Gianella, C. (2000): Local unemployment and wages, INSEE document de travail, 2000 / 12, pp. 1 – 26.

Hoddinott, J. (1996): "Wages and Unemployment in an Urban African Labour Market", Economic Journal, vol. 106, pp. 1610 – 1626.

Huitfeldt, H. (2001): Unemployment, labour market programmes and wage determination: evidence from the Czech and Slovak Republics, Uppsala University, Working Paper, 2001 / 1, pp. 1 – 32.

Iara, A. / *Traistaru*, I. (2004): "How Flexible Are Wages in EU Accession Countries?", Labour Economics, vol. 11, pp. 431 – 450.

Ilkkaracan, I. / *Selim*, R. (2003): "The Role of Unemployment in Wage Determination: Further Evidence on the Wage Curve from Turkey", Applied Economics, vol. 35, pp. 1589 – 1598.

Janssens, S. / *Konings*, J. (1998): "One More Wage Curve: The Case of Belgium", Economics Letters, vol. 60 (2), pp. 223 – 227.

Johnes, G. (2007): "The Wage Curve Revisited: Estimates from a UK Panel", Economics Letters, vol. 94, pp. 414 – 420.

Kennedy, S. / *Borland*, J. (2000): "A Wage Curve for Australia?", Oxford Economic Papers, vol. 52 (4), pp. 774 – 803.

Kertesi, G. / *Kollo*, J. (1997): The Birth of the Wage Curve in Hungary, 1989 – 1995, William Davidson Institute Working Paper, 104, pp. 1 – 33.

Kingdon, G. G. / *Knight*, J. (2006): "How flexible are wages in response to local unemployment in South Africa?", Industrial and Labour Relations Review, vol. 59, pp. 471 – 495.

van der Meulen Rodgers, Y / *Nataraj*, S. (1999): "Labor market flexibility in East Asia: Lessons from Taiwan", Economic development and cultural change, vol. 48, pp. 51 – 69.

Montuenga, V. / *García*, I. / *Fernández*, M. (2003): "Wage Flexibility: Evidence from Five EU Countries Based on The Wage Curve", Economics Letters, vol. 78, pp. 169 – 174.

Montuenga Gómez, V. (2000): "La curva de salarios como una curva de determinación salarial", Documentación Laboral, vol. 63 (3), pp. 53 – 78.

Morrison, P. / *Papps*, K. / *Poot*, J. (1999): The wage curve and local labour markets in New Zealand, Annual meeting of WRSA, pp. 1 – 24.

– (2000): Local labour markets, migration and wage determination: Theory and evidence for the wage curve in New Zealand, GSBGM Working paper, 1 / 00, pp. 1 – 38.

Pannenberg, M. / *Schwarze*, J. (1996): "Regionale Lohne und staatliche Qualifizierungsmassnahmen", Mitteilungen aus der Arbeitsmarkt und Berufsforschung, vol. 29 (3), pp. 494 – 497.

– (1998): "Labor Market Slack and the Wage Curve", Economics Letters, vol. 58 (3), pp. 351 – 354.

Papps, K. (2001): "Investigating a Wage Curve for New Zealand", New Zealand Economics Papers, vol. 35, pp. 218 – 239.

Partridge, M. D. / *Rickman*, D. S. (1997): "Has the Wage Curve Nullified the Harris Todaro Model? Further US Evidence", Economics Letters, vol. 54 (3), pp. 277 – 282.

Pekkarinen, T. (2001): "The wage curve: Evidence from the Finnish Metal Industry Panel data", Finnish Economic Papers, vol. 14, pp. 51 – 60.

Poot, J. / *Doi*, M. (2005): "National and Regional Wage Curves in Japan 1981 2001", Review of Urban and Regional Development Studies, vol. 17, pp. 248 – 270.

Sanromá, E. / *Ramos*, R. (2005): "Further Evidence on Disaggregated Wage Curves: The Case of Spain", Australian Journal of Labour Economics, vol. 8, pp. 227 – 243.

Sanz de Galdeano, A. / *Turunen*, J. (2006): "The Euro Area Wage Curve", Economics Letters, vol. 92, pp. 93 – 98.

Turunen, J. (1998): "Disaggregated Wage Curves in the United States: Evidence from Panel Data of Young Workers", Applied Economics, vol. 30 (12), pp. 1665 – 1677.

Wagner, J. (1994): "German Wage Curves, 1979 1990", Economics Letters, vol. 44 (3), pp. 307 – 311.

– (1996): "Zur (Nicht)Existenz von Lohnkurven in Deutschland", Mitteilungen aus der Arbeitsmarkt und Berufsforschung, vol. 29 (3), pp. 484 – 486.

Winter Ebmer, R. (1996): "Wage Curve, Unemployment Duration and Compensating Differentials", Labour Economics, vol. 3 (4), pp. 425 – 434.

Wu, Z. (2004): "Wage Curve for Urban China: A Panel Data Approach", Applied Economics Letters, vol. 11, pp. 425 – 428.

Yamaguchi, S. (2005): Wage Flexibility in Turbulent Times: A Practitioner's Guide, IMF Working paper 2005 / 134, pp. 1 – 33.

The Value of Life in Europe – A Meta-Analysis

*Jochen Kluve** and *Sandra Schaffner***

Abstract

Deciding on the allocation of scarce societal resources to life-saving activities is a problem that a wide variety of regulations and government programs face. In particular, it is a problem arising in very similar ways for social and public policy across countries. A commonly used approach to empirically assess the life-saving benefits of regulations is the Value of a Statistical Life (VSL). The VSL essentially summarizes and expresses the monetary value of small reductions in mortality risks of the population. Such reductions could be brought about, for instance, by environmental regulations aiming at CO_2 reduction or health care programs targeting preventive medical examinations. In this paper, we investigate the Value of a Statistical Life in Europe by collating estimates of the VSL across countries. Based on 94 observations from 37 studies, our meta-analysis finds that VSL estimates based on health risks are lower than those based on traffic and environmental risks. Moreover, VSL studies based on wage-risk studies find higher estimates than contingent valuation studies.

Zusammenfassung: Der Wert eines Lebens in Europa – Eine Meta-Analyse

Politische oder gesellschaftliche Entscheidungen über den Einsatz knapper Mittel zur Erhaltung oder Verlängerung menschlichen Lebens stellen in vielen öffentlichen Bereichen eine Herausforderung dar. Diese Herausforderung gilt in sehr ähnlicher Weise für verschiedene Bereiche der Sozialpolitik und des Gemeinwesens, und insbesondere auch über Ländergrenzen hinweg. Üblicherweise wird dabei die erreichte bzw. erreichbare Verringerung des (vorzeitigen) Todesrisikos anhand des Kon-

* Rheinisch-Westfälisches Institut für Wirtschaftsforschung (RWI), Büro Berlin, Hessische Straße 10, 10115 Berlin, Telefon: +49/30/2021-598-13, Fax: +49/30/2021-598-19; Email: jochen.kluve@rwi-essen.de; http://www.rwi-essen.de/kluve.

** Rheinisch-Westfälisches Institut für Wirtschaftsforschung (RWI), Hohenzollernstraße 1 – 3, 45128 Essen; Telefon: +49/201/8149-282; Fax: +49/201/8149-200; Email: sandra.schaffner@rwi-essen.de; http://www.rwi-essen.de/schaffner.

zeptes des *Wertes eines statistischen Lebens* (VSL) bewertet. Der VSL stellt den monetären Wert dar, den die Gesellschaft einer kleinen Reduktion des Todesrisikos beimisst. Solche Veränderungen des Todesrisikos können z. B. durch Umweltregelungen zur Reduktion des CO_2-Ausstosses oder Maßnahmen zur Prävention im medizinischen Bereich erreicht werden.

In dieser Arbeit fassen wir Studien zum Wert eines statistischen Lebens aus europäischen Ländern zusammen. Auf Basis von 94 Beobachtungen aus 37 Studien zeigt unsere Meta-Analyse, dass Studien, die die Verringerung von Gesundheitsrisiken betrachten, einen geringeren VSL ermitteln als Studien von Verkehrs- und Umweltmaßnahmen. Des Weiteren lässt sich feststellen, dass Lohn-Risiko-Studien höhere Schätzwerte des VSL erzielen als Befragungsstudien.

1. Introduction and Background

According to economic theory, in competitive markets the price mechanism leads to an efficient allocation of limited resources. Since public goods are not traded on markets, the price mechanism does usually not lead to maximum social welfare. Therefore, cost-benefit analysis is used to decide about investments in public goods. Often policymakers must decide about health and safety measures that aim at reducing people's risks to life and health. Such programs may be, for instance, road safety programs that establish compulsory use of seat-belts, environmental protection programs targeting CO_2 reduction, and health care programs such as preventive medical examinations.

Deciding on the allocation of limited societal resources to life-saving activities is therefore a problem that a wide variety of regulations face. Specifically, it is a problem that arises in very similar ways for social and public policy across countries. On the one hand, costs of such programs can be measured. On the other hand, we assume that the risk reduction they achieve can also be measured, or at least approximated. Nevertheless the outcome is not directly comparable with the costs, because it is not measured in monetary terms. Thus, changes in risks have to be valued. This can be done using the concept of the Value of a Statistical Life (VSL). The VSL essentially summarizes and expresses the monetary value of small reductions in mortality risks of the population.

The standard approach to determining the monetary value of life-saving benefits of a public policy regulation is based on society's willingness to pay for mortality risk reductions (*Kenkel* 2003). When focusing on regulations, the specific people whose lives are saved by public policy cannot be identified – unlike e.g. in the case of an emergency rescue operation. As an example (*Kenkel* 2003), consider a hypothetical food safety regulation that reduces the annual risk of dying of a foodborne disease by 0.00001. In a population of 100,000 this regulation will save 1 "statistical life", because it will be expected to result in 1 fewer death from foodborne illness each year. If each person in that population of 100,000 is willing to pay USD 20 a year for this risk reduction, the corresponding VSL would be USD 2 million. Such an estimate of the VSL would be important for public policy in assessing whether that food safety regulation, the implementation of which comes with certain costs, should be put into effect or not.

In this paper, we investigate the Value of a Statistical Life in Europe by collating estimates of the VSL across countries. While the usefulness of the VSL concept for a) juxtaposing costs and benefits of certain regulatory interventions and b) cross-country comparisons is apparent, there are two different perspectives from which critics of the VSL concept believe it to be unethical. The first is based on the view that human life cannot be valued. This ethical argumentation is comprehensible in principle, but it must be taken into account that the concept of the VSL does only measure the valuation of life that people act upon in their daily life. Everybody faces different risks to life and health on an everyday basis, which we can minimize but not eliminate. The most apparent examples of such risks are traffic risks. By using traffic lights to cross the street, fastening the seat-belt in a car, driving slowly, driving a car with airbag etc. we can reduce the risks we face. Because of monetary and non-monetary costs of these possibilities we do not always choose the safest possibility. Hence, the value of life differs between individuals, because everybody chooses his own level of risk.

The second critical view on statistically valuing life relies on the idea that the true value of life must be infinite. Proponents of this reasoning ignore the fact that a statistical life is meant. If people were asked for their willingness to pay to save their own lives against certain death, their answer would certainly be infinite. The VSL, in fact, asks for the willingness to pay for an infinitesimal reduction in fatal risk. Thus, the VSL is less than infinite, because people do not choose between life or death, but rather value a marginal risk reduction. Furthermore, there is a difference between an identified and an unidentified statistical life. Imagine a mine-worker is trapped in a mine. In this – identified – case all efforts will be done to rescue this worker. But the willingness to pay for a project which saves an unidentified life in the future is finite.

There exist three types of willingness-to-pay studies which estimate the value of a statistical life by estimating the value of a risk reduction: contingent valuation studies, consumer behavior studies and wage-risk-studies. First, contingent valuation is adequate to estimate demands for goods that are not – or only infrequently – traded on markets. It is a survey method in which respondents are asked to state their preferences in hypothetical risk reduction. Second, consumer behavior studies measure consumers' preferences indirectly: Prices reflect the characteristics of goods and services, therefore different characteristics lead to different prices. Finally, wage-risk studies estimate the risk premium that workers are paid for high fatality risks at work.

Many studies on the value of a statistical life exist, both based on contingent valuation and on wage-risk analyses, while consumer behavior studies constitute a clear minority. The bulk of studies covers the VSL in the US. However, there is substantial variation in the estimates. As a consequence, several meta-studies have been produced during the last decade to summarize findings from individual studies. All of these meta-analyses have in common that the majority of the results that are surveyed are for the US. For example *Viscusi/Aldy* 2003 give an overview of more than 60 studies on the VSL. For the US American studies, they find that the VSL typically ranges between USD 4 million and USD 8 million, with a median of USD 7 million. In their meta-study, developing countries tend to have a lower VSL than do developed countries.

Since safety is considered a normal good, income must have an impact on the VSL. Point estimates of the income elasticity range from 0.5 to 0.6. *Bellavance/Dionne/Lebeau* 2006 base their meta-analysis on 37 studies on the willingness-to-pay approach using a mixed effect regression model. Only five of the studies they include are based on European findings. According to their analysis, the observed variability in the VSL is due to the methodology that a study uses and the wealth of the population considered. Another meta-analysis on wage risk estimates of the VSL by *Day* 1999 finds an income elasticity of 0.55. The VSL is not only influenced by individuals' income, but also by the sample on which the estimation is based. Estimates based on union members or male workers only return higher values of the VSL. The variation in the VSL between countries is examined in the meta-analysis of *Miller* (2000). He finds that wage-risk studies and contingent valuation studies yield higher VSL than consumer behavioral studies do. Wage-risk studies which do not control for occupational dummies overestimate the VSL.

The VSL is a concept that can be used for public policy decisions on measures that reduce or alter the risk of dying. Since such decisions are similar in content and importance across countries, VSL estimates are an important source of information for policy makers. In contrast to the existing meta-studies focusing on the US, we restrict our meta-analysis to findings from European countries. In collecting the data, contingent valuation studies, wage-risk studies and consumer behavior studies are taken into account. The outline of the paper is as follows: we first introduce the theoretical VSL model in the next section. The third section describes the data collection, gives summary statistics and presents our empirical approach to analyzing the data. Section 4 presents the estimation results and section 5 concludes.

2. *Modeling the Value of a Statistical Life*

Our meta-analysis is based on studies estimating the VSL in different ways. This section gives a brief overview on these concepts. The estimation strategies are based on the standard VSL concept, which was introduced by *Drèze* 1962 and *M. Jones-Lee* 1976. An individual maximizes his expected utility, which is defined as

$$EU(w) = (1-p)U_a(w) + pU_d(w)\,, \tag{1}$$

where $U_a(w)$ and $U_d(w)$ represent the conditional von Neumann-Morgenstern utility of wealth w at life (a) and at death (d) and p is the probability of surviving the given time period. It can be assumed that the utility is higher for life than at death because individuals prefer life to death:

$$U_a(w) > U_d(w), \qquad \forall w. \tag{2}$$

The marginal utility drawn from wealth is greater at the state of life than at the state of death. *Pratt/Zeckhauser* 1996 argue that an individual profits more from increasing her wealth while she is alive rather than while she is dead. In both states she is risk averse, the marginal utility is decreasing:

$$U_a'(w) > U_d'(w) > 0\,, \tag{3}$$

$$U_a''(w), U_d''(w) \leq 0, \qquad \forall w. \tag{4}$$

Under these assumptions the indifference curves (equation 1) are increasing and strictly convex. Firstly, the same utility can be achieved by a low wealth w if the risk p is low as by a high wealth and a high risk. Secondly, the smaller marginal utility from death leads to the convexity.

The willingness to pay (WTP) is the amount an individual is willing to pay to reduce his fatality risk. In this model it means which amount x the individual is ready to pay to reduce the risk from p to p^*, while keeping the expected utility constant. Hence, the following equation must be satisfied:

$$\begin{aligned} EU(w) &= (1-p)U_a(w) + pU_d(w) \\ &= (1-p^*)U_a(w-x) + p^*U_d(w-x)\,. \end{aligned} \tag{5}$$

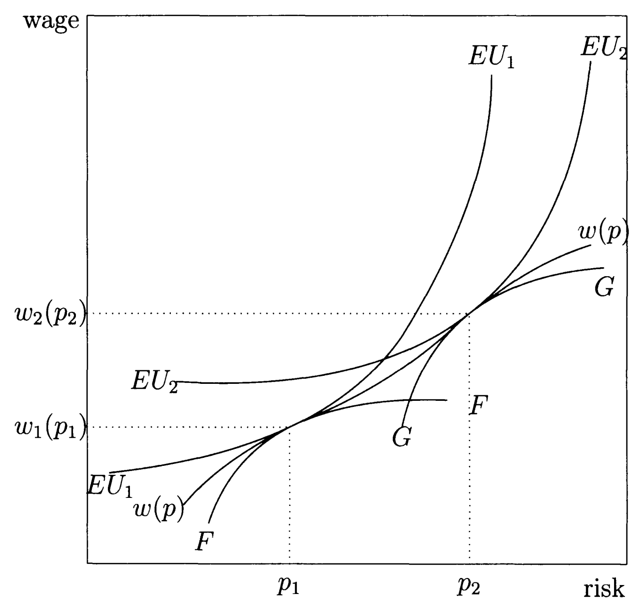
The marginal WTP corresponding to the marginal substitution rate between wealth and the initial probability of death can be received by differentiating w with respect to p.

$$WTP = \frac{dw}{dp} = \frac{U_a(w) - U_d(w)}{(1-p)U_a'(w) + pU_d'(w)}\,. \tag{6}$$

The WTP does not measure what the individual is willing to pay to avoid a certain death nor what she is willing to accept for a certain death. It only measures the marginal willingness to pay / accept for an infinitesimal change in risk. The VSL is the marginal rate of substitution between wealth and risk and is defined as follows

$$VSL = \frac{dw/dp}{\Delta p}\,. \tag{7}$$

Figure 1 presents this concept transferred to wage-risk studies. Because it is costly for firms to provide a lower risk at the workplace, they have to pay lower wages to offset these costs. The isoprofit curves FF and GG for two firms are displayed, each showing the same profit that arises from different wage-risk combinations. These wage offer functions increase with risk. Also the utility functions of two workers EU_1 and EU_2 are shown in this *figure*. In the actual data, only the wage-risk combinations (points) actually realized and the curve $w(p)$ are observed.



Based on *W. K. Viscusi* (1993).

Figure 1: Market Process for Determining Compensating Wage Differentials

To observe the points realized by assuming everything else constant, researchers estimate the following equation

$$w_i = \alpha + \beta_1 X_i + \beta_2 Y_i + \gamma p_i + \epsilon_i\,, \tag{8}$$

where w_i is the worker i's wage rate, α a constant, X_i is a vector of personal characteristics of individual i, Y_i a vector of job characteristics, p_i the job fatality risk of worker i, and ϵ_i is the random error reflecting unmeasured factors influencing worker i's wage rate.

Some studies interact personal characteristics with the fatality risk to capture how the returns to risk vary by different characteristics. Most researchers have estimated the wage equation using a semi-logarithmic specification.

3. *Data*

Our meta-analysis considers VSL studies from Europe. We collect our data according to the following procedure. First, we include European studies considered in the previous (US-focused) meta-analyses. Second, we collected studies using a keyword search in the "RePEc" (Research Papers in Economics) database. The keywords used were "Value of Life", "Compensating wage differential", "Contingent valuation", and "Consumer behavior studies". The search was conducted in January 2008, and again studies focusing on Europe were extracted.

After collecting the studies according to these steps, we consider all studies that give at least one explicit VSL estimate, or that contain sufficient information to allow for a calculation of the VSL. Studies with insufficient information were not included. Our resulting meta-data take 37 studies into account.

Most of the studies create several VSL which depend on different factors: the amount of risk reduction and the type of risk in contingent valuation studies, and the empirical specification and / or the restriction to different subgroups in wage-risk studies. Because of these variations within the studies we create two different data sets. In the first data set we choose one VSL for each study. If possible we take the value for the whole sample in wage-risk studies (and not for specific subgroups such as blue collar workers). Since contingent valuation studies usually contain a range of risk reductions, we use a mean value of this range to calculate the VSL. If the preferred specification of the respective authors is made explicit in the study, we use this specification. *Table 1* presents the different studies and the ranges of their VSL as well as the chosen VSL. All values are expressed in 2007 euros, updated using the consumer price index as reported in EUROSTAT2 and the exchange rates reported by EUROSTAT1.

Table 1

Range of Statistical Life Values by Study

Study	Country	Type	Value Range	Value Chosen
Alberini / Chiabal (2005)	ITA	CV	0.921 – 4.035	4.035
Alberini et al. (2006)	F	CV	1.058 – 1.762	1.762
Alberini et al. (2006)	UK	CV	0.764 – 1.144	0.764
Alberini et al. (2006)	ITA	CV	1.165 – 1.442	1.442
Alberini et al. (2004)	CZE	CV	1.302	1.302
Andersson (2005)	SWE	CV	1.025 – 1.438	1.438
Andersson (2006)	SWE	CV	3.045 – 7.349	7.349
Arabsheibani / Marin (2000)	UK	WR	25.593	25.593
Baranzini / Luzzi (2001)	SUI	WR	6.273 – 8.731	6.273
Barone / Nese (1996)	ITA	WR	0	0
Beattie et al. (1998)	UK	CV	6.567 – 17.094	17.094
Bellmann (1994)	GER	WR	3.931 – 23.075	3.931
Carthy et al. (1999)	UK	CV	4.368	4.368
Desaigues / Rabl (1995)	F	CV	1.031 – 23.976	3.241
Ghosh et al. (1974)	UK	BH	0.853	0.853
Gyrd-Hansen et al. (2007)	NOR	CV	7.672	7.672
Hintermann et al. (2006)			0 – 119.308	8.145
Hultkrantz et al. (2006)	SWE	CV	2.212 – 5.834	5.834
Johannesson et al. (1997)	SW	CV	2.793 – 4.328	3.764
Johannesson et al. (1996)	SWE	CV	2.049 – 7.111	7.111
M. W. Jones-Lee et al. (1985)	UK	CV	4.394 – 10.509	10.509
Kidholm (1995)	DK	CV	14.203 – 20.160	14.203
Leiter / Pruckner (2006)	AUT	CV	2.090 – 2.455	2.090
Lorenz / Wagner (1988)	GER	WR	0	0
Maier et al. (1989)	AUT	CV	4.514 – 5.799	4.514
Marin / Psacharopoulos (1982)	UK	WR	4.973	4.973
Melinek et al. (1973)	UK	CV	0.632	0.632
Melinek (1974)	UK	CV	0.195	0.195
Needleman (1980)	UK	BH	0.332	0.332
Persson / Cedervall (1991)	SWE	CV	4.858 – 8.392	8.244
Persson et al. (2001)	SWE	CV	1.573 – 3.628	2.867
Sandy / Elliot (1996)	UK	WR	6.680 – 89.377	89.377
Schaffner / Spengler (2007)	GER	WR	2.857 – 6.262	3.569
Spengler (2004)	GER	WR	1.341 – 1.884	1.804
Weiss et al. (1986)	AUT	WR	4.472 – 7.454	4.472
Zhu (2003)	NOR	CV	0.828 – 14.641	1.791

In million Euros (2007).

WR: Wage-Risk Study, CV: Contingent Valuation Study, BH: Behavioral Study.

As can be seen, most European studies are studies covering the United Kingdom. Only three of the studies are consumer behavior studies. There are also three studies which do not find a significant VSL because of an insignificant or negative coefficient for the fatal injury risk in wage-risk studies. These studies are excluded in the following empirical analysis, because such a small number of observations does not permit an investigation of the reasons for insignificant findings in wage-risk studies.

In addition to this first data set, in which the preferred VSL of each study is used, we create a second, more extensive data set, for which we extract, if possible, several robust VSL estimates from each study. The means and percentiles of the two samples are given in *Table 2*. There is a wide range of values between 200,000 Euros and 119 million Euros. However, half of the values range between 2 million and 8 million Euros, which is in the same range as the findings by *Viscusi / Aldy* (2003). The average

VSL is estimated to be 7.7 million Euros in the small sample, and 9.3 million Euros in the bigger sample.

Table 2

Summary of Estimates of the VSL in Europe

	All Values	One Observation per Study
Mean	9.340	7.692
Minimum	0.195	0.195
Maximum	119.308	89.377
10 % Percentile	1.058	0.764
25 % Percentile	2.049	1.762
50 % Percentile	4.381	3.983
75 % Percentile	8.051	7.349
90 % Percentile	18.982	14.203

In million Euros (2007).

The average VSL by type of study are displayed in *Figure 2.* The highest average VSL estimates are found in wage risk studies, while contingent valuation studies focusing on health risks and focusing on miscellaneous risks produce the lowest VSL. *Figure 3* presents the mean VSL by country. The estimated VSL are the highest for the UK and Denmark. The majority of VSL estimates is available for Sweden (24) and the UK (27).

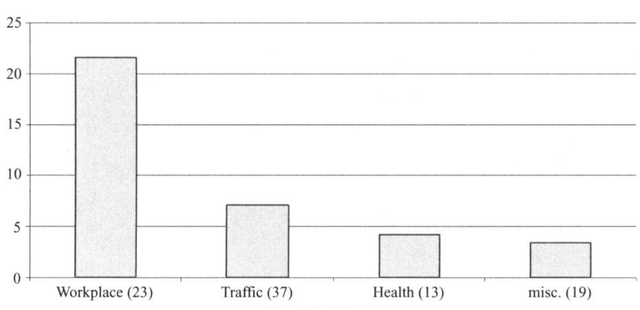


Figure 2: Averaged VSL by Kind of Study

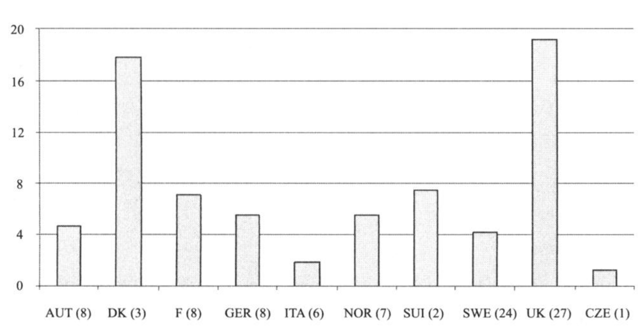


Figure 3: Averaged VSL by Country

We aim at investigating the correlation between the estimated VSL and a set of variables characterizing the studies on which these estimates are based. The variables we consider are delineated in *Table 3.* As shown in the *table,* we first distinguish by type of study. The mean statistics show that the majority of studies (64 per cent) is contingent valuation.

The second set of variables describes the type of risk considered in a study. This includes, for instance, health and environmental risks in contingent valuation studies, and injury risk by occupation and industry in wage-risk studies. We also control if the analysis is restricted to males or to blue-collar workers.

For wage-risk studies, differences in the type of data can be measured. While some of the studies use household surveys or census data, some also use administrative data. Administrative data are more reliable in measuring wage information, but generally cover fewer variables for wage regressions. The empirical estimation of a VSL may or may not control for endogeneity of the risk, and for selectivity of individuals, i.e. whether a specific type of worker self-selects into certain occupations characterized by high fatality risk. The estimation approach may then use a logit or Weibull (see *Leiter/Pruckner* 2006) specification in a contingent valuation study, or a panel regression in wage-risk study.

A further set of variables with which we characterize the VSL studies captures if standard socioeconomic covariates – such as age, gender, education, etc. – are controlled for. In contrast to *Miller* 2000 we do not take the GDP per capita as the variable describing income or wealth, but we use the mean income of the estimation sample of the individual study. We calculate the mean yearly income of observed individuals if some information on wages or income is available. In addition, the age of the individuals is taken into account. If the age is not known, we approximate it using information on educational background and work experience.

We distinguish five types of countries: the United Kingdom, Sweden, Middle Europe (Germany, Austria, Switzerland, and the Czech Republic), Other Scandinavian country (Denmark, Norway), and Western Europe (Italy and France). Furthermore, we divide studies by time period, depending on whether they were conducted the 1970s, in the 1980s, the 1990s, or the 2000s. Finally, we consider the sample size – i.e. the log of number of observations in the study – to approximate the empirical robustness of the study, and we take into account if a study is published in an academic journal. This is the case for almost 60 per cent of the studies we consider.

The variables described above are used as a vector of explanatory variables X in the following regression, which we use to correlate the VSL with study characteristics.

$$ln(VSL) = \alpha + \beta X_i + \epsilon_i \,. \quad (9)$$

We use a log-linear specification to interpret coefficients as the percentage changes in the VSL that they are associated with. Traditional meta-analysis in, for instance, health and medical science often aims at increasing the precision of impact estimates by drawing together data from several (identical) clinical trials to estimate the relationship of key variables and a health outcome. The main advantage of this approach relative to individual studies is the large number of observations. The application of meta-studies in Economics is somewhat different. Here, the aim is to identify a relationship between the particular features of a study and an estimated coefficient.

4. *Results*

Table 4 presents the results of correlating the VSL with the set of variables delineated in *table 3.* Columns (1) and (2) display results of a basic specification for the small and large sample, respectively. Columns (3) and (4) contain our preferred specification including the entire set of covariates. In column (4), the mean risk is included as an explanatory variable, which slightly reduces the number of observations to 80. In the specifications shown in columns (5) and (6) we include age and income information, respectively. Since this information is available for only about half the number of observations in each case, we can estimate their relation with the VSL on a limited set of covariates only.

The results show several interesting patterns. First, and most importantly, the type of VSL study seems to play an important role. Contingent valuation studies estimate significantly lower Values of a Statistical Life than wage-risk studies (base category). The size of the coefficient on "contingent valuation" – e.g.

–2.162 in specification (3) – implies that wage risk studies estimate a VSL that is about 200 per cent larger than that of contingent valuation studies. Similar findings hold for the behavioral studies, though only few are included in the meta data. With respect to the contingent valuation studies, this may relate to a subjective over-estimation of fatality risks in survey data. At the same time, wage-risk studies might produce higher VSL estimates if wage premiums on high-risk jobs compensate workers for other non-desirable job characteristics – that are not measured – as well.

Table 3

Description of the Meta-Analysis Dataset

Variable Name	Definition	*N*	Mean
VSL	Value of a statistical life (2007 Euros, mill.)	94	9.340
Wage-Risk	= 1 if wage-risk study (WR)	94	0.245
Contingent Valuation	= 1 if contingent valuation study (CV)	94	0.638
Behavioral Study	= 1 if behavioral study (BH)	94	0.021
Health Risks	= 1 if health risks are covered in CV	94	0.138
Traffic Risks	= 1 if traffic risks are covered in CV or BH	94	0.404
Environmental Risks	= 1 if environmental risk is covered in CV	94	0.045
Miscellaneous Risks	= 1 if risk different to health, traffic, and environmental in CV or BH	94	0.160
Injury Risk by Occupation	= 1 if the injury risk by occupation is used in WR	94	0.160
Injury Risk by Industry	= 1 if the injury risk by industry is used in WR	94	0.074
Mean Risk	mean/baseline risk in the study	81	0.094
Restricted to Males	= 1 if the sample is restricted to male workers	94	0.191
Restricted to Blue-Collar Workers	= 1 if the sample is restricted to blue-collar workers	94	0.160
Household Data	= 1 if a household survey is used in WR	94	0.074
Census Data	= 1 if census data is used in WR	94	0.043
Administrative Data	= 1 if administrative data is used in WR es	94	0.085
Controls for Endogeneity of Risk	= 1 if it is controlled for the endogeneity of the risk in WR	94	0.053
Controls for Selectivity	= 1 if it is controlled for selectivity into occupations/industries in a WR	94	0.085
Logit	= 1 if a logit regression was applied in CV	94	0.170
Weibull	= 1 if a weibull regression was applied in CV	94	0.074
Panel Regression	= 1 if a panel regression method in WR	94	0.053
Controls for Sex	= 1 if it is controlled for Sex	94	0.564
Controls for Age	= 1 if it is controlled for Age	94	0.596
Controls for Health Status	= 1 if it is controlled for Health Status	94	0.149
Controls for Education	= 1 if it is controlled for Education	94	0.628
Controls for Union	= 1 if it is controlled for Union Status	94	0.117
Controls for Occupation / Industry	= 1 if it is controlled for Occupation/Industry	94	0.106
Controls for Working Time	= 1 if it is controlled for Working Time	94	0.138
Age	mean age of the sample	45	45.02
Income	average yearly income (2007 Euros, thsd.)	42	25.78
1970s	= 1 if the observation period is in the 1970s	94	0.074
1980s	= 1 if the observation period is in the 1980s	94	0.223
1990s	= 1 if the observation period is in the 1990s	94	0.500
2000s	= 1 if the observation period is in the 2000s	94	0.202
France, Italy	= 1 if the observation sample is drawn in France or Italy	94	0.149
UK	= 1 if the observation sample is drawn in the United Kingdom	94	0.287
Sweden	= 1 if the observation sample is drawn in Sweden	94	0.255
Middle Europe	= 1 if the observation sample is drawn in Germany, Austria, Switzerland, or the Czech Republic	94	0.202
Other Scandinavia	= 1 if the observation sample is drawn in Scandinavia	94	0.106
ln (Observations)	log of number of observation in the study	94	6.948
Published in journal	= 1 if the study is published in a journal	94	0.596

Another pattern in the data is that relative to studies from the 1980s (the base category omitted in the regression) studies from other decades find either similar or significantly lower VSL. The latter is true for both the 1970s and the 2000s. This may reflect the fact that in the 1980s incomes in real terms were higher than in the preceding and succeeding decades. Looking at the country in which a VSL study originates, the main significant finding is that VSL estimates from Central Europe (Germany, Switzerland, Austria, Czech Republic) are lower relative to other countries. Regarding sample size and publication in an academic journal, no clear pattern can be observed in the data.

Table 4

Regression Results (Dependent Variable is the Log of the Reported VSL)

	one obs (1)	all obs. (2)	all obs. (3)	all obs. (4)	all obd. (5)	all obs. (6)
Contingent Valuation	–1.838*** (0.469)	–1.756*** (0.409)	–2.162*** (0.281)	–1.516** (0.631)	–2.680*** (0.731)	–2.407*** (0.430)
Behavioral Study	–2.146** (0.793)	–2.433*** (0.810)	–1.977*** (0.233)			
1970s	–1.974*** (0.607)	–1.590* (0.853)	–1.514*** (0.292)	–1.465*** (0.235)	–0.850** (0.377)	–0.642* (0.345)
1990s	–0.738 (0.450)	–0.653** (0.263)	–0.965*** (0.172)	–0.746 (0.447)	–0.136 (0.573)	–0.353 (0.429
2000s	–0.712 (0.504)	–0.466 (0.365)	–1.404*** (0.278)	–1.030** (0.372)	–0.062 (0.333)	–0.555 (0.535)
UK	0.024 (0.572)	–0.240 (0.412)	–0.046 (0.192)	0.473 (0.560)	–0.471 (0.356)	–0.573 (0.369)
Sweden	0.612 (0.566)	0.138 (0.329)	0.153 (0.173)	0.153 (0.153)	0.496 (0.532)	–0.848 (0.851)
Other Scandinavia	0.896 (0.643)	0.317 (0.547)	1.171*** (0.219)	1.110*** (0.175)	1.241** (0.569)	
Middle Europe	–0.894 (0.603)	–1.302*** (0.398)	–1.816*** (0.266)	–0.918 (1.037)	–1.070* (0.536)	–1.163** (0.458)
ln (Observations)	–0.089 (0.094)	–0.025 (0.055)	–0.040 (0.057)	–0.156* (0.090)	–0.245* (0.134)	–0.247** (0.114)
Published in Journal	–0.222 (0.321)	–0.652** (0.262)	0.130 (0.256)	0.442*** (0.117)	–0.827** (0.357)	–1.278** (0.435)
Traffic Risks			0.792*** (0.242)	0.727** (0.344)		
Environmental Risks			0.868*** (0.111)	0.026 (1.029)		
Miscellaneous Risks			0.223 (0.477)	0.793** (0.369)		
Injury Risk by Industry			2.094*** (0.550)	2.234*** (0.346)		
Mean Risk				–0.012 (0.009		
Restricted to males			0.792 (0.679)	0.478 (0.527)		
Restricted to blue-collar workers			–0.691** (0.259)	–0.398 (0.247)		
Census Data			–1.631* (0.920)	–1.149* (0.575)		
Administrative Data			0.121 (0.979)	1.275 (0.921)		
Controls for Endogeneity			1.925*** (0.145)	2.059*** (0.220)		
Controls for Selectivity			–0.357 (0.213)	0.252* (0.146)		
Panel Regression			–0.767*** (0.130)	–1.112*** (0.301)		
Logit			1.282*** (0.210)	0.782*** (0.099)		
Weibull			2.026*** (0.326)	1.775*** (0.310)		
Controls for Sex			–0.831*** (0.185)	–0.184 (0.140)		
Controls for Age			0.658** (0.239)	0.784*** (0.115)		
Controls for Health Status			–0.443** (0.171)	–0.328** (0.145)		
Controls for Education			1.651*** (0.255)	1.532*** (0.149)		
Controls for Union			–1.446* (0.815)	–0.359 (0.891)		
Controls for Industry Occupation			–0.225 (0.237)	–0.802*** (0.208)		
Controls for Working Time			–0.560* (0.318)	–0.788*** (0.221)		
Age					0.009 (0.028)	
Income						–0.010 (0.015)
Constant	4.100*** (0.949)	4.102*** (0.624)	2.716*** (0.303)	2.094*** (0.470)	5.518*** (1.314)	6.782*** (0.923)
R-squared	0.708	0.381	0.594	0.548	0.423	0.440
N	34	94	92	80	45	42

Clustered standard errors in parentheses.

*** Significant at the 1 % level; ** significant at the 5 % level; * significant at the 10 % level.

If we further consider specifics of the study – columns (3) and (4) – it is interesting to note that studies focusing on traffic and environmental risks yield higher VSL estimates than studies focusing on health risks (base category). This finding, again, seems plausible if the perception of risk is subjective: Health risks often appear much more part of everyday life and an aspect that individuals are "naturally" used to, whereas traffic and environmental risks – e.g. the absence of speed limits and the construction of a nuclear power plant – appear more threatening. In wage-risk studies, if the injury risk by industry is used rather than the injury risk by occupation, this is associated with a significantly higher VSL. This may reflect the fact that a classification by industry gives a better indication of fatality risks.

Controlling for the endogeneity of risk – i.e. the extent to which risk may be influenced by the wage through individual behavior – also seems to play an important role in empirical VSL estimates, as including such a control is associated with a higher VSL. In general, if only few socioeconomic characteristics are included as controls, this tends to an upward bias in VSL estimates, as inclusion of most of the variables we consider here (sex, health status, union membership, etc.) is associated with a lower outcome.

Finally, looking at the age and income variables in columns (5) and (6), no significant relationship with the VSL estimate is identified. This, however, may be due to the substantially smaller sample size for these specifications.

5. Conclusion

In this article, we give a systematic review of the available estimates on the Value of a Statistical Life in Europe, an exercise that has so far been conducted for the US only. Such a review is of particular interest because the public policy concerns that the VSL helps to assess arise in similar ways across countries: Indeed, investigating the costs and benefits of attributing scarce societal resources to life-saving activities is a relevant issue in all European countries.

Our meta-analysis covers 94 estimates of the VSL originating in 37 individual studies, most of which are either contingent valuation studies or wage-risk studies. The countries most frequently analyzed are Sweden and the UK. While the estimated VSL cover a broad range from around 200,000 Euros to about 120 million Euros in current values, most studies are in a fairly narrow range of between 2 and 14 million Euros. In particular, the average of 9.6 million Euros is directly comparable to values established for the US in previous meta-analyses.

Our quantitative analysis correlates the VSL outcomes with an extensive set of variables characterizing the individual studies. Several interesting patterns emerge from the empirical results. First, controlling extensively for socioeconomic factors seems to lower VSL estimates, and the general economic situation regarding real income (captured by the decade) seems to be reflected in VSL analyses as well.

Most importantly, wage-risk studies tend to find significantly higher VSL estimates than contingent valuation studies. Studies based on health risks estimate lower VSL than those based on traffic and environmental risks. Both findings likely have to do with the subjective perception of fatality risks that enters into contingent valuation studies: The first result may be due to the fact that survey respondents likely overestimate fatality risks in everyday life, mostly because very small probabilities are difficult to appraise. The difference between a fatality risk of 0.0001 and 0.00001 is hard to evaluate for the individual, but has a substantial effect on the corresponding VSL.

The second result relates to individuals' perception of whether a regulation reduces risks in an apparent way. To ban people from driving at 150 mph or to prohibit the construction of a nuclear power plant very clearly reduces fatality risks in the affected population. Introducing regulations on preventive medical checkups to decrease cancer rates, for instance, has less obvious effects, since becoming ill is much more perceived as an exogenously determined "fate" rather than a risk that can be influenced by individual action and policy regulations. Public policy should therefore take into account that the life-saving benefits of certain regulations – such as preventive medical care – are likely systematically underestimated in the public view.

The more objective VSL estimates in this sense are therefore derived from wage-risk studies, which are based on the compensating wage premium that individuals are offered for taking risky jobs. Wage-risk studies are therefore important to inform policy makers about the market-determined benefits of fatality risk reductions, an information that can help make the cost-benefit analysis of public policy regulations more balanced.

References

Alberini, A. / *Chiabai*, A. (2005): Urban Environment Health and Sensitive Populations: How Much are the Italians Willing to Pay to Reduce Their Risks? (Working Paper 105.2005). Milano.

Alberini, A. / *Hunt*, A. / *Markandya*, A. (2006): Willingness to Pay to Reduce Mortality Risks: Evidence from a Three-Country Contingent Valuation Study. Environmental and Resource Economics 33, 251–264.

Alberini, A. / *Ščasný*, M. / *Braun Kohlová*, M. / *Melichar*, J. (2004): The Value of a Statistical Life in the Czech Republic: Evidence from a Contingent Valuation Study. In: M. Ščasný / J. Melichar (Eds.), Development of the Czech Society in the European Union. Part V: Nonmarket Valuation Methods in Environmental Area. (p. 373–391). (Praque, Matfyzpress, Charles University Environment Center.

Andersson, H. (2005): The Value of Safety as Revealed in the Swedish Car Market: An Application of the Hedonic Pricing Approach. The Journal of Risk and Uncertainty, 30(3), 211–239.

– (2006): Willingness to Pay for Road Safety and Estimates of the Risk and Death (Working Paper). Solna, Sweden.

Arabsheibani, G. R. / *Marin*, A. (2000): Stability of Estimates of the Compensation for Danger. Journal of Risk and Uncertainty, 20(3), 247–269.

Baranzini, A. / *Ferro Luzzi*, G. (2001): The Economic Value of Risks to Life: Evidence from the Swiss Labour Market. Schweiz. Zeitschrift für Volkswirtschaft und Statistik, 137(2), 149–170.

Barone, A. / *Nese*, A. (1996): Rischio Sul Lavoro E Premio Salariale In Italia (Working Paper). Napoli.

Beattie, J. / *Covey*, J. / *Dolan*, P. / *Hopkins*, L. / *Jones-Lee*, M. / *Loomes*, G. et al. (1998): On the Contingent Valuation of Safety and the Safety of Contingent Valuation: Part 1 – Caveat Investigator. Journal of Risk and Uncertainty, 17(5) 5–25.

Bellavance, F. / *Dionnes*, G. / *Lebeua*, M. (2006): The Value of a Statistical Life: A Meta-Analysis with a Mixed Effects Regression Model (Working Paper). Montreal.

Bellmann, L. (1994): Entlohnung als Risikokompensation. Mitteilungen aus der Arbeitsmarkt- und Berufsforschung, 27(4), 353–358.

Carthy, T. / *Chilton*, S. / *Covey*, J. / *Hopkins*, L. / *Jones-Lee*, M. / *Loomes*, G. et al. (1999): On the Contingent Valuation of Safety and the Safety of Contingent Valuation: Part 2 – The CV / SG „Chained" Approach. Journal of Risk and Uncertainty, 17(3), 187–213.

Day, B. (1999): A Meta-Analysis of Wage-Risk Estimates of the Value of Statistical Life (Working Paper). University College London.

Desaigues, B. / *Rabl,* A. (1995): Reference Values for Human Life: An Econometric Analysis of a Contingent Valuation in France. In: N. S. Christe / N. Soguel (Eds.), Studies in Risk and Uncertainty - Contingent Valuation, Transport Safety and the Value of Life (pp. 85 – 111). (Boston: Kluwer Academic Publishing).

Drèze, J. H. (1962): L'Utilité Sociale d'une Vie Humaine. Revue Française de Reserche Opérationelle, 6, 93 – 118.

EUROSTAT (2008a): Exchange Rates. http: // epp.eurostat.ec. europa.eu.

– (2008b): Prices. http: // epp.eurostat.ec.europa.eu.

Ghosh, D. / *Lees,* D. / *Seal,* W. (1974): Optimal Motorway Speed and some Valuations of Time and Life (Working Paper). University of Nottingham.

Gyrd-Hansen, D. / *Halvorsen,* P. A. / *Kristiansen,* I. S. (2007): Willingness-To-Pay For a Statistical Life in the Times of a of a Pandemic. Wiley InterSciene.

Hintermann, B. / *Alberini,* A. / *Markandya,* A. (2006): Estimating the Value of Safety with Labor Market Data: Are the Results Trustworthy? (Working Paper). Milano.

Hultkrantz, L. / *Lindberg,* G. / *Andersson,* C. (2006): The Value of Improved Road Safety. Journal of Risk and Uncertainty, 32(2), 151 – 170.

Johannesson, M. / *Johansson,* P.-O. / *Löfgren,* K.-G. (1997): On the Value of Changes in Life Expectancy: Blips Versus Parametric Changes. Journal of Risk and Uncertainty, 15, 221 – 239.

Johannesson, M. / *Johansson,* P.-O. / *O'Conor,* R. M. (1996): The Value of Private Safety Versus the Value of Public Safety. Journal of Risk and Uncertainty, 13, 263 – 275.

Jones-Lee, M. (1976): The Value of Life: An Economic Analysis (Working Paper). Chicago: The University of Chicago Press.

Jones-Lee, M. W. / *Hammerton,* M. / *Philips,* P. (1985): The Value of Safety: Results of a National Sample Survey. The Economic Journal, 95, 49 – 72.

Kenkel, D. (2003): Using Estimates of the Value of a Statistical Life in Evaluating Consumer Policy Regulations. Journal of Consumer Policy, 26, (1), 1 – 21.

Kidholm, K. (1995): Assessing the Value of Traffic Safety Using the Contingent Valuation: Technique : The Danish Survey. In: N. S. Christe / N. Soguel, (Eds.), Studies in Risk and Uncertainty, (pp. 45 – 61). (Boston: Kluwer Academic Publishing).

Leiter, A. M. / *Pruckner,* G. J. (2006): Proportionality of Willigness to Pay to Small Risk Changes - The Impact of Attitudinal Factors in Scope Tests (Working Paper). Milano.

Lorenz, W. / *Wagner,* J. (1988): Gibt es kompensierende Lohndifferentiale in der Bundesrepublik Deutschland? Zeitschrift für Wirtschafts- u. Sozialwissenschaften, 108, 371 – 381.

Maier, G. / *Gerking,* S. / *Weiss,* P. (1989): The Economics of Traffic Accidents on Austrian Roads: Risk Lovers or Policy Deficit? Empirica – Austrian Economic Papers, 16(2), 177 – 190.

Marin, A. / *Psacharopoulos,* G. (1982): The Reward for Risk in the Labor Market: Evidence from the United Kingdom and a Reconciliation with Other Studies. The Journal of Political Economy, 90(4), 827 – 853.

Melinek, S. J. (1974): A Method of Evaluating Human Life for Economic Purposes. Accident analysis and prevention, 6, 103 – 114.

Melinek, S. J. / *Woolley,* S. K. / *Baldwin,* R. (1973): Analysis of a Questionnaire on Attitudes. Fire Research Note (962), 1 – 25.

Miller, T. R. (2000): Variations between Countries in Values of Statistical Life. Journal of Transport and Policy, 23(2), 169 – 188.

Needleman, L. (1980): The Valuation of Changes in the Risk of Death by Those at Risk. The Manchester School of Economic & Social Studies, 48, 229 – 254.

Persson, U. / *Cedervall,* M. (1991): The Value of Risk Reduction: Results from a Swedish Sample Survey (IHE Working Paper 1991:6). Lund University.

Persson, U. / *Norinder,* A. / *Hjalte,* K. / *Gralén,* K. (2001): The Value of a Statistical Life in Transport: Findings from a New Contingent Valuation Study in Sweden. The Journal of Risk and Uncertainty, 23(2), 121 – 134.

Pratt, J. W. / *Zeckhauser,* R. J. (1996): Willingness to Pay and the Distribution of Risk and Wealth. Journal of Political Economy, 104(4), 747 – 763.

Sandy, R. / *Elliot,* R. F. (1996): Unions and Risk: Their Impact on the Level of Compensating for Fatal Risk. Economica, 63(250), 291 – 309.

Schaffner, S. / *Spengler,* H. (2007): Using Job Changes to Evaluate the Bias of the Value of a Statistical Life (Discussion Paper). RWI Essen.

Spengler, H. (2004): Kompensatorische Lohndifferenziale und der Wert eines statistischen Lebens in Deutschland (Discussion Paper). Darmstadt.

Viscusi, W. / *Aldy,* J. E. (2003): The Value of a Statistical Life: A Critical Review of Market Estimates Throughout the World (NBER Working Paper No. 9487), Cambridge.

Viscusi, W. K. (1993): The Value of Risks to Life and Health. Journal of Economic Literature, 31, 1912 – 1946.

Weiss, P. / *Maier,* G. / *Gerking,* S. (1986): The Economic Evaluation of Job Safety. Empirica, 13(1), 53 – 67.

Zhu, W. (2003): Valuation of life: a study using discrete choice analysis (Working Paper 2004:3). Ragnar Frisch Centre for Economic Research.

Buchbesprechungen

Althammer, Jörg / Andersen, Uwe / Detjen, Joachim / Kruber, Klaus-Peter (Hrsg.): Handbuch ökonomisch-politische Bildung, Wochenschau-Verlag, 1. Auflage, 2007, 525 S.

Mittlerweile besteht weitgehender Konsens: Ökonomische Grundbildung ist notwendiger Bestandteil einer zeitgemäßen Allgemeinbildung, die auch vermehrt in der Schule zu vermitteln ist. Die hier versammelten – von Hochschuldozenten verfassten – Grundlagenaufsätze zu volkswirtschaftlichen und wirtschaftspolitischen Fragen bieten dieses Grundlagen- und darüber hinaus gehende Wissen. Sie bestechen zudem durch ihre didaktisch ausgerichtete Darstellung. Der gesamte Stoff der wirtschafts- und sozialpolitisch relevanten ökonomischen Bildung wird weitgehend ohne formalen Ballast vorgestellt. Alle politikrelevanten Aspekte der Volkswirtschaftslehre inklusive der Schnittstelle zu wirtschaftlichen Fragestellungen in der Politikwissenschaft werden behandelt. Nach einer ordnungspolitischen Grundlegung des Systems der Sozialen Marktwirtschaft wird in mikroökonomische Aspekte der Marktpreisbildung eingeführt. Im Anschluss stehen die wichtigsten wirtschafts- und sozialpolitischen Fragestellungen auf dem Programm: Geld und Währung, Wachstum und Wirtschaftsstruktur, Beschäftigung, Verteilung und Sozialpolitik, Umweltpolitik und Finanzpolitik. Breiten Raum widmet der Band ebenfalls der Einführung in die Grundfragen der Außenwirtschaft sowie der Erörterung der Folgen der Globalisierung und der Rolle der Weltwirtschaftsordnung bei der Lösung grenzüberschreitender Probleme. Multiplikatoren, Praktiker und Studierende können das Buch nicht zuletzt mit großem Gewinn lesen, da für jeden Problembereich auch die fachdidaktischen Zusammenhänge und mögliche alternative Betrachtungsweisen des jeweiligen Bereiches sehr ver-