and statistically

[1]The survey question focuses on how often the respondents' travel with either bicycle, moped, electric scooter or electric kick scooter.

significant throughout,which is in line with previous literature.

Table 2: Well-being regressions. Restricted model specification

	Own injuries		Family/friends	
	Bike/walk	Car	Injured	Deceased
Accident experience	0.127	−0.267	−0.022	−0.149
	(0.190)	(0.193)	(0.156)	(0.186)
Log(income)	0.308**	0.309**	0.323**	0.319**
	(0.096)	(0.096)	(0.098)	(0.097)
Adjusted R^2	0.009	0.011	0.010	0.011
Observations	853	853	824	842

Notes: Standard errors in parentheses are normal standard errors. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

Table 3 shows that excluding the respondents who experienced more than one type of accidents leads to changes of the estimated coefficients of accident experience. All estimated coefficients of the type of accident experience are now positive and experiencing an accident as cyclist/pedestrian has a statistically significant impact on life satisfaction. Respondents who experienced bike or pedestrian accidents have on average 0.589 units higher life satisfaction than those who have no experience with traffic accidents. The estimated coefficients of income still have a positive statistical significant impact on the life satisfaction.

Table 3: Well-being regressions. Restricted samples

	Own injuries		Family/friends	
	Bike/walk	Car	Injured	Deceased
Accident experience	0.589*	0.154	0.177	0.232
	(0.284)	(0.325)	(0.218)	(0.323)
Log(income)	0.371**	0.310*	0.248	0.321*
	(0.130)	(0.138)	(0.130)	(0.139)
Other controls	No	No	No	No
n	435	418	457	377

Notes: Standard errors in parentheses are normal standard errors. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 4, on the other hand, shows that using the same samples as the ones used to produce the results reported in Table 2 and enlarging the model specification does not affect the estimates for accident experience but the estimated coefficients for income are lower and no longer statistically significant. This suggests that the individuals' demographic and socioeconomic characteristics do not have a strong association with their accident experiences but they are associated with their income.

Table 4: Well-being regressions. Full model specification and unrestricted samples

	Own injuries		Family/friends	
	Bike/walk	Car	Injured	Deceased
Accident experience	0.146	−0.246	−0.025	−0.136
	(0.181)	(0.184)	(0.149)	(0.180)
Log(income)	0.021	0.027	0.050	0.040
	(0.102)	(0.102)	(0.105)	(0.104)
Woman (CG: Man)	−0.007	−0.035	0.021	0.011
	(0.146)	(0.146)	(0.148)	(0.146)
Age	0.013	0.012	0.010	0.011
	(0.007)	(0.007)	(0.007)	(0.007)
Foreign born (CG: Swedish born))	0.533	0.530*	0.524	0.509
	(0.266)	(0.264)	(0.271)	(0.271)
Married or cohabited (CG: Single)	0.709***	0.710***	0.721***	0.671***
	(0.161)	(0.161)	(0.164)	(0.163)
Widow (CG: Single)	−0.147	−0.114	−0.181	−0.243
	(0.716)	(0.716)	(0.715)	(0.716)
Divorced (CG: Single)	−0.315	−0.271	−0.340	−0.388
	(0.377)	(0.375)	(0.373)	(0.373)
2 y high school (CG: Primary educ)	0.837*	0.828*	0.637	0.630
	(0.349)	(0.348)	(0.354)	(0.353)
3-4 y high school (CG: Primary educ)	0.254	0.234	0.138	0.061
	(0.297)	(0.297)	(0.304)	(0.302)
1-3 y university (CG: Primary educ)	0.323	0.322	0.170	0.143
	(0.329)	(0.329)	(0.336)	(0.333)
More than 3y university (CG: Primary educ)	0.267	0.245	0.165	0.068
	(0.296)	(0.296)	(0.302)	(0.302)
Self-employed (CG: Employed)	0.018	0.046	0.060	0.050
	(0.343)	(0.343)	(0.346)	(0.343)
Retired (CG: Employed)	0.492	0.509	0.570*	0.536*
	(0.269)	(0.268)	(0.274)	(0.271)
Student (CG: Employed)	−0.250	−0.230	−0.179	−0.281
	(0.311)	(0.310)	(0.324)	(0.311)
Unemployed or on sick leave (CG: Employed)	−1.895***	−1.895***	−1.852***	−1.857***
	(0.322)	(0.322)	(0.333)	(0.330)
Adjusted R^2	0.115	0.115	0.106	0.109
Observations	849	849	820	838

Notes: CG stands for comparison group. Standard normal errors are reported in parentheses. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

Our estimates suggest that there is no statistically significant association between life satisfaction and being hospitalized several times due to traffic accidents. Furthermore, different definitions of accident experience produce different estimates, which might be a result driven by the data design. Overall, except the restricted sample of own accident experiences when biking or walking, we find no statistically significant association between traffic accident experience and life satisfaction. This implies that our estimates cannot be used to calculate the shadow price of traffic accident experiences as outlined in Section 2.

5 Discussion and conclusions

In this paper we aimed to use a posteriori approach in an attempt to estimate the monetary compensation for traffic accident experiences that would keep the individual's subjective well-being unchanged by exploiting the relationship between individuals' past experiences with traffic accidents and their life satisfaction. We analyzed both own or first-hand accidents and someone near, family or friend, accidents. The association between the individual life satisfaction and knowing someone near, family or friend, who was injured or died due to a traffic accident has, to our knowledge, very seldom been previously explored empirically.

Using data from May 2020, we estimated the impact of traffic accident experiences on individuals' current life satisfaction. Our findings indicate that bike or pedestrian accidents are statistically associated with being worried for recurring accidents but we found no statistically significant association between traffic accident experience that led to hospitalization and life satisfaction. Even knowing someone near, family or friend, who at some point in life was severely injured or died in a traffic accident has no statistically significant effect on life satisfaction. Our findings are in line with the extensive empirical research on hedonic adaptation that suggest individuals' tendency to adapt to new life circumstances, and therefore no monetary compensation is needed to keep the individual's life satisfaction unchanged after experiencing traffic accidents. In this way, our results offer few relevant insights to

the current policy debate about the importance of assuring traffic safety. Our estimates of experiencing traffic accidents are not statistically significant, a result that highlights a few methodological challenges of the empirical research of well-being in general, and the use of the well-being valuing method in particular. First, the main limitation of our study is that our data does not provide information on exactly when the respondents had their accident. Assuming accidents shift life satisfaction downwards, the duration from the time of accident would help us map out the path of well-being recovery. This limitation can be addressed by collecting this information from administrative registers or collecting it via survey over time in longitudinal data [24][16][13][7][19]. Future research should be designed as to measure the variables in Section 2.2 at different points in time. Second, with a research design rooted in a cross-sectional context, it is necessary to elaborate on whether traffic accidents happen to individuals randomly or if accidents are correlated with some observed or unobserved variable. Our data do not contain, for example, information about driving style and driving experience, which are variables reported by earlier studies to affect the risk for traffic accidents [9]. However, variables in our model specifications can be argued to be relatively good proxy variables; for example, *Woman* for driving style and *Age* for driving experience. Nonetheless, if unobserved factors make some individuals more likely to be involved in traffic accidents than others, the estimated coefficients reported in Section 3 would not be reliable. Addressing issues related to unobserved heterogeneity is an additional reason why longitudinal/panel data is desirable.

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Appendix

Table A1: Mean values by sample

	Initial sample (1)	Bike/Walk (2)	Car (3)	NFF Injured (4)	NFF Deceased (5)
Life satisfaction	6.55	6.63	6.62	6.64	6.63
Gender					
Male	0.49	0.53	0.52	0.52	0.53
Female	0.50	0.47	0.48	0.48	0.47
Do not want to answer	0.00	NA	NA	NA	NA
Age					
Age	47.23	47.86	47.85	47.97	47.87
Place of birth					
Swedish born	0.91	0.92	0.92	0.92	0.92
Foreign born	0.08	0.08	0.08	0.08	0.08
Other/do not want to answer	0.00	NA	NA	NA	NA
Marital status					
Single	0.32	0.31	0.31	0.31	0.31
Married/cohabited	0.62	0.63	0.63	0.63	0.63
Widow	0.01	0.01	0.01	0.01	0.01
Divorced	0.04	0.04	0.04	0.05	0.05
Education					
Primary education	0.07	0.08	0.08	0.08	0.08
2-year high school	0.11	0.10	0.10	0.10	0.11
3–4-year high school	0.30	0.31	0.30	0.30	0.30
Higher education, less than 3 years	0.15	0.14	0.14	0.14	0.14
Higher education, 3 years or more	0.37	0.37	0.37	0.37	0.37
Employment					
Employed	0.57	0.59	0.59	0.59	0.59
Self-employed	0.05	0.05	0.05	0.05	0.05
Retired	0.21	0.21	0.21	0.22	0.21
Student	0.08	0.07	0.07	0.06	0.07
Unemployed/Sick leave	0.07	0.06	0.06	0.06	0.06
Other	0.02	0.02	0.02	0.02	0.02
Traffic accident experience					
Own; bike/walking	0.18	0.19			
Own; car	0.18		0.18		
Indirect; injured	0.37			0.38	
Indirect; deceased	0.20				0.21
N	1026	849	849	820	838

Notes: The table shows mean values of the explanatory variables used in the *Life satisfaction*'s equations. NFF stands for near family and friends. Columns (2)-(5) corresponds the samples used to produce the estimates reported in Tables 2 and 4.

Figure A3: SWB by own Bike/Walk accident

Figure A4: SWB by own car accident

Figure A1: Worried Own bike/walk accident

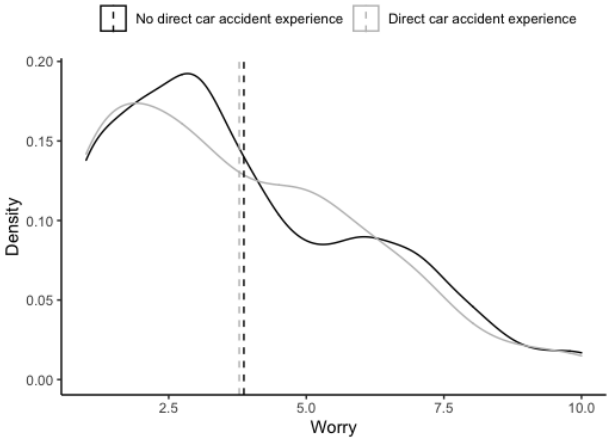

Figure A2: Worried Own car accident