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Computing what the public wants: Some issues in road safety cost–benefit analysis

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ABSTRACT

In road safety, as in other fields, cost–benefit analysis (CBA) is used to justify the investment of public money and to establish priority between projects. It amounts to a computation by which 'few' – the CB analysts – aim to determine what the 'many' – those on behalf of which the choice is to be made – would choose. The question is whether there are grounds to believe that the tool fits the aim. I argue that the CBA tool is deficient. First, because estimates of the value of statistical life and injury on which the CBA computation rests are all over the place, inconsistent with the value of time estimates, and government guidance on the matter appears to be arbitrary. Second, because the premises of New Welfare Economics on which the CBA is founded apply only in circumstances which, in road safety, are rare. Third, because the CBA requires the computation of present values which must be questioned when the discounting is of future lives and of time. Because time savings are valued too highly when compared to life and because discounting tends to unjustifiably diminish the value of lives saved in the future, the CBA tends to bias decisions against investment in road safety.

Cost–benefit analysis (CBA[1]) is the determination by computation of whether to spend public money on some action. Ideally the outcome of the CBA computation should tell what, given the opportunity, a well informed public would choose. However, when applied to road safety, cost–benefit analysts mix in their computations questionable values with a debatable method. Are these blemishes grave enough to say: "Computing what is best for us doesn't inspire confidence; let's search for better ways?"

Decisions in road safety management are typically about actions (interventions, programs, regulations, projects, standards, etc.) that involve the expenditure of public money and aim to reduce the toll of accidents. The central feature of such decisions is that they are made by few on behalf of many. To have legitimacy one must be able to claim that what the few decide is what the many would give their consent to.[2] In addition, decisions of this kind must be demonstrably appropriate. The attribute of demonstrability is that the reasoning leading to decisions can be put into words and numbers. The usual 'words & numbers' framework is the CBA. The attribute of appropriateness is more difficult to capture.[3] In the CBA context an action is appropriate when its benefits exceed costs and if no alternative use of the same money is more attractive than the chosen one.[4] It follows that, by hook or crook, one needs to ascertain what do the 'many' (those on whose behalf the decision is made by the 'few') think are the benefits and costs of alternative courses of road safety action.

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[1] Several acronyms will be used and it may help to list them all here for ease of reference: AIS, abbreviated injury scale; CBA, cost–benefit analysis; DOT, Department of Transportation; EPA, Environmental Protection Agency; FHWA, Federal Highway Administration; G&L group, the set of persons consisting of both gainers and losers; KH, Kaldor–Hicks; OMB, Office of Management and Budget; PPI, Potential Pareto Improvement; SDR, social discount rate; SOC, Social Opportunity Cost Of Capital; SRTP, Social Rate of Time Preference; VSL, value of a statistical life; VOT, value of time; WTP, Willingness-to-Pay.

[2] Who the 'few' are usually clear from the context of the decision. Suppose, e.g., that a State DOT contemplates the paving of shoulders on a rural highway. Now 'few' are the officials of that DOT. It is less clear who the 'many' are; are they the users of that rural highway, all taxpayers in that State, all citizens, are they the only the contemporaries of the 'few' or all future road users? For more discussion along these lines see, e.g., MacLean (1986).

[3] Nowadays the inspiration for what is appropriate usually derives from the principles of New Welfare Economics; mainly the 'Potential Pareto Optimality'. More about this in Section 4.

[4] Here too difficulties may arise. How wide must be the search for alternative uses of money; within the department, within the agency, among all agencies? As Kornhauser (2000) argues, one "must consider how cost–benefit analysis functions within the wider institutional framework within which administrative action occurs. . . No one thinks that the Environmental Protection Agency (EPA) has acted improperly because it has failed to improve the safety of automobiles even though a given expenditure that reduces the death rate from automobile accidents might improve welfare more or save more lives than the equivalent expenditure on air quality would. The task of regulating auto safety has been delegated to other government agencies." (p. 1054). This is true as long as the budgets of the EPA and the DOT are fixed and future budgetary allocations to the two agencies are independent of their past performance.

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The purpose of a CBA is twofold: to rank actions by their attractiveness and to determine whether spending the money is justified. The hallmark of CBA is that all benefits and all costs are expressed in money terms, discounted to a 'present value', and added up. The benefits of road safety interventions are mainly in terms of life and health. Therefore the main question is how much the 'many' are willing to spend to reduce the chance of a future road fatality and injury. Such questions are not easy to answer convincingly.[5] Costs in road safety management are mainly in investment of money, loss of time, and loss of freedom.[6] Ascertaining the money costs of interventions presents no unusual conceptual difficulties. However, expressing the loss of time and freedom in dollars is problematic. Also problematic is the calculation of the present value of future benefits and costs. In spite of the habitual use of discounting, the notion that a statistical life lost next year has now less value than a statistical life lost this year may raise eyebrows.

Elvik (2001) examined the applicability of CBA in road safety. He discussed the implications of the various criticisms of cost–benefit analysis for its applicability and tells how to determine whether cost–benefit analysis may be applied to a certain intervention. Graham (2008), in a monograph based on his years with the OMB, provides a comprehensive overview of the conceptual and practical issues whirling around the CBA when applied to lifesaving regulation. In this paper I discuss in some detail two issues central to the CBA in road safety; the problem of assigning money value to a statistical life and the problem of discounting life and time. My aim is to diminish the certitude of those who apply CBA to road safety actions without questioning. I ask whether, in road safety, the CBA computation is a reasonable way for few to guide decisions made on behalf of many.

1. Value of statistical life in road safety: estimates, guidelines, blemishes

The benefit of a road safety intervention is mainly in the reduction of fatalities and injuries. To represent this benefit in a CBA one has to use the money equivalents for life and injury. The money equivalent of the loss of life is usually called the 'value of a statistical life' (VSL). The term 'statistical' serves to emphasize that, at the time the CBA is done it is not known whose life will be saved.

A brief historical review of some typical VSLs used by the U.S. DOT is instructive. In June 1990 the Office of the Secretary of transportation said that "*. . .those agencies that use a dollar value of life in economic analysis should use $1.5 million.*" (FHWA, 1994, p. 2). In January 1993 the use of $2.5 was recommended. Table 1 is from a Technical Advisory issued by the Federal Highway Administration (FHWA, 1994). The VSL value in Table 1 is based on Miller et al. (1991).

Table 1
Comprehensive costs[a] in police-reported crashes by AIS[b] severity, FHWA (1994).

Severity	Descriptor	Cost per injury (1994 dollars)
AIS1	Minor	5,000
AIS2	Moderate	40,000
AIS3	Serious	150,000
AIS4	Severe	490,000
AIS5	Critical	1,980,000
AIS6	Fatal	VSL = 2,600,000

[a] According to the DOT guidance (FHWA, 1994, pp. 2–3): "Comprehensive Cost – a method of measuring motor vehicle accident costs that include the effects of injury on people's lives. This is the most useful measure of accident cost since it includes all cost components and places a dollar value on each one. Comprehensive life values are estimated by examining risk reduction costs from which the market value of safety is inferred. The 11 components of comprehensive safety costs are: property damage, lost earnings, lost household production, medical costs, emergency services, travel delay, vocational rehabilitation, workplace costs, administrative, legal, and pain and lost quality of life.".

[b] The AIS (Abbreviated Injury Scoring) system was first developed in 1969 by the American Association for Automotive Medicine and has been periodically revised since. It assigns a score between 1 and 6 (1 = Minor, 2 = Moderate, 3 = Serious, 4 = Severe, 5 = Critical, 6 = Virtually Unsurvivable) to injury in each of six body regions (Head or Neck, Abdominal, Extremities, Face, Chest, External).

In 2002 the U.S. DOT adjusted the VSL value noting that: "Recent years have seen considerable expansion in the number of studies published and refinement in analytical techniques. However, it does not appear that newer estimates converge on a consensus value or range that would justify modification of our established standard, and significant estimates continue to lie well below it. . . .we now recommend the use of a value of $3.0 million in all DOT analyses." (Emphasis added).

The tabulated costs are per injury. To get at 'per crash' values one has to account for the average number of injured persons per crash and the severity of their injuries. This was done by Council et al. (2005) and Zaloshnja et al. (2006) who provide cost estimates for each of 22 'crash geometries'. To illustrate, the cost of a fatal accident for crash geometry '1' (single vehicle with pedestrian when the speed limit is less than 45 mph) the 'mean comprehensive cost per crash' in $2005 is estimated to be $3,234,016. Council et al. (2005) and Zaloshnja et al. (2006) rely on Zaloshnja and Miller (2004) who got their estimate directly from the $3 million VSL set in 2002 by the Office of the Secretary of Transportation. In this manner an estimate given in 2005–2006 to the last dollar comes from a chain that hinges on a round number provided by administrative guidance in 2002, which was inherited from similar guidance in 1994 because the" *newer estimates did not converge on a consensus value or range*" and which, in turn, evolved from a research report tabled in 1991.

The FHWA-DOT guidance on VSL is based on meta-analyses. A meta-analysis is a sort of averaging; finding the 'center' of many research results. One meta-analysis (Mrozek and Taylor, 2002) examined 203 VSL estimates derived from data about how much wage compensation people tend to accept for work associated with various levels of risk. They find that "Reported estimates of the VSL vary substantially, from less than $100,000 to more than $25 million" and that "This meta-analysis suggests that a VSL range of approximately $1.5 million to $2.5 million (in 1998 dollars) is what can be inferred from past labor-market studies when "best practice" assumptions are invoked." (p. 253).

A year later, Viscusi and Aldy (2003) also reviewed VSL estimates from U.S. labor market studies and report that: "Half of the studies of the U.S. labor market reveal a value of a statistical life range from $5 million to $12 million in $$\text{US}_{2000}$. Estimates below the $5 million value tend to come from studies that used the Society of Actuaries data, which tends to reflect workers who have self-selected them-

[5] Difficulties of this kind arise not only in road safety but also in other domains of public activity involving the management of risk (in medicine, occupational safety, environmental regulation, food safety, etc.). This means that many have grappled with the same problems. What they know is dispersed in a very large array of learned papers and books of many disciplines.

[6] As far as I know, the loss of freedom is seldom accounted for on the cost side of the CBA ledger. And yet, it is often a significant consideration. Thus, e.g., the safety benefit of mandating the use of motorcycle helmets usually overwhelms the cost of their use. However, over and above of what could be accounted for as discomfort or as not feeling the wind in the hair, there is evidently a loss of freedom in the compulsion to use a helmet, in the making of non-use illegal, and in the attendant threat of police enforcement. This loss of freedom was absent from the cost–benefit computations which preceded the adoption of compulsory motorcycle helmet wearing laws. But, as lawmakers in the U.S.A. found to their chagrin, this loss of freedom was valued highly enough to force most state legislatures to abandon the universal version of the motorcycle helmet law and to adopt a weakened version that applies only to riders younger than seventeen.
Sen (2000) elevated the need to account for all important consequences of an action, including loss of freedom, to the level of a foundational principle of CBA. However, inasmuch as actual accounting for 'loss of freedom' in real road safety related CBA analyses seems to be virgin territory, there is not much of substance that can be said on this topic in spite of its importance.