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A Comparison of Benefit Cost and Cost Utility Analysis in Practice:

Divergent Policies in Sweden

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Abstract

We compare state-of-the-art implementation of Benefit Cost Analysis (BCA) and Cost Utility Analysis (CUA) as tools for making priorities in allocation of national public funds in the transport sector and health sector, respectively, in Sweden. While the principal distinctions between these methods are well known, less notice has been given to a number of other differences that have emerged as national and international practices have evolved over time along separate lines. We compare cost and benefit components and economic parameter values and find some surprising disparities. There are inconsistencies, both across methods and within each method. Both can be improved by learning from the other. We also find that some current practices conflict with the underlying welfare theory and/or insights from recent empirical analysis.

JEL Classification: D61, I18, H51

Keywords:

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1. Introduction

In economic evaluations for guiding policy makers in allocation of public funds there are two different traditions. The first is Cost-Benefit Analysis (BCA), which has a long tradition within planning of public infrastructural investments.[2] The second is Cost-Utility Analysis (CUA); a special version of Cost-Effectiveness Analysis that is used in health economics in general and in particular for assessments of drugs and other health technologies. The principal difference between these methods is that in BCA benefit effects of a policy alternative, including health effects, are valued in monetary terms using the willingness to pay (WTP) approach, while in CUA effects on life and health of people are measured using a health-related quality of life measures, most often quality-adjusted life years (QALY). In practice, though, this difference is subtle since when CUA is used for allocation of limited funds, there is a monetary shadow value of a QALY. Also, BCA studies only ideally identifies, quantifies and values all effects; in most real-world cases there will be several unknown effects that cannot be monetized and therefore have to be considered aside.[3]

However, while this difference with respect to health effects, and the relation of BCA and CUA to the economic welfare theory, has been much studied and discussed (Just et al. 2004, Bleichrodt and Quiggin 1999, Johannesson 1995), less notice has been given to a number of other differences that have emerged as practices have evolved over time along separate lines. Since some of these differences are not motivated by profound differences on principles, it could be expected that both sides can have something to learn from each other. Moreover, the fields of applications have widened over time and now often overlap; leading to inconsistencies and confusion over the state of the art of economic evaluation that needs to be resolved.

In this paper we compare implementation of BCA and CUA as tools for making priorities in allocation of national public funds in the transport and health sector, respectively, in Sweden. Key indicators from economic evaluations significantly affect high-stake economic decisions in both sectors, by two government agencies, "Trafikverket" (The Swedish Transport Administration - STA) and "Tandvårds- och läkemedelsförmånsverket" (The Dental and Pharmaceutical Benefits Agency - TLV) spend significant resources on such evaluations. Both agencies

[2] The roots can be traced back in the U.S. to a recommendation by the Secretary of the Treasury Albert Gallatini 1808 on comparison of costs and benefits in water related projects, and in Europe to the analysis of the economics of bridges in 1844 by the French engineer and economics Jules Dupuit.

[3] See Banzhaf (2009) on the heated discussion among U.S. economists in the 50's and 60's on how to treat multiple objectives. Also, there is a huge literature on tools for multi-objective decision making. However, irrespective of whether effects that cannot be included in a one-dimensional bottom line monetary net present value are handled by sophisticated operation-analysis models or are just left to the decision maker's free consideration, BCA (and CUA) may be very helpful by the reduction of a many-dimensional decision problem into a not-so-many dimensional problem.

have extensive international collaborations and close relations to the research community. Several other government agencies (for the instance the Environmental Protection Agency, The National Board of Health and Welfare (NBHW) and The Swedish Civil Contingencies Agency) make similar economic evaluations, but more on an ad hoc basis, and with a close eye on the procedures applied by STA and TLV. We compare the current practices with respect to their roles in the public funding decision processes, what type of effects on the cost and benefit sides that are considered, and what parameter values that are used in the economic assessment.

The rest of the paper is structured as follows. In section two we discuss BCA and CUA practices for allocation of public funds in Sweden. Section three reviews some fundamental theory for the evaluation problem at hand. Section four compares economic evaluation procedures in Sweden, while section five continues the reviews economic parameters used for BCA and CUA in Sweden. The last section concludes.

2. BCA and CUA practices for allocation of public funds in Sweden

2.1 BCA for national planning of transport infrastructure and transport systems

2.1.1 History

In Sweden, the National Road Administration (NRoadA) started using BCA for evaluation of national road investment objects in the 1960´s. Following a parliamentary decision in 1978 that national traffic policy should be guided by economic principles (Sw govt bill 1978/79:99) the BCA methods were described in detail (Bruzelius 1980, Statens vägverk 1981), so that the theoretical foundations, parameter values and empirical functions used to assess effects on traffic could be evaluated by decision makers and researchers. This also made possible development of computer software needed for the use of BCA as a regular routine in evaluation of the vast number of alternative investment objects that are considered in a rolling four-year planning cycle to make ten year investment plans for the national road network.

Another milestone was reached in 1988 with the vertical split up of the national rail operator from which emerged a new agency, The National Rail Administration (NRailA), in charge of the planning and management of the national railroad infrastructure (Hansson and Nilsson 1991). NRailA started to use BCA as a regular procedure for evaluation of infrastructure investment proposals. Although the methods used to a large extent were borrowed from the NRoadA, there were now two agencies more or less competing for the same national investment funds. Both agencies, however, controlled the rules of their own part of the game, i.e., their own BCA protocols, and had obvious incentives to choose traffic forecasts and economic parameters that were advantageous to their own transport mode. Therefore, in 1993 the government set up a new agency, SIKA[4], which was made responsible of "making traffic forecast, planning models and cost-benefit assessments of the development of the transport system" (Dir 1993:92).

From 1993 to 2008 SIKA coordinated, in close cooperation with NRoadA and NRailA, four sequential revisions of the BCA protocols, published in 1995, 1999, 2002, and 2008.[5] In 2006 an EU funded project (HEATCO 2006) presented recommendations for harmonized European approaches for transport costing and assessment. The Swedish BCA protocol in 2008 follows these recommendations a long way, but not in all respects.

In 2010 STA, the result of a merger of NRoadA and NRailA, has taken over the responsibility to maintain and develop the BCA models. This body, The Swedish National Transport Administration, will publish an update of the BCA guidelines in 2012.

2.1.2 The role of BCA in infrastructure investment planning

The importance of BCA evaluations to the national infrastructure planning decisions has gradually increased. Nilsson (1991) analyzed the final priority ranking of investment objects made 1985 in a ten-year national plan to the ordering implied by the results of BCA evaluations of these objects. He concluded that there was a considerable discrepancy between the two orderings, implying that the BCA results did not have had a strong impact on the final decision making. Further, Hultkrantz, Lindberg and Nilsson (1997) pointed out that the government tended to railroad mega-size projects through Parliament on a special track aside the regular evaluation process. Later, The Parliament Audit (2000) voiced criticism over the negligence of economic assessment of these mega projects and both the Parliament´s Transport and Communication Committee and the Ministry of Finance marked that they expected BCA to play an important role in the planning process.

[4] ,SIKA had initially another name (DPU), see Swedish Goverrnent Directives (Dir 1993:92).
[5] Jansson (1995), SIKA (1999, 2002, 2008)

Therefore, when the preparation of the most recent plan, for the period 2010-2021 started, the government declared that BCA results should carry more weight than for earlier plans. In a recent evaluation of how BCA was used in making this plan, Eliasson and Lundberg (2010) found that project with a higher benefit-cost ratio indeed had a higher probability of being included in the plan, and the relationship was stronger at lower levels of benefit-cost ratios. Decision makers seemed to use economic evaluations to exclude unprofitable projects, whereas among profitable projects the relationship was significantly weaker. Projects specifically selected by politicians did not show any relationship between the benefit-cost ratio and probability of being included in the plan. Finally, the mere fact that BCA is used has made planners "trim" proposed investments by trying to reduce investment costs without significantly reducing benefits.

In summary, BCA has been in use for half a century in Swedish infrastructure planning. The methodology has developed over the years, and it seems, has grown in importance for decision making.

2.2 CUA of new pharmaceutical products

2.2.1 History and Methodological Considerations

As compared to the use of BCA, CUA has a more recent history. Australia was the first country to use CUA as part of evaluating the appropriateness of new drugs (Drummond, 2006). After Australia several countries followed in using CUA as a decision making tool or part of the evaluation process for new drugs and medical technologies; Canada, New Zealand, Norway, Finland and Sweden. In these countries all drugs are part of the evaluation process where CUA is one part and the decisions regarding public reimbursement of the drugs. In the UK, the National Health Service (NICE) requests CUA of a new drug if it is deemed that it will have significant effect on the national health budget and/or if it is believed to imply significant medical breakthroughs.

In Sweden a government agency "Tandvårds- och Läkemedelsförmånsnämnden" (The Dental and Pharmaceutical Benefits Agency - TLV)[6] was set up in 2002 for the task, among others, of determining which prescription drugs that should be subsidized in the national health system. A pharmaceutical company with a new drug innovation that seeks subsidization normally submits a CUA for the drug based on a suggested price; based on

[6] The initial name Läkemedelsförmånsnämnden ("The Pharmaceutical Benefits Agency") was changed to the present in 2008.

the application TLV decides on subsidization (yes/no). TLV is to consider principles of human dignity, need and solidarity as well as cost-effectiveness (ex-ante evaluation) and marginal utility. This means that TLV explicitly prioritizes diseases with more severe consequences and diseases for which few or no treatment alternatives exist, but otherwise cost-effectiveness, most often expressed as cost quality-adjusted life-years is the guiding principle (Persson et al., 2010).

TLV also continuously evaluates different pharmaceutical areas regarding whether or not a drug should keep being subsidized at current prices (ex-post evaluation). In some cases the sheer initiation of such evaluations may lead to price decreases by the pharmaceutical companies in order to keep the subsidies for a drug, which for example was the case when an evaluation was made of previously subsidized drugs for lowering blood pressure (Persson et al., 2010).

There are general guidelines for how the cost-effectiveness should be conducted by submitting drug companies (available online: http://www.tlv.se/lakemedel/pris-och-subvention-av-lakemedel/halsoekonomi/); however they are not particularly detailed. The main effect measure is recommended to be QALYs and if data is based on intermediate effect measures ("surrogate end-points") modeling should be conducted in order to translate these into gained QALYs. In some cases where QALYs may be difficult to use, BCA with WTP measures may be acceptable. The brief guidelines further state that the evaluation should take a societal perspective, the reference alternative should be the "most relevant alternative", which generally is the current treatment. They also highlight that economic evaluations based on clinical trials need to include modeling if the clinical trial is not fully relevant for the cost situation for the full potential patient population. Lost production due to treatment and morbidity should be included using the human-capital approach and if treatment affects survival all costs due to increased survival should be included (net of total consumption and production for the gained life years).

2.2.2 The role of cost-effectiveness in drug subsidy decisions

Studies have suggested that the importance of cost-effectiveness in the decision making process is more significant at central, as compared to the decentralized, level (Hoffman and Graf von der Schulenburg, 2000). Anell and Persson (2005) evaluated decisions made between 2002 and 2005 and found that the importance of cost-effectiveness varied significantly across pharmaceutical groups. For example, it seemed that CUA played a very minor role regarding decisions for orphan drugs, i.e. drugs targeting a very rare medical condition, whereas it seemed to be more important for drugs with a significant budget impact, for example drugs targeting hypertension (LFN, 2008). Drugs that have been rejected subsidization only in some cases have had a poor cost-efficiency, rather, other reasons such as a low political health priority seems to have been more important in cases of rejection (such as for drugs treating erectile dysfunction - even though shown to be cost-efficient for severe cases).

3. Comparison of Evaluation Methods

A BCA or CUA of an investment proposal, a new drug or medical technology etc. seeks to finds what options in a choice set that give the highest "utility" (defined in some way) subject to constraints.[7] Two constraints occur in most decisions problems; one is related to the choice of the "reference or "default" alternative", i.e., a specific construction design or intervention method, and the second is the budget constraint.[8] The first constraint emerges when alternative actions are mutually exclusive, for instance one new road is to be built between A and B, not less or more, or a patient will use one drug to reduce blood pressure, not several. The budget constraint is present in all economic problems, however, it can be explicit (considered ex ante by the decision maker) or implicit (ex post). In the ex post cost "someone else" is picking up the bill, but the budget constraints may be still present in the selection procedure through formal or informal conditions on which the decisions are delegated. The welfare effects are summarized in the form of a Benefit Cost Ratio (BCR) or Cost Effectiveness Ratio, CER, in CBA and CUA, respectively. The various options are ranked and selected in descending order with respect to BCR or CER until the budget fund is exhausted.

However, real-world choice sets are often not limited and clearly defined. There can be many; sometimes even infinitely many, possible actions, so it is not always obvious what the evaluation default is. Second, the budget constraint is often not perfectly known when decisions are made. For instance, the selection process may be sequential, so that the decisions made at an early stage and have to be stages are based on guesses on how scarce these funds will be in the end. Third, there may be not just one but several budget constraints. Public budgets are often determined for a short period at a time (for instance a year), but can have budget consequences for much

[7] See Boadway (2006) for an overview of the principles of benefit-cost analysis.
[8] Another potentially important constraint comes from the irreversibility (sunk cost) nature of many investments, which introduces a choice between investing now (wholly or partly) or later.

longer periods. Fourth, the consequences of all actions are not completely described, i.e., some important effects cannot be quantified and/or valued (in either monetary or QALY terms). The decision maker then hence has to consider some effects aside.

In this section we describe and discuss in some detail how these real-world complexities are handled – or ignored – in the Swedish context by the STA and TLV, respectively.

3.1. Choosing a reference alternative

Economic evaluation of a specific activity, such as an investment to eliminate a bottleneck in a transport network or the granting of a state subsidy to a pharmaceutical product for the treatment of a specific patient group, has to focus on narrow set of alternative options as the evaluation of each option will be costly. BCA and CUA always compare at least two options; a proposed action and a reference alternative. In the BCA-based infrastructure planning the proposed action is called "the evaluated alternative" (EA) and the reference is the "comparison alternative" (CA). The Benefit-Cost Ratio of the suggested alternative is defined with the benefit and cost differences, i.e., BCR = (dB-dC)/dC, where dB and dC are the differences of the present value benefits and costs, respectively, between the EA and the CA. In CUA the corresponding bottom-line variable is the Incremental Cost Effectiveness Ratio (ICER), which is given by the difference in present value of the cost between two health care programs divided by the differences in outcomes (U) between the programs for the same patient group, i.e., ICER=dC/dU.

The choice of reference alternative leaves room for some discretion by the evaluator which could be used for manipulation ("BCA capture") from persons seeking to promote specific interests. CUA evaluation studies are often made by pharmaceutical companies and other parties with direct stakes in the outcome. The TLV have in some cases prompted the applicant-firm to conduct the CUA with adjusted or revised comparison alternatives (Persson et al. 2010), and it is noteworthy that the very brief instructions by TLV on how to conduct a CUA have specific recommendations on the choice of reference alternative.

However, in the transport sector, guidelines are not very specific on this issue, although they are much more elaborated in other respects. This is surprising because also in transport planning, decision makers are presented studies that have been conducted by business firms or various interest groups.[9] Moreover, also when evaluations are made by civil servants, CA can be selectively used in the interest of promoting allocation of funds to the public agency, or as a concession to external interest groups. This can be done in two different ways; CA can be either too weak or too strong compared to a balanced “medium cost” alternative that could have been a stronger contender to the EA, but is not presented. A too weak CA will exaggerate the benefit side of the EA, and a too strong CA will underestimate cost. In an audit of some mega-size infrastructure project, the Swedish Parliament Audit (2000) concluded that the CA often “lacked realism”. Examples were given of both too weak and too strong CA. In the case of a proposed extension of the railway between Stockholm city and the main airport Arlanda (“the Northern Bend”), “do nothing” would probably had been the preferred alternative but was not included (Hultkrantz 2000); while in the case of a major railway tunnel under the city of Malmö, no ground-surface alternative that addressed problems with the existing railroad was presented, leaving a very expensive tunnel as the only politically feasible alternative (Nilsson 2000).

TLV prescribes that comparison should be made with “the in Sweden most relevant treatments (for instance, the most commonly used)” (TLV 2003). This statement thus acknowledges that there are two difficulties involved in the selection of reference; (i) that there may be several relevant treatments and (ii) that the relevant treatments may vary in different countries. Another problem is what to do when there exists no pre-existing treatment and the CA is a placebo from clinical trials. Clinical trial data is not necessarily well generalized into real-world treatment contexts creating further issues of uncertainty regarding cost and effect differences in the EA and CA. Clinical trials may often use a time-horizon that is too short for a CUA implying that modeling also needs to be conducted in order to estimate QALY changes.

In transport, these issues are even more complicated as both placebo and “non-action” alternatives are lacking. Refraining from an investment on a specific link of a transport network often has ramifications on investment requirements in other part of the transport network, sometimes even for other transport modes, and may also affect the future cost of maintenance and habilitation work.

[9] An example is a politically influential report by the consultancy form Railize (2008) made on commission by a group of major railway industry companies (SJ AB, Green Cargo AB, Jernhusen AB, Alstom Transport AB and The Nordic Investment Bank). The report claimed that investment in a high-speed rail network connecting Stockholm, Göteborg and Malmö would yield a BCR at 2.2. Aside a number of other possible concerns with this study, it is noteworthy that it used a zero action reference alternative. Soon after this report was presented the government instigated an own study of this investment object, that was not included in the regular planning process.

3.2 Effective budget constraint

An often noted fundamental difference between BCA and CUA is that a CUA can never indicate the optimal level of funding going into new medical technologies; however it may be useful in order to rank and evaluate projects when there is a predetermined fixed budget (Cohen, 2003). On the other hand, BCA can be used to maximize social welfare without a predetermined budget allocation into different sectors.

Looking on the STA and TLV procedures, however, this distinction is considerably blurred, and if a simple characterization must be made, it would rather be that in a real-world setting it is the other way around, i.e., the BCA starts from a budget constraint while CUA builds on an open budget.

Considering that the TLV has, although informal, rough guidelines on the monetary shadow value of a QALY it is quite unlikely that a new medical technology with proven significant clinical effects and an ICER well below the informal shadow value would be rejected subsidization. Considering that the TLV does not have any formal control of the number of incoming applications or innovations of new technologies, a surge in new efficient technologies that targets larger patient populations will have significant health care budget effects.

In comparison, the national infrastructure planning is based on an explicit budget for a ten year period, even though the national state budget is decided by the Parliament one year at the time. Before the work starts on a new plan starts, the Parliament decides on a budget frame for the new National Transport Investment Plan, which thus is a formal, but not binding, commitment to allocate resources within the next ten annual budgets. The most recent plan, valid for the period 2010-2021, was based on a decision in 2008 to grant 156 billion SEK (17 billion Euros) to new investments. It is thus fair to say that the planning process was based on an explicit ex ante budget constraint. However, the constraint was made flexible in several ways. First, out of the 156 billion SEK, 115 billion SEK were already earmarked to investment objects in an Initial Plan. Most of these objects were included in the overlapping investment plan (2004-2015), and were now in the building stage or in the final planning stages. There were also a few, but very expensive, objects that had been given priority previously but had been decided by a previous government as part of an effort to support continuation of operations at a car assembly plant[10]. Thus, not more than

[10] A plant in Trollhättan (SAAB),then owned by General Motors.

a quarter of the frame was “free” money that could be allocated to new projects, although the overlap of the previous plan was just five years. Second, the government asked for suggestions for investment objects for a possible Extended Plan that added 20 billion SEK. The Extended Plan were later on included in the final plan, based on additional funding expected to be raised from road tolls in the cities of Stockholm and Göteborg and increased track user charges. Third, separate from the preparation of the national plan, a study was commissioned in 2008 to evaluate a “Super-Mega” project, a new fast-speed rail line between Stockholm-Göteborg-Malmö. The investigator proposed in August 2009 the construction of such a railroad, expected to cost 115 billion SEK[11] and to be conducted during the same period as the transport investment plan.

These aspects all tend to soften the budget constraint. The Initial Plan was underfunded, showing that too many objects had been “squeezed in”, and evidently there are incentives to do that as objects included in a previous plan will be given priority over new objects in the plan. The Extended Plan gave the transport authorities incentives to press for new road pricing programs and to raise existing charges. Noteworthy is that after the National Plan was decided by the Parliament, which included the objects of the Extended Plan, studies were instigated to evaluate whether road tolls in Göteborg and increased track user charges were consistent with the marginal cost pricing. Finally, the separate study of the fast-speed train network signaled that the budget constraint could be quite flexible under specific conditions.

3.3 Multiple budget constraints

In the previous section we discussed whether planning is based on a budget constraint. Another issue in both transport and health sector planning is that decisions often have enduring budgetary consequences that extend beyond the period for which a budget constraint is considered. For instance, investment in new road or rail infrastructure will increase (or reduce) future demand for funds for maintenance activities. Likewise, a decision to subsidize a new type of medical intervention will draw on public budget funds for a long time. Hence there are multi-temporal budget constraints. This can be handled in two alternative ways. One possibility is to explicitly set up and solve a multi-period optimization problem, including choice sets and budget constraints of future periods. However,

[11] In fact, for reasons discussed by Hultkrantz (2009) and later confirmed in SNTA (2012), this cost estimate is considerably biased downwards.

the information needed to do that is seldom present. A second option, that requires less specific information, is to evaluate future budgetary effects with shadow prices that reflect the expected relative scarcity of budget funds in future periods.

Observing that real world budget allocation problems for healthcare interventions are multiyear budget problems, Cohen (2003) suggests that health care evaluation should use what he calls "The Single Cohort Approximation" to the multiyear budget constraint, by assuming that "a fixed amount has been budgeted for the given cohort, and that funds can be carried over into subsequent years" (Cohen 2003, p. 79). However, he presumes that CUA is already used "as a guide to allocating healthcare resources so as to obtain the maximum health benefits possible under a given constraint (Cohen 2003, p. 76), which as we observed in the previous section is not a true description of current practices. Also, even if the suggested method would introduce a limited number of future budget constraints in the analysis, it would not handle the problem that evaluations are made case by case, which means that the effective scarcity of the future funds that are allocated to each cohort is unknown as that will depend on not just previous and present selection of interventions but also on future decisions.

In contrast, Gafni and Birch (2006) observe that the current practice of using a constant monetary shadow value of a QALY over time in evaluation of new health technologies may give uncontrolled cost growth, since "the use of the ICER threshold approach requires increased expenditures on the program for every new drug introduced wherever the ICER value is positive (i.e., drug has greater effects but costs more than the current treatment." (Gafni and Birch 2006, p. 2095).

Gafni and Birch seem to assume that the drug benefits approval process has a ratchet-like effect, i.e., there is an inflow of new products but no outflow as new products are compared to old, but not to products that are introduced after the approval decision date. But to what extent this is so depends on the duration of the approval. If a sunset review is required after some time, the decision can be re-considered in view of later developments. Further, sunset reviews may decrease costs via the mechanism that companies reduce prices in order to pass the reviews, which happened, as discussed previously, with blood pressure drugs in Sweden (Persson et al., 2010).

In infrastructure, a ratchet effect can be associated with maintenance. Maintenance expenditure typically accrues some time after the initial investment. New infrastructure therefore adds to future needs for funding maintenance. Also, maintenance requirements depend on the standard and design of the infrastructure construction. In some countries (for instance UK), maintenance costs are included in the “cost denominator” of the BCR. In Sweden these costs are instead subtracted from the “benefits numerator” and are therefore not limited by the initial budget constraint. A possible source of bias to trade-offs between up-front investment expenditure and future maintenance cost is therefore that planners have an incentive to trim investment expenditure so as to squeeze in a project in the investment plan, which may lead to unnecessary high maintenance needs. Noteworthy is that one of the main motives for Public Private Partnership contracting of infrastructure projects in Sweden is a wish to promote a life cycle perspective on total costs, which indicates that regular public funding introduces some intertemporal bias.

3.4 Validation and development of procedures

The purpose of BCA and CUA is to look forward, i.e. to make recommendations on appropriate policy decisions. Ex post reviews of decisions made are, however, instrumental for the gradual development of the ex ante tools. An obvious reason is to facilitate learning from experience. In fact, the mantra of modern quality management is “plan-do-check-act”, where “plan” is a prerequisite for the more essential “check” phase of the quality improvement cycle. In addition, reviews of the single items in the ex ante materials make it feasible to understand whether the appropriate parameter values were used, not least when it comes to the financial costs for implementing investments.

The Swedish government has since 1997 required ex post cost evaluations of large road and rail infrastructure projects from the national road and rail administrations. In recent reports from the National Audit, however, these evaluations are said to be “neither transparent, understandable, nor relevant” (National Audit 2010, p. 27, see also National Audit 2011). Nilsson et al. (2012) investigate this issue further; finding that all information required for such evaluations is electronically recorded and could have been collected and presented at a very low cost, but that this is simply not done.

Backward-looking analysis raises questions on accountability, which may be a reason for resistance among decision-makers to such studies. Nilsson et al (2012) speculate that some reasons are budgetary ratchet effects (a government agency has a strong incentive to spend all money allocated in the budget, as it otherwise signals that it needs less in the future) and a pure lack of interest among policy makers in exploring "issues of the past". Unfortunately, this limits the possibilities to learn and in particular to improve construction cost assessment models. For instance, it is not possible to make a reliable estimate of the size of the so called optimism bias in Sweden (i.e. of any systematic underestimation of construction costs).

The BCA guidelines are, as was described earlier, revised every fourth year, i.e., some time before the next National Transport Plan is made. This is done within the transport sector, presently by the National Transport Administration. This contrasts to procedures in several other European countries. In Norway general guidelines for BCA is set up by the Ministry of Finance, in order to assure that sector agencies do not design different BCA rules. However, while this could be a potential problem, perhaps a more pressing consequence of the lack of centrally determined guidelines in Sweden is that agencies outside the transport sector do not have any guidelines at al. This is therefore one reason for the differences we observe between BCA and CUA practices.

Mikael: Reviews

4. Economic parameters

4.1 Value of life, life year and the lambda value: Practice and evidence

As previously observed some of the alleged main differences between BCA and CUA are blurred when one takes a closer look on actual practices. This is in particular true when it comes to the economic evaluation of effects on mortality and morbidity, BCA is believed to be based on a consumer preference approach for valuing these effects, while CUA assesses these effects by use of the QALY concept, and make priorities based on a threshold value derived from public budget constraints. It turns out however that the TLV, although it does not have a definite cut-off value, is adapting a range of values that are "inspired" by the VSL used by STA (Persson and Hjelmgren, 2003). Persson and Hjelmgren (2003) have used a modeling technique based on a value of preventing a fatality (VPF) accepted by the Swedish Government for use in traffic safety planning of SEK 16.3 million in 2001 prices (approximately €1.75 million). This approach resulted in a cost per QALY of approximately SEK 655,000 (€70,000). On the other hand, STA uses value parameters for valuation of health effects from airborne pollution from cars that resemble QALY threshold values used in health economic evaluations.

At a first glance, it may seem to be in the interest of overall efficiency in the BCA sense to use an ICER cut-off level (i.e., the lambda) in the health sector that is consistent with values used to make economic assessments of traffic safety. However, that presumes that consumers really are indifferent to whether a life (year) is gained by a safety enhancement program in the transport sector or a health technology improvement. It is unclear if this is the case; almost all published evidence on the value of a statistical life in Sweden is based on mortality risks in an infrastructure context (Hultkrantz and Svensson, 2012). Further, a general finding is that VSL estimates are higher when preferences are elicited in the context of a private risk reduction compared to a public risk reduction (Svensson and Vredin-Johansson, 2010), and CUA generally concern public (health) risk reductions, which may indicate that the current lambda as used informally by the TLV is "too high".

4.2 Discounting

Discount rates used in the transport and health sectors in Sweden are 4 and 3 percent, respectively. The reason that discounting is made at different rates in two different fields of budget allocation within the same national government is obscure. The choice of rate is motivated for the transport sector only. In recent BCA protocols, reference is made both to the principles of the marginal social rate of time preference (SRTP) and to the marginal social opportunity cost of capital (SOC), while earlier documents (Bruzelius 1980, Statens Vägverk 1981) were based mainly on the SRTP principle. The SRTP principle is demand-side oriented and adds (1) a time preference term, representing impatience of individuals and/or different weights given to future generations in relation to the present; and (2) the expected annual growth rate of income per capital times the elasticity of utility with respect to consumption (the Ramsey formula). The SOC principle is supply-side oriented and uses the real (i.e., inflation adjusted) rate of interest on public debt.

The rate of discount used in transport planning was 8 percent in the early 1980's, but was later reduced to 5 percent and then finally set at 4 percent in 1994. This development seems to have be caused by a tension between the first application of the STRP principle made by Bruzelius (1980), resulting in a suggested a 5 – 12 percent span[12] where 8 percent represented a neutral central value, and the SOC, which was negative in most

[12] Pure time preference was assumed to be 2 percent, annual per capita growth 3-5 percent, and the utility elasticity (minus) 1-2.

years in the 1970´s and 1980´s[13], and has fluctuated between 1-3 percent since then. Later applications of the Ramsey formula have adjusted the expected growth considerably downwards and given equal weighting to different generations, and thereby arrived at or below four percent.[14]

An issue that is not addressed however is whether a risk term should be added to the risk free SRTP or SOC rate. Doing that would raise the discount rate considerably. Since the social return from infrastructure to a large extent depends on GDP growth, a "social beta" value is likely to be close to unity, so the rate of discount would increase with the so called equity premium.[15]

In the health economics literature it has also been discussed to use different discount rates for benefits and costs, something rarely discussed in the BCA context. For example, it has been argued that individuals discount health at a different rate from monetary benefits, even though most of the literature tends to argue for using the same discount rate for costs and effects (Viscusi, 1995). A further complexity with discounting in a CUA context is that if QALY weights have been elicited using time trade-off, time-preferences are already captured in the QALYs. Hence, it may lead to double-discounting if the health effects in the CUA are discounted (Johannesson, 1994).

A related issue that has been largely ignored so far concerns real price changes. In BCA, future relative prices are normally assumed to remain constant. However, some relative prices, notably the value-of-travel-time-savings, which is closely related to the wage rate, values of safety and health, and values of some environmental goods that are limited in supply (Sterner and Persson 2008) are likely to increase with income growth. Several recent empirical studies have provided evidence on how the willingness to pay for various benefits increase with income changes over time (and not just cross-sectionally) with income. Börjesson et al. (2012) analyze a pooled data set consisting of data from two identical value-of-time surveys done in 1993 and 2009 and find that (after deflation with CPI) the relation between value of time and income is equal between the two surveys, implying a unit income elasticity of the willingness to pay for travel time savings. Similar results, indicating income elasticity at 0.9, were held by Abrantes and Wardman (2011) in a meta-analysis of value-of-time studies in the UK. Hammit and Robinson (2011) review longitudinal studies and cross-country comparisons that suggest that the income elasticity of the value of statistical life may be considerably larger than one. Finally, it seems safe to assume that the real-price values of some benefits

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[13] The credit markets were strongly regulated and inflation was high.

[14] For instance from 0 +2*2.

[15] In Norway a risk premium of 2.5% is added to the risk-free discount rate for infrastructure investments.

related to environmental effects, for instance the social cost of greenhouse gases, are likely to increase over time. The ignorance of future relative price changes may therefore be a serious flaw of the current practices.

4.3 Marginal cost of public funds and shadow value of public goods

Public funding is not a free lunch as there is an excess burden associated with taxes. For this reason, the BCA evaluations in Sweden until 2008 multiplied public investment expenditure by a factor 1.3, representing the marginal cost of public funds (MCPF). However, as an adaptation to the European harmonization recommendations by HEATCO (2006) this was dropped in the BCA protocol published in 2008 (SIKA 2008). This change seems to have gone unnoticed by the TLV as the agency has continued to refer without further comment to the lambda value estimation by Person (2003) that makes an adjustment with the 1.3 MCPF factor.

This change of the Swedish BCA guidelines was not endorsed by the scientific experts that were consulted before the revision was made and the issue has remained controversial also afterwards. HEATCO (2008) did not object to the inclusion of MCPF on principal grounds, but gave three practical, or politico-tactical, arguments; (1) that there is a large uncertainty about how large the marginal costs of public funds are, (2) that MCPF is normally not considered when evaluating public, “thus, inclusion in the transport sector would bias decisions against transport”, and (3) “Because only the best projects get financed, these projects tend to have a high BCR” (HEATCO 2006, p.48).

None of these arguments, however, are valid in the Swedish context. (1) MCPF estimates with reasonable precision are available (Birch Sörensen 2010), suggesting values close to the previously used 1.3 factor[16]. (2) BCA is not used for making priorities in allocation of public funds between sectors. (3) Many projects that get funding have a BCR close to unity (see Eliasson and Lundberg 2010).

Still, it could be claimed that the issue is not so important given that the BCRs are used to make priorities within a given investment budget frame. However, as discussed previously, this frame is in practice very flexible. In fact, in the making of the recent National Transport Investment Plan, the initial frame at 41 billion SEK for new investments could had been extended by (at least) another 115 billion SEK if the parallel study made of a new fast-speed rail network had led to a positive decision by the parliament; accounting for the MCPF (abstracting from

[16] For a proportional increase of the income tax on labor, Birch Sörensen estimates MCPF at 1.32.

several other concerns that could be raised) would have been enough to change the estimated BCR into the negative.

Distortions, and/or positive externalities, may arise also on the expenditure side, thus the shadow prices of public expenditure (i.e., “the effect on deadweight loss of people´s actions brought about by the provision of an extra unit of the public good” (Usher 2006, p. 4) should also be considered (Atkinson and Stern 1974, Usher 2006). These are however likely to be idiosyncratic and are normally seen as part of the “wider economic benefits” that seldom are included in the BCA. However, a Swedish model to assess these effects has been developed (Anderstig et al. 2012) and has been used in a couple of studies, especially in evaluation of congestion charges.

4.4 Conversion from factor prices to market prices (unit of account)

Public expenditure is normally expressed in factor prices while consumers/tax payers elicit willingness-to-pay in the market price level, i.e., including commodity taxes such as the value added tax. The Swedish BCA guidelines recommend that both benefits and costs should be denoted in the market price level, so costs have been inflated by a factor representing indirect taxes (at present 21 percent). A similar practice is used by the Department of Transport in the United Kingdom, based on recommendations in an unpublished report by Sugden (1999), Likewise, the European project for harmonization of BCA-rules, HEATCO (2006) recommends that both benefits and costs are expressed in the same “unit of account”, although preference is given to factor prices as this facilitates evaluation of infrastructure projects that include several countries with varying indirect tax rates.

Surprisingly however, there is no theoretical support for this procedure in the literature on cost-benefit rules. The “modified Samuelson rule” compares marginal cost (in factor prices) of a public good, adjusted by the MCPF, with the sum of individuals’ willingness to pay (in market prices) for this good.

Also, the practice in CUA is unclear and seems to be split. TLV refers to the lambda estimate by Persson (2003), based on the road safety VSL value deflated by the indirect tax factor, thus expressing the lambda in the factor price level. However, the corresponding “reference lambda values” by NBHW do not seem to be based on such a transformation. The TLV, in their guidelines, state that drug costs should be valued using factor prices (“Apotekets utförsäljningspris”). However, it is not explicitly addressed in the TLV recommendations that factor prices, rather than consumer prices, should be used throughout in the CUA. Hence, using a societal perspective in the CUA it is not clear whether effects to patients not included by QALY measures, for instance time savings, are to be valued in factor prices or market prices (even though implicitly we have to assume that TLV argues for factor prices).

4.5 Overview of comparable economic parameters used in BCA and CUA

Table 1 below summarizes differences in method and parameter values between BCA and CUA practices by Swedish government authorities as discussed in this paper. There are several similarities, but still significant differences that in most cases there are no well understood theoretical reasons for; including different discount rates, marginal cost of public funds, value of life/life year,

Table 1 Comparison of BCA and CUA in Sweden – practice and parameter values

	BCA		CUA
Evaluation principles			
Bottom-line variable (difference to reference alternative)	BCR		dC/dQALY
Reference alternative	Varying		"Current practice"
General parameters			
Rate of discount	4%		3%
Producer/consumer price conversion factor	1.21		1 (implicit)
Marginal cost of public funds	1 – 1.3		1 (implicit)
Planning horizon	40 years		Varies
Cost/Benefit parameters			
Value of a statistical life	22.3 million (no age adjustment)		
Value of a severe injury	4.15 million		
Value of a moderate injury	0.2 million		
Value of a QALY			450 000 – 655 000*
Consumers´value of time	Private trips <10 km	51 SEK/h	Not considered
	Private trips >10 km	102 SEK/h	
	Business trips	275 SEK/h	
Out-of pocket expenditure	Yes (tickets, fuel, etc.)		No guidelines

Note: * Not official and based on conversion from old Swedish value of a statistical life.

5. Concluding Discussion and Suggestions for Future Research and Policy

In this paper we have compared BCA and CUA methods as they are used by Swedish government authorities. It is evident that both this evaluation methods "live a life of their own", developing along separate, but sometimes crossing, lines. They are formed in interaction between economists and representatives of different professions in various, mostly public, sectors such as environmental preservation agencies, transport administration, medicine and social welfare.

The role of national government agencies have been more pronounced in the development and implementation of BCA than in CUA. Especially transport agencies have put considerable resources, including research funding, in development of national planning models. Only more recently efforts have been made for harmonization of models and parameter values with other countries within the EU. In contrast, the Swedish CUA guidelines are brief and more or less summaries of guidelines set up in other countries.

The most important difference between the BCA and CUA practices are related to the different perspectives on mortality and morbidity effects. First and foremost, the BCA tradition has a focus on life vs. death, while CUA focuses life years lost or gained, and differentiates with respect to the quality-of-life of these years. The choice between these perspectives is a matter of ethics, and possibly politics, and it has important ramifications on priorities. For instance, fatalities among car driver hit mostly young drivers, while most pedestrians killed in traffic accidents are old people. BCA usually makes no difference, while a CUA evaluation would prioritize accidents involving young persons. However, the willingness-to-pay approach of BCA is quite flexible and can easily be adjusted so as to differentiate health and safety effects with respect to the number of life years lost or gained (if not quality of life), so it is not clear why the value of statistical life remains in focus.

Going through the various practices, some of the more important observations we have made regard the use of budget restrictions, both in the case of BCA and CUA. The use of CUA does not, explicitly and formally, in principle considers the budget restriction at all. Also in the use of BCA the budget restriction effect is vague. Both methods, in practice, ignore future budget restrictions that may give rise to ratchet-effects. Hence, there seems to be a need for better approaches to deal with current and future budget restrictions.

Further, and much surprisingly we find differences in discount rates and in whether the marginal cost of public funds is considered or not. These inconsistencies of course reflect the lack of coordination at the national level, but some confusion is also due to a too rigid application of the HEATCO recommendations. In both BCA and CUA, the issue of whether future benefit (and cost) values should be inflated with respect to real income (real wage or GDP per capita) growth has so far been ignored.

We also find that Sweden, as some other European countries, employ a procedure for equalizing “the unit of account” of both benefits and costs in either market or factor prices that is not consistent with the underlying theory of cost-benefit rules in a second-best setting. This a standard practice in CBA has also led to some confusion in CUA practices.

Finally, in order for economic evaluations of infrastructure investments and health technologies to develop and keep up with consumer preferences it is necessary to have principles for how to revise and update parameter values. The BCA protocol has been developed over a long time in regular revisions that have engaged several government agencies and with the help of domestic and international expertise. It has also been supported by considerable research funding that has been granted directly by the transport agencies to fill in knowledge gaps that have been identified in the revisions. Over time this has made the BCA models more sophisticated and more encompassing with respect to various aspects of the transport system. This has largely enhanced the respect for and acceptance of the BCA routines within the agencies, the political decision-makers, and among the general public.

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