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Lives in the hands of economists: a critical review of the main methodologies used to derive the value of a statistical life

Abstract

This paper aims at describing the notion of the value of a statistical life and its use for conducting cost-benefit analysis relevant to policies that affect health and safety. The distinction between statistical and identified lives is discussed, and the common methodologies for valuing a statistical life are critically presented. It is argued that moral issues aside, there is also a series of technical and conceptual problems that relate to the valuation of a statistical life. The implication of this assertion is that, although cost-benefit analysis may generate insightful results, their policy suggestions should by no means be conclusive – especially when safety is at stake, and that various exogenous considerations should also be taken into account.

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JEL Classification: Q50, D01, D61, I10.

Introduction

Among the priceless things in life, the most prominent one has to be life itself. Not only people are generally unable to name a value for their own lives or the life of somebody else, but they are also repulsed with the very idea, feeling that the task is too morbid or awesome to consider. The consensus seems to be that death, being the end of everything, is an event that virtually nobody (some special cases excluded) would consciously consent to, no matter how much they would possibly be paid for it.

Considering life as priceless generates an anomaly for neoclassical economics: use of expected utility theory implies that rational individuals would never engage in an action that would increase, even marginally, their probability of dying; for if the utility from death is taken to be infinitely negative (a consequence of life being assumed as priceless), any lottery that would incorporate a risk of death with no matter how small a probability would be valued at ∞ too. Thus, any other lottery that would not include such an outcome would be preferrable. This would mean, for example, that individuals would never accept even slightly risky jobs no matter the wage offered, or that they would never rationally choose to smoke a cigarette, drink alcohol, have a meal in a fast-food restaurant or ride the roller coaster in the local amusement park. Because the multitude of people who actually do these things cannot all be irrational, it seems that the risk of death does carry a price, no matter how technically hard it may be to determine.

The reason why it is interesting to assign some real number to that price is that, in economics, the value of life is an essential element for conducting cost-benefit analyses on policies and regulations relevant to health and safety. For prevention of accidental deaths or a decrease in fatal risks encountered in some specific context may imply vast expenditures, knowledge of the value of life is decisive on whether these expenditures should be undertaken or not. Since, however, considering life as a commodity proper violates moral rules inherent in humans, economists stress that such calculation is acceptable only ex ante, when the fatal risk targets nobody in particular, but remains a statistical figure. This means that valuation of life does not refer to identified lives, but to "statistical lives" – to anonymous persons whose lives may or may not be at stake, and who cannot be known to be at risk beforehand, not until they are actually affected by that risk, if it so happens.

The aim of this paper is to offer a discussion on the valuation of statistical life in economics. Although, it is mainly a review paper, its contribution is not restricted to surveying the relevant literature; primarily, its contribution lies in the critical and comparative presentation of the main methods used for measuring the value of a statistical life (VSL hereafter), as well as in the offering of a discussion on the implications of these method's limitations. As it is argued in the next Sections, some of these limitations are linked to deeper problems within economic theory, and more specifically, to the axiomatic definition of the rational individual as a utility-maximizing agent.

The shortcomings of the methods used to measure VSL have been discussed in several papers in the literature. Among the most recent ones, Ashenfelter (2006) and Viscusi (2008) place the focus on trade-offs between money and fatal safety risks, Guria et al. (2005) explore inconsistencies in individuals' stated preferences, and Becker (2007) offers an insightful discussion on health as human capital. Our approach is more general and theoretical, to encom-

pass all prominent methods, and to provide a link between the methods' shortcomings and those of rational choice theory.

The methodology used in this paper focuses on the theoretical issues of the most common methods for evaluating a statistical life, and not too much on their technical aspects. Before this presentation, we offer a discussion on the distinction between actual and statistical lives (Section 1), in order to clarify what these methods attempt to measure and to juxtapose with what they actually measure. Section 2 continues with the comparative analysis of the main VSL methods. We distinguish between two classes of methods: the human capital approach (Section 2.1) and the willingness to pay approach (Section 2.2). The latter is further distinguished into two categories: hedonic valuations (Section 2.2.1) and contingent studies (Section 2.2.2). Finally, Section 3 concludes with a discussion on the emerging practical, philosophical and ethical problems, and suggests that, because cost-benefit analysis using VSL present limited validity, their use in policy making with regards to safety and health should not be conclusive, but rather, complementary to exogenous and ad hoc considerations.

1. Life through statistics

There are two ways in which a statistical life can be understood (Heinzerling, 2000). Firstly, a statistical life is a real (but unidentified) life expected to be lost (or saved) as a function of probabilities of death, applied to a population of persons, and after the assessment of risk data available. A simple example would be an expectation, based on past data, that in the next *x* years, there will be *y* fatalities due to train accidents. Naturally, a prediction like this may or may not come to be confirmed, and this is why these lives are referred to as "statistical" (as opposed to "actual"). Another interpretation is that a statistical life is an aggregation of fatal risks that threaten individuals in a population; for example, an estimated fatality risk of 1/100 in a population of 1,000 means the loss of ten statistical lives, and decreasing this risk to 1/1,000 means that nine statistical lives shall be saved. In this regard, "statistical life" is a measure of collective risk affecting a population.

A statistical life is understandably very different from an actual life, in both theory and practice; the statistical life is an abstract concept, much closer to a probability of some risk than the life of a real person, and as such, it cannot prompt feelings of moral duty, awe, or sympathy, at least not to the degree an identified life can. For a telling example, one could think of the difference between earthquake victims trapped alive under ruins and individuals, whose houses put them at fatal risk if an earthquake occurs. People would generally be more willing to provide help to the former than to the latter, since the former are identified as actual victims, while the latter are potential, "statistical" victims. It is as if the uncertainty regarding the statistical life somehow removes some weight off it, making it less valuable than a life proper.

Except for uncertainty, another feature of the statistical life that allegedly makes it less valuable than an actual life is the issue of unidentifiability. It seems that an identified victim generates stronger reactions of altruism and care than an anonymous one, which can be explained on the grounds that people generally feel more connected when they know who is the victim. Indeed, there are numerous researchers to support this conjecture, for example, Charness and Gneezy (2000) and Small and Loewenstein (2003). In both studies, subjects in a laboratory experiment playing the dictator game were more generous when they had some information on their co-players than when they had none at all. The writers conclude that determined victims possibly provide more salient reasons to act, for identifiability diminishes psychological and social distance. The less the social distance, to more one is made willing to help, which means that the "more identified" the victim is (that is, the more information available on them), the more the public is expected to want to help them.

Nevertheless, in a subsequent article, Small and Loewenstein (2005) show that identifiability can have other effects too (like, creating a tendency for punitiveness), depending on the available information on the target to what extent people will be affected by someone, being a victim, is contingent on the characteristics of the victim themselves. This last point is best illustrated by Heinzerling (2000) who gives the example of people generally being indifferent towards a homeless person they see in the streets, even if "it is hard to imagine a more clearly identified person in need". The conclusion is that identifiability of a victim plays a role in altering people's reactions towards them, even if this may not always be for the better. How one's perception and psychological response shall be formulated seems to depend on the traits the identification shall bring forward. For a simple but illustrative example, people may be more willing to help a young or good-looking person than an older or less good-looking one, even when the victims are identified to equal degrees.

This ambiguity with regards to how people react towards identified and unidentified victims implies

an uncertainty as to whether an identified life is always valued more than an unidentified one. And even if it could be proved that a statistical life is always less significant (as evaluated by people themselves) than an actual life, this should not necessarily mean that the latter is priceless, while the former is not. It appears that the difference between an actual and a statistical life which enables economists to proclaim the former as priceless and to monetise the latter is not an empirical or theoretical fact, but rather, a theoretical decision that serves a moral code, saying that it is unacceptable to treat actual lives as commodities, but it is adequate to attach a price to statistical lives.

Although such theoretical decision makes sense, it remains arbitrary, in the same way that economics arbitrarily bans interpersonal utility comparisons: it has been argued (Varoufakis, 1998) that not allowing for interpersonally utility comparisons relieves economics of many moral dilemmas and leads towards a "neutral" economic theory. Similarly, axiomatically disallowing the monetisation of an identified life excludes unpleasant implications of the sort that an economic agent would be entitled to take somebody else's life if they paid the corresponding price. Nevertheless, dealing with statistical lives only does not resolve all moral issues, if the statistical life is commodified then, for example, and in a reasoning analogous to the above, an economic agent would be able to buy the right to take away one life at random with some positive probability.

The main point of this discussion is that, axiomatically allowing for valuation of statistical lives as a proxy for actual ones only partly removes the moral issues attached. Still, if one wants to conduct a cost-benefit analysis relating to matters of health and safety, one inevitably will have to use some price, so, it is helpful that the distinction is made at all. If the whole cost-benefit analysis is justifiable in these regards is a different matter, and one we will briefly discuss in Section 3. Before that, the Section that follows presents how VSL is actually performed and what further problems may emerge because of the methodologies chosen.

2. Methods for estimating the value of a statistical life

In theory, VSL could be calculated by asking all individuals within the population to place their valuations, and then by computing the average, using whatever weights one would find appropriate. Obviously, the main problem of such an imaginary approach is that most individuals would simply not know how to respond to such a query, and the primary reason for that is that the loss of a life (even if it is statistical) is too complex an event to be captured in one and only number.

Indeed, the loss of a statistical life has a variety of consequences, some of which are quite easy to be expressed in monetary terms, while some others are not. Schelling (1968) makes the distinction between one's life and one's livelihood, the latter referring to the material losses associated with death (such as the loss of working potential), which are generally possible to compute with objectivity, as being marketable. But on the other hand, there is an array of other implications (like grief or pain) which are hard to quantify and be added up to the cost of life as it would appear in an accountant's book. The prominent method of VSL, which is based on individuals' willingness to pay for small changes in fatality risks that affect them, surpasses the inconvenience in a manner similar to how rational choice theory circumvents the issue of one-dimensional utility: it uses individual choices (either intended or already made) as revelatory for preferences. Another common method, the human capital approach, deals with the problem of non-marketable aspects of life by ignoring them completely.

2.1. The human capital approach. The human capital (HC hereafter) method of valuing life is based on the assumption that the loss of a life only amounts to the loss of livelihood, that is, to the corresponding future production potential (Landefeld and Seskin, 1982). The main task comes down to the calculation of the present discounted value of expected labour earnings, although, there are numerous contributions in the literature to have enriched the method with additional considerations, aiming to make the computation more accurate. For example, some studies deduct expected consumption from expected wages, others incorporate taxation, and most of them include some value for housekeeping activities. The resulting figure is supposed to reflect the value of a life from society's perspective, being nothing more than an estimate of how GNP shall be altered by one fatality.

Even if livelihood was all that mattered about life, the HC approach would still be unavoidably generic, and rather loose with regards to its results: the valuation, it makes, is inevitably based on a series of assumptions, for example, there are no "shocks" in consumption or changes in income, or that the discount rate remains fixed throughout the years of calculation. Of course, it would be technically easy to make fuller HC models to allow for such changes, but this would not make sense as an ex ante procedure. Generally, there would be no good reason why the model should, for example, incorporate a random income shock in T years from now, or use a

changing discount rate rather than a fixed one). For this reason, the HC method provides a proxy for the value of livelihood, but sometimes its too simple premises render its accuracy debatable.

On the other hand, this simplicity of the HC method seems to be its greatest advantage: the value for statistical lives generated by HC estimates fails to cause moral objections (at least to the degree other methods do) because, by definition, it is a neutral display of accounting and simple algebra. It is, in fact, so neutral that it does not apply to anyone in particular but to the "ideal" individual, whose income is given and unchanged for the rest of their lives, whose consumption streams are constant, who will retire at exactly the predicted moment and pass away exactly at the age given by life expectancy statistics, with nobody missing them when they are gone. That aside, another virtue of the method is the clarity in its concept and its uncomplicated mathematics, as well as the indisputable character of its results – the features that the HC technique owes its popularity to. Starting with the same data on labour force participation and projected earnings, two different researchers will arrive at the same valuation, provided that they use the same discount rate.

Choice of a discount factor is a decision of major importance, and one that is also crucial for the whole framework of cost-benefit analysis as well. As the results provided by the HC approach are functions of the discount rate to be used, it is obvious that, if there is no pre-set value for the discount rate upon which everyone agrees, the valuations of livelihood will vary within sizeable ranges along with the different rates of discount. This observation strongly challenges the objective character of the method, especially if one considers that some researcher favouring a specific outcome might be able to choose the rate that shall so produce it. To overcome the problem, researchers usually perform sensitivity analyses (Berk et al., 1978). Arrow et al. (1996) suggest the use of a variety of discount rates, ideally to be the same across different analyses, also stressing the need for external reviews of the corresponding conclusions.

Another discrepancy of the HC technique relates to the fact that the input it requires violates, to a degree, the notion of a statistical life: the unknown and unidentified targets are not completely anonymous, for there is a substantial amount of information acquired about them – their age, their income or their consumption. Along with this point, the HC approach has several unpleasant implications; for example, if computed for a retired person, the value of life is found to be negative (and as such, the strict cost-benefit analysis would instruct society to dispose of the said individual). Also, someone with a higher wage would be valued more than someone with a lower wage (ceteris paribus), which is an unsettling implication, not only from a moral point of view, but also because this seems to violate incomparability of interpersonal utilities. To its defense, HC was never meant to be egalitarian or appeal to moral sentiment: all, it calculates, is the material costs of someone dying and nothing else. Thus, if the value of a life of a businessman turns out to be greater than that of a worker, that is only because the death of the former affects GNP more. Up to this point, the logic is well understood, and perfectly reasonable; however, to use these values for deciding on health regulation requires a great logical leap that remains unjustified and unaccounted for.

It appears that, while the HC approach results in an objective and irrefutable valuation on some components of life, it is largely inadequate as a number to reflect the value of a statistical life, for it ignores other components that are too important (both practically and theoretically) to just forgo. Adopting the HC methodology means that life is not but a stream of assets – a view that clearly diminishes the nature of life, as conceived by individuals. Notwithstanding its usefulness in assessing the material side of life, the HC method remains irrelevant to give a credible indication of what the value of life really is and what it really means for society – and not just for its accounting books. For these reasons, even if it might still be used in certain contexts (for example, by insurance companies), the technique is considered to be outdated, having being replaced by the alternatives presented in the next subsection.

2.2. Willingness to pay. Rather than trying to theoretically assess the statistical life with a computational method, if the task is to capture how life is truly valued by individuals, it makes sense to try and extract that number from them directly. The willingness to pay method (WTP) is an attempt to perform VSL based on individual preferences with regards to the money they would be willing to spend or that they have already spent for a specific decrease in some risk. There are two different classes of methodologies: hedonic studies use data already available from existing markets; the underlying preferences are supposed to reveal risk-money trade-offs implicitly (or explicitly) made by economic agents. In contingent valuation studies, individuals are asked to place ex ante valuations (for example, by use of questionnaires), after considering imaginary scenarios of risk-money trade-offs. These two approaches are often referred to as re-

vealed preference (RP) and stated preference (SP) methods, respectively.

2.2.1. Hedonic valuation. The hedonic approach uses existing markets as proxies for the value of fatality risks. Commonly, researchers use data from the labour market (a description of the methodology and a detailed review of empirical data from various such studies appears in Viscusi and Aldy, 2003). There are also numerous studies that use data from commodity markets, involving risk-money or risk-time trade-offs. For example, Ashenfelter and Greenstone (2004) consider individual choices about road safety by investigating the speed with which agents choose to drive on highways vs. the corresponding risk that their choices entail. Dreyfus and Viscusi (1995) examine road safety too, by regressing car purchase prices on the safety they provide, while Jenkins et al. (2001) examine the purchase of bicycle helmets. To construct a hedonic model, consideration of any marketable product or service that entails some – however small – fatal risk is apt for the analysis, like the market for cigarettes (Ippolito and Ippolito, 1984) or the market for houses near hazardous waste site areas (Gayer et al., 2000).

The rationale of the approach is straightforward: any market-based choice made by an individual reveals an implicit or explicit preference of risk that can be quantified. A worker accepting a job with some risk p that offers wage W is assumed to be compensated for undertaking that risk, otherwise they would demand a higher wage or look for a safer job. Consumers buying cars are not just buying means of transportation but a whole bundle of goods, some of which are related to safety. If some of the car's components did not interest the consumer, they would opt for a cheaper car and, therefore, the fact that, for example, consumer i chose a car with an airbag at cost c rather than a car with no airbag that would cost $c' < c$ means that, ceteris paribus, the consumer values the reduction of risk offered by the airbag at $c - c'$ or more. In some other cases, the calculation is even simpler when risk preferences are revealed directly, for instance, by actions like the purchase of additional cigarette filters, smoke detectors or private security services.

It is not surprising that this approach is subject to all the criticisms that may apply to neoclassical economics and rational choice theory. To rely on market choices in order to compute the cost of some fatal risk presupposes confidence in that individual preferences are consistent, and more radically, that rational individuals act on the sole purpose of maximising what is on the top of their preference lists, subject to their budget constraints (a theoretical view on rationality often referred to as 'act utilitarianism').

Both these premises are often believed to be inadequate for describing individual behavior (for example, Sugden, 1991). Act utilitarianism gets often contrasted with "rule utilitarianism" (for a detailed comparison, see Harsanyi, 1985), which provides an alternative explanation for human behavior that does not always agree with the neoclassical view. For example, someone accepting a hazardous job as a fireman[1] may not consider at all the risk encountered with regards to the wage offered (they may even find the job downright ineffective in strictly monetary terms), but still think of the occupation as worthwhile because of its social and moral tenure. The consistency of preferences has also been questioned: the Allais and the Ellsberg paradoxes (Allais, 1953; Ellsberg, 1961) are standard (counter) examples; more recently, the behavioralists' school of thought have effectively argued that individuals are not really consistent in the market choices they make. For example, in the context of VSL, an individual's preference over wearing their seatbelt may imply a certain value for risk, but the wage this very individual accepts for their job may imply a different value for it. In this regard, the phenomenon of smoking is in itself a paradox (Schelling, 1978), if people actually spend money to increase a fatal risk rather than decrease it.

Criticisms related to rational choice theory are not the only reasons why hedonic methods may fail to determine an objective value for statistical life. Another issue of critical importance is whether individuals have perfect information or not. To accurately be able to calculate someone's valuation of risk from one's market choices, it is implied that the exact risk to be encountered is acknowledged and taken into consideration. But more often than not, this assumption fails to apply: people typically do not know exactly in how much danger they are if they do not wear their seatbelts, they might deliberately forget the increase in risk when lighting up another cigarette or may be in ignorance of the full dangers that can happen on the job. Thus, what is truly revealed by this method is the valuation of risk as subjectively perceived by the individual, if, of course, considered at all.

This does not mean that risk data are unavailable per se. Of course, in many instances, economic agents can plausibly be believed to remain unaware of the risks they encounter (for example, workers typically do not know exactly how many fire distinguishers

[1] Example is taken from Anderson (1993).

are installed in the workplace), but because this information can generally be obtained (unless someone else has an incentive to hide it), the real problem is often not so much one of ignorance, but of correct interpretation of risk data. It is argued that, people are unable to understand or deal with very small numbers, as the changes in risks to be considered typically (Schelling, 1968), which means that even if individuals do their best to be consistent, they may show more willingness to eliminate a 1/10,000 risk than a 5/40,000 risk, simply because there is a chance that they will fall short of comparing the two numbers correctly. Even if these risks are evaluated correctly, their difference is so small that it might not have any particular meaning for the individuals making the calculation.

Another issue pertaining to hedonic methods is that of their relevance: the revealed willingness to pay may not reflect the individuals' true valuation for safety but a proxy for its lower bound. When someone pays an extra cost for a car with an airbag means that this individual values the decrease in risk at least what they paid for it. They might as well pay more, if the car was more expensive. On the one hand, budget constrained individuals, who would normally be willing to spend some amount of money for protection, are expected to spend less than they would want to, and therefore, their market choices do not say much about these persons' true valuation of safety. On the other hand, wealthy persons can afford to spend more for eliminating risk, and in some cases, they may even purchase extra safety as a luxury, leading again to a misleading revelation of their true preferences with regards to risk. These observations imply that the level of wealth is unavoidably an additional factor that has to be taken into account while conducting hedonic methods.

The relevance of hedonic methods is further questioned when one considers that these methods are likely to circumvent the distinction between an identified and a statistical life. When the reduction in risk is to be privately enjoyed, then the revealed valuation is not so much that of a statistical life but of the economic agent's own. For example, the value of risk implied by someone's contribution to fund public security services is not comparable to the value implied by the same individual's choice on what to spend on a car with an airbag: poor public security affects all members within a society, but an unavailable airbag affects a very much identified driver. Therefore, the corresponding choices do not reveal valuation of the same thing. The choices agents make usually refer to their own lives (and not to "statistical people"), and for this reason, the revealed values should be taken as approximations for the value of the statistical life that the method seeks to compute. The same conclusion emerges if one acknowledges that market choices may incorporate interpersonal factors (Viscusi, 1993; Strand, 2003), which generally implies an upward bias in the revealed valuations of life. For example, someone would be willing to pay more for additional security on the job than on their own home, because of feelings of altruism towards their colleagues. This would mean that the valuations would appear to be higher than they should be, for a fraction of each worker's valuation would already be reflected in the valuations of others.

As hedonic methods often use data from labour markets, a lot of attention has been given on whether the estimates generated from information on wage contracts are accurate. Except for the reasons mentioned above (like inconsistency in preferences or incomplete information), Chapter 9 of Anderson (1993) provides an insightful discussion on why the method may fail to provide a meaningful value for statistical life. One prominent argument is that the studies in question would reveal what workers are willing to pay for reductions in risk, provided that the underlying choices were free, informed and autonomous. But it's not uncommon for workers to choose a job they consider to "pay badly", only because they have no other option. To assume that workers not feeling compensated enough for the risks they bear, can freely (or at least, easily) choose another job, having a more favourable risk/wage ratio, is an arbitrary hypothesis that fails to always apply. Additionally, the labour market is typically not perfect: if there is high demand for jobs but not enough supply then employers have an incentive to give the jobs to the less risk-averse. Thus, the danger of unemployment will make the more risk-averse agents engage in unwanted contracts and accept wages well below what they would feel appropriate for undertaking certain risks.

The imperfections of the markets hedonic methods are trying to use for VSL, as well as the inadequacies of rational choice theory challenge the reliability of these approaches considerably. This suggests that the idea to deduce the value of a statistical life from consumer choices is probably based on too normative a view and, hence, a more positive approach would be more appropriate. To this end, contingent studies seem a lot promising, since individuals are asked to place their valuations directly, without markets being the intermediary.

2.2.2. Contingent studies. The contingent valuation method elicits the value of a statistical life from individuals' responses to sample surveys (questionnaires).

People are asked to answer questions in the vein of "what is the greatest amount of money you would pay for [some policy] that would decrease the probability of [some risk in health] by [some amount]?", and their replies are used as indicative of their preferences. Such studies offer hypothetical scenarios that seek to emulate market-based choices, in the absence of a market proper. Typically and despite of its shortcomings, this method is employed quite often for trying to evaluate environmental goods. A comprehensive overview is provided in Portney (1994). His publication in the Fall's (1994) issue of "Journal of Economic Perspectives" was originally followed by two more studies, conducted by Hanemann (1994) and Diamond and Hausman (1994) that stood at different sides of the fence, presenting arguments for and against the methodology, respectively.

One obvious disadvantage of contingent studies is that what agents are stating they would do in an imaginary setting. It is not necessarily that this setting to be true. Defenders of the method do not agree with this criticism, but they suggest ways of calibrating the results accordingly, or place more attention on the questionnaires' design in such a way that the subjects' responses are as near as possible to what the method is really trying to estimate.

Calibration of the results seems, however, to elevate the problem to a higher level of complexity, without really solving it. Successful "translation" of the results in a contingent study to what they actually "should" be, implies two things: there are some objective results that can be contrasted and compared to the ones of the contingent study upon calibration; and secondly, that the same calibration factor is apt to apply for other contingent studies as well. The former implication creates a problem because, unless they are derived from an experiment, there are no such "actual" results (and if such data existed, there would be little need for a contingent survey in the first place). As a result, the latter point becomes redundant to consider, but even if it was not, there would be nothing to guarantee that some calibration factor that worked well for one case, would work equally well for another.

The issue of the questionnaires' design is obviously fundamental and much of the debate across researchers is centered around that. There exist several guidelines meant to facilitate the making of such a questionnaire (some of them are presented in Portney, 1994). It is acknowledged that it makes a difference how many questions are asked, if they have predetermined answers (i.e., multiple choice questions) or in what order they appear. The same question may be asked in two different ways and generate two different results. This last observation is of particular significance when it comes to VSL: to illustrate with an example, the questions "how much would you pay for tolerating one statistical death in a population of 1 million" and "how much would you pay for decreasing the fatal risk by 1/1,000,000 in a population of 1 million" ask exactly the same thing but the different phrasing is likely to have people respond differently for a number of reasons.

Regardless of the questionnaire's design, it is also argued that answers to such surveys are influenced by the "warm glow" effect (Andreoni, 1989) or, as Kahneman and Knetsch (1992) put it, "the purchase of moral satisfaction": the higher the valuation placed, the more "moral satisfaction" individuals get, because they know that they are expressing support for a good cause. In line with that, and since the asked questions are hypothetical, the individuals know they will not be called to honour their valuations. So, rather than expressing their own (economic) preferences, they might use the survey to make moral judgements or express opinions on the policies under consideration. In general, economic preferences are, to a degree, embedded in social preferences (Granovetter, 1985). This means that the corresponding responses are unlikely to reflect true economic values and the sources of this bias are so numerous and complex that efforts at calibrating them seem to be too hard a task.

Although contingent studies avoid a big part of the hedonic methodology's problems (since they rely on no markets), the criticism towards the latter with regards to rational choice and perfect information applies here as well. The preferences are stated (rather than revealed) directly, does not necessarily make them consistent (for some examples, see Diamond and Hausman, 1994). Also, as it is also true for hedonic studies, the underlying assumption that people actually understand risk and can conceive small changes of it is equally problematic in the context of contingent studies. Moreover, there is again the issue of asymmetric information which commonly confounds the survey's conclusions.

Either because of their inconsistencies and their tendency to be affected by psychological factors or because of their incentives to be untruthful, it may be contended that, in general, individuals are not well trained for providing reliable answers to contingent surveys (neither, of course, is it a solution to perform such studies only with selected, experienced subjects). This conclusion is all the more true when the public good is relevant to safety and health. Individuals tend to be overly sensitive with regards to a fatal risk. As a result, they are likely to deviate considerably from the rational profile, they are assumed to conform to, and this is bound to in-

validate the results of any such survey. Because of the additional sentimental weight attached to life and death, it seems that if contingent studies are sometimes criticised as inadequate for valuing an environmental good, they are even more problematic if the valued good is a (statistical) life.

Discussion and conclusion

All three methodologies discussed above present shortcomings. Researchers typically tend to react differently as to how serious these inadequacies are. There, however, seems to be unanimous agreement that the human capital approach is not appropriate for VSL, on the grounds that it ignores everything there is about life but its material dimension. HC might be a useful tool for insurance companies, but it is not particularly helpful for policy making with regards to safety and health. Instead, it appears that some version of the WTP methodology has to be adopted[1].

It was previously claimed that, because explicit valuation of life entails indeterminate psychological and emotional reactions, contingent studies do not seem likely to produce accurate results, regardless of their possible success in other instances of environmental policy. Stated preference studies of VSL may have greater flexibility than hedonic techniques but, in general, their conclusions are bound to be less reliable. Thus, among two classes of the willingness to pay methodology, discussed in the previous Section, hedonic studies seem to be most apt for generating accurate results. This doesn't mean that their own theoretical problems are not important, but the fact that they seek to explain implicit market choices make them more objective, albeit only marginally in some cases.

Unsurprisingly, empirical results vary a lot across researchers. Viscusi and Aldy (2003) provide a review of the literature and estimate the median value of prime-aged workers (across studies that use the hedonic methodology for labour markets) to be around $7 million in U.S., with most studies under consideration ranging between $3.8 million to $9 million U.S. These values are almost the same (if not a little lower) if evidence from housing and product markets is used. They also find the results to be affected by the level of income, union affiliation and age. The PESETA project (Watkiss et al., 2009), which aims at quantifying the effect of climate change on health in Europe, uses a value of statistical life equal to €1.11 million.

The previous Sections provided several reasons for possibly staying opposed to the rationale of VSL. The basic assumption that there always exists a finite sum that compensates somebody for taking a higher risk is axiomatic, and it could be rejected just as axiomatically. The distinction between statistical and actual lives is founded on the assumption that statistical lives can be valued while actual lives cannot but, as was argued in Section 1, there is evidence to also support the contrary. Moreover, this differential is somehow blurred in the minds of agents who try to make risk-money trade-offs: we cannot know if someone who is willing to pay a certain amount for better road safety does it for eliminating their own risk when driving or for the sake of unidentified drivers. Section 2 presented numerous reasons why the methods being used for VSL may generate inaccurate or irrelevant results. With these shortcoming acknowledged, the interesting question is if policy making should still use VSL to perform cost-benefit analysis when deciding upon health issues.

An alternative could, of course, be not to perform cost-benefit analysis at all. However, the resources being scarce, it is not possible to grant all potential projects for eliminating health risks. On the other hand, abandoning all such projects is, understandably, even more repugnant than pondering on which cost to draw the line (Usher, 1985). To abandon any project decreasing fatal risks on the grounds that such risks cannot be valued is akin to considering that they have a value of zero and, as such, no project is ever worth the expense. Nevertheless, this observation does not legitimise use of cost-benefit analysis at blind. Even if economists decide to give up the search to discover a value for human life (as proposed by Mishan, 1985), some (however arbitrary) proxy shall have to be adopted for it, explicitly or not, if any improvements in safety are going to be made at all.

Of course, the straightforwardness of the cost-benefit analysis methodology cannot be denied. The real issue is not if it works, but if it should be considered as a panacea. One would be hard-pressed to think of good reasons why not to conduct a cost-benefit analysis that would involve, for example, replacing all computers in a firm with newer models. But when it comes to public goods, the methodology's limitations become clear. The absence of real markets, the necessary (and rather ugly) monetisation of things nobody would normally consider to place a value on or the confounding factors amount to too much uncertainty and ambiguousness for cost-benefit analysis to still remain a consistent and unfailing tool. It may continue to give useful information as to effi-

[1] This does not mean the HC approach is abandoned (Landefeld and Seskin, 1982). However, more recent studies generally tend to consider it as obsolete.

ciency but without additional criteria (that should be allowed to vary according to the problem encountered each time), the method appears to be insufficient for conducting environmental policy. Even if the efficiency test is passed, there are other (ethical or otherwise) tests to pass and this seems hard to be accomplished, when the theorist does not allow for exogenous amendments such as procedural, behavioral or moral considerations.

This is all the more true when the environmental good to be evaluated is health and life itself (even if statistical). The emotional components of these "goods" are too complex to afford a standard calculation based on benefits and costs to guide the corresponding actions. Undeniably, there are cases, where tragic choices shall have to be made and, where some value for life will unavoidably be implied. But, following the discussion offered in this and the previous sections, it appears that it would be more appropriate to restrict the cost-benefit approach to being an advisory side-tool and then, encounter each problem within the frame of its uniqueness, avoiding the resort to predetermined values for statistical lives. The handling of decision-making with regards to health and safety in an ad-hoc manner may lack a solid theoretical background but it could prove to be a better approach for practical purposes.

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