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International Comparison of Transport Appraisal Practice

Annex 4 Sweden Country Report

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SWEDEN COUNTRY REPORT

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1. Project appraisal in Sweden

Sweden has a relatively long history of evaluating public decisions with cost-benefit analysis. Starting in the early 1970's, there was a trend towards evaluating many types of public decisions with CBA. This eventually became less popular in many sectors during the 1980's, but continued to increase in importance for the transport sector. Since the early 1990's, virtually all major national transport investments are evaluated using a standardized CBA framework, the *ASEK* guidelines ("ASEK" means "Arbetsgruppen för SamhällsEkonomiska Kalkyler", the workgroup for cost-benefit analysis). The ASEK guidelines are revised regularly, usually every 3-5 years. Over time, responsibility for the ASEK guidelines have been assigned to different public authorities, but they have always been decided in a collaboration between several public authorities (the Road Administration and the Rail Administration, which was merged into the Transport Administration in 2010, the Environmental Protection Agency etc.) and independent experts and researchers. Currently, the responsibility lies with the Transport Administration. It should be pointed out that public administrations in Sweden (and most Scandinavian countries) serve many roles that in other countries are performed by governmental ministries or departments.

One of the main purposes of the harmonised ASEK guidelines is to make sure that transport investment CBAs are comparable, so they can be used to prioritise among project suggestions from different parts of the countries – most or all major transport investments are paid with national funding, with no or relatively little regional funding. The same need for national harmonisation led to the development of the national transport forecast models SAMPERS (person trips) and SAMGODS (freight transport), which, together with national forecasts of future scenarios, have to be used to produce the traffic forecasts going into the CBA. SAMPERS became operational around 2001 and SAMGODS a few years later.

Both the ASEK guidelines and the national forecast models have traditionally focused mostly on CBA for transport investments. There is an increasing interest, however, in also evaluating various policy measures, operations and maintenance using CBA; for example, the CBAs of the Stockholm congestion charges and a suggested kilometre charge for heavy traffic attracted widespread attention. The methodology for such kinds of appraisal is still relatively little developed, although many recommendations and methods can easily be transferred from investment appraisal.

2. CBA and Comprehensive Assessment

As of 2009, all suggestions for national transport investments must be accompanied by a *Comprehensive Assessment* ("Samlad effektbedömning"), presenting the project suggestions, its effects, the reasons for it, the status of the planning process (e.g. whether it is at an early idea stage or at a late stage where blueprints and careful cost estimates are produced), CBA results and non-monetized effects. The CBA includes

- Accessibility benefits for private trips (time savings, costs savings etc.)
- Accessibility benefits for business trips
- Accessibility benefits for freight transport
- Changes in emissions (CO_2, NO_x, SO_2, particles)

- Traffic safety (fatalities, severe injuries, light injuries, material damage)
- Noise (this is often omitted, however, due to the cost of calculating reliable noise effects)
- Producer surplus for transport operators (marginal change in fare revenues minus marginal operations costs for train and PT operators)
- Maintenance costs
- Investment costs
- Changes in transport-related tax revenues from (primarily fuel tax and road tolls)

"Accessibility benefits" include changes in travel times, travel costs, reliability and any other part of generalized travel costs.

The Comprehensive Assessment also includes verbal descriptions of non-monetized effects, if any: these may for example include effects on the natural and cultural landscape. It also describes (verbally) distribution effects – which groups win and lose from the project. Finally, it describes in short verbal terms the effects on the overall policy targets for the transport system (these are verbal targets set by the Government, such as "an efficient and reliable transport system" etc.).

3. CBA methodology

Benefit valuations are mostly derived from willingness-to-pay estimates. The exception is the value of carbon emissions, which is currently based on the carbon tax on fuel. Benefit valuations are assumed to increase over time proportionally to the forecasted growth in GDP/capita. This is a recent change: until 2012, benefit valuations were assumed to be constant over the project lifetime, despite income growth (income growth affects transport demand forecasts, however). All costs and benefits are summarised to the net present value using a discount rate of 3.5%. This rate was recently changed from 4%; this was not based on any new scientific evidence, however, but was a direct intervention of the head of the Transport Administration.

Valuation of travel time savings

The value of travel time savings are based on a recent national study (Börjesson & Eliasson, 2011). The study was a stated choice survey, based on a pivot design of an actual trip the respondent recently had made.

The values are differentiated with respect to mode, travel purpose and trip length (shorter or longer than 100 kms). Income effects are removed from the valuations, however – this is possible due to recent econometric advances which give much better possibilities to include covariates such as income in the value of time estimation. The decision to remove income effects was taken after a long debate and against the recommendations of most involved experts. The following quote from (Börjesson & Eliasson, 2011) relates the most important arguments of both sides:

> "There has been a long debate in the literature regarding whether values of time in applied appraisal should be allowed to vary with income. Some authors have argued that appraisal should be based on actual willingnesses-to-pay (see (Sugden, 1999) in the context of transport policy and appraisal, and (Harberger, 1978, 1980) in the context of general cost-benefit analysis). Others have argued that this implicitly assumes welfare weights inversely proportional to the marginal utility of income,

hence giving more weight to high-income groups than to low-income groups (Galvez & Jara-Díaz, 1998; Mackie, Jara-Díaz, & Fowkes, 2001; Pearce & Nash, 1981).

The position of the latter group of authors can be summarized as follows: Assume that the decision problem is to create maximal total utility assuming equal welfare weights (i.e. a strictly utilitarian welfare function) in a context where travellers are the final beneficiaries of transport improvements, individuals differ in terms of marginal utility (MU) of travel time and MU of money, and acquiring public funds is associated with some welfare loss (e.g. due to deadweight losses)1. Then, it can be shown that travel time improvements should be converted to money using a "value of time" which is the ratio between the travellers' MU of time and the paying group's average MU of money – which is not necessarily the same as the travellers'. This means that the relevant VTTS will depend on how the policy is funded. If the funding of a project comes from the travellers themselves, for example in the form of ticket revenues or road user charges, then the welfare measure should be based on the VTTS of the travellers. If the policy is publicly funded, then the VTTS should be based on the MU of money of the relevant funding source, for example a state, region or city; the VTTS will be different for regionally financed projects compared to nationally funded projects. Note that differences in the MU of time should not be discarded. Further, note that the conclusion that income effects should be removed is obtained starting from a strictly utilitarian welfare function. It should not be confused with the type of "weighted CBA" where explicit distributional weights are introduced in the welfare function to capture equity concerns.

A common counter-argument is the Kaldor-Hicks argument: as long as the winners can compensate the losers, the government is free to carry out redistributions by a number of policy instruments, including taxes and various welfare systems. This argument is open to a number of objections, however, since governmental redistributions in reality are constrained in a number of ways, by political constraints and the deadweight cost of taxation to name but two.

A more persuasive counterargument is that the argument for removing income effects from the VTTS assumes that travellers are the final beneficiaries of transport improvements. But in the long run, the benefits will be dispersed across the economy, and the final beneficiaries will be a mixture of land owners, tax payers, transport companies, employers, businesses, customers and travellers. Assuming perfect markets, benefits will be captured by land owners, but in a reality with imperfect competition, price restrictions and planning regulations, the final incidence is virtually impossible to know. This would be an argument to use actual values of time, since it is benefits in terms of actual willingnesses-to-pay that are dispersed across the economy.

The crux of the debate seems to be what should be assumed about the final beneficiaries of a transport investment. In a situation where one has reason to believe that a substantial part of the benefits stay with the travellers, differences in VTTS due to income differences should be removed; otherwise, the actual VTTS should be used."

In addition to values for in-vehicle time, there are values for interchange time, frequency (waiting time), access time (the trip to the first transit stop), driving in congested conditions and in-vehicle time in crowded buses or trains.

[1] This provides an explanation of why there may be differences in MUs of money across individuals, even if the government is "almighty and benevolent" and uses unit welfare weights.

The value of business travel time is based on a slightly modified cost savings approach. The baseline value of business travel time is taken to be the average gross wage rate of business travellers (using data from the national travel survey). The value for long train trips, however, is reduced by 15% to account for productivity during the trip. There is no particular evidence for this figure: it was a compromise between the little available evidence (that indicated a figure around 30%) and a wish not to introduce too much differentiation between modes.

The value of bicycle time is based partly on (Börjesson & Eliasson, 2012) and partly on an unpublished study by Björklund. Values distinguish between different cycling environments, such as roads, streets and bicycle lanes.

Valuation of reliability

For road traffic, travel time reliability is measured by the standard deviation of travel time, with a reliability ratio of 0.9 (based on (Eliasson, 2004)). There is a lack of reliable methods to calculate what effects a project will have on the standard deviation, however. A relationship between the standard deviation and congestion (Eliasson, 2007) has been used, but this has not worked quite satisfactorily because of the inability of static network models to provide reliable congestion measures.

A special case for road traffic is long, completely unexpected delays. The standard deviation above is supposed to be used in situations when the driver can anticipate the distribution of the travel time, and choosing margins accordingly. In situations such as accidents, where drivers have virtually no chance to foresee the delay, a value of 3.5 times the value of time times the length of the delay is used instead.

For public transport, travel time reliability is measured by the average delay, with a reliability multiplicator of 3.5 (Börjesson, Eliasson, & Franklin, 2012). Just as for road traffic, it has proven difficult to calculate what effects a project will have on the delay frequency and delay length. Currently, there are no quantitative methods at all. Instead, rough “experts’ judgments” are used.

All studies above are stated choice studies, using pairwise choices pivoting around an actual trip the respondent has made recently (usually, respondents are sampled during the trip).

Traffic safety

Traffic safety valuations are based on a number of contingent valuation studies summarised in (Hultkrantz & Svensson, 2012). These studies only deal with fatalities, however; values of severe injuries and light injuries are then calculated using the “Bush index”.

The entire traffic safety effects is assumed to be external, i.e. drivers are assumed not to take the risk of accidents into account when making trip decisions.

Noise

Noise valuations are based on two hedonic price studies for road and rail noise, respectively (VTI 2009, 2010 – currently only available as Swedish reports). On top of the hedonic estimate, a 42% mark-up is made to capture the value of “unconscious” health effects, i.e. the effects of noise on residents’ health that they are not aware of and hence are not reflected in house prices. The mark-up is based on a Danish study.

Emissions

Valuations of emissions, except for carbon, are ultimately based on the same value of life used for traffic safety benefits. The connection is made using estimated exposure/mortality relationships for various types of emissions. There is currently a debate about whether the valuation should be based on the value of quality-adjust life-years (QALY) used in other sectors (such as medicine), but no change has been decided so far. There is also some recent evidence that the health and mortality effects of emissions may be several times higher than what is currently assumed. This would mean a significant increase of the emission valuations.

The value of carbon emissions is currently based on the carbon tax on fuel, which translates to around 0.11 €/kg CO_2. This is interpreted as the politically decided shadow price for carbon emissions in the transport sector. It can be noted that this is considerably higher than the market value of carbon in the traded sector has ever been, or is expected to be in the foreseeable future; at its peak, the ETS price of carbon was around 10-20% of the Swedish carbon tax on fuel. For investment appraisal, the valuation is assumed to increase over time in proportion to the growth in GDP. This translates to a "present" value of carbon emission of around 0.15 €/kg CO_2

Health effects

When investments cause more people to start cycling, this is assumed to generate health effects that the cyclists are now aware of. Since it is assumed to be an external effect, it should be added to the CBA. Very rough guidelines exist to estimate these effects. It has proven particularly difficult to establish what share of "new" cyclists are already doing some exercise and what share of cyclists would otherwise have been physically inactive. The health effects is several times larger for the latter group.

There has been a long debate regarding the extent to which health effects are actually internalized, i.e. cyclists are aware of them. The current stance of the Transport Administration is that they are completely external.

Marginal cost of public funds, VAT additions

Public expenditures (such as investment costs) are multiplied by the marginal cost of public funds (MCPF), taken to be 1.3. This is supposed to reflect the deadweight loss of collecting tax for public expenditures.

Benefits, costs and prices are expressed in consumer prices (not factor prices), but public costs are expressed net of VAT. This is a recent change; it used to be that public costs (such as investment costs) were multiplied by a consumer/producer price conversion factor of 1.21 (reflecting the average indirect tax rate), but after some rather complicated discussions, this was abolished in the latest guidelines[2].

[2] To be honest, I don't quite understand why, and I'm not completely convinced that this was a correct decision.

Wider economic benefits

"Wider economics benefits" (WEBs) in the form of increases in total wages may be presented along the CBA results, but may not be included in the final BCR. WEBs are to be calculated by the model *SamLok* (Anderstig, Berglund, Eliasson, Andersson, & Pyddoke, 2012).

SamLok is based on an estimated relationship between labour income and workplace accessibility. To reduce endogeneity and confounding problems, the model is based on how *changes* in workplace accessibility are related to *changes* in income, i.e. not on cross-sectional estimation. Accessibility measures are taken from a transport model (and hence ultimately based on travel behaviour). This means that changes in the transport system will be properly captured by the accessibility measure. Estimations are based on "quasi-disaggregate" data on the "kommun" (="municipality", roughly corresponding to "cities", but large cities typically consist of many municipalities), where individuals are grouped into segments based on location and socioeconomic characteristics.

4. Transport models

SAMPERS is the national transport model for person trips, covering all types of domestic person trips. First developed around 2000, SAMPERS is the official Swedish transport model used by virtually all public authorities. This has the benefit that virtually all analyses of transport investments or transport policy measures are comparable with each other, even if the analyses are carried out by different authorities or interest groups. SAMPERS consists of five different regional sub-models for short-distance trips and one national sub-model for long-distance trip. The demand models are nested logit models, while the assignment to the road and transit networks is carried out with EMME/2.

Similarly, SAMGODS is the official national freight model. It operates on a much coarser geographical scale than SAMPERS (Sweden is divided into 288 zones in SAMGODS), and has a rather simplistic model structure. Freight volumes per origin-destination (O-D) pair are calculated by adjusting a prior O-D matrix with the change per economic sector using an external multiregional input-output model. The resulting freight volumes per O-D pair are hence not sensitive to changes in transport costs. O-D volumes are then assigned to transport chains (combinations of modes and routes) with a deterministic assignment model (STAN).

Sampers and Samgods used for larger projects, and also provide baseline national forecasts. For smaller projects, however, where demand can be assumed to be unaffected by the investment, the simplified appraisal tools EVA (road) and BANSEK (rail) are usually used.

5. The use and impact of CBA in investment planning

Cost-benefit analysis has a high status in Sweden, at least nominally. The overall goal of national transport policy is that the transport system should be "socially efficient and sustainable"[3]. References to the social profitability (or unprofitability) of investments are common in public debate, and the general principle that investments should be "cost-efficient" or "socially profitable" is seldom argued against. Advocates of specific investments typically argue that an investment brings "additional benefits not captured by traditional CBA" – but they seldom dismiss the principle that investments should be judged on the grounds of social profitability.

In practice, CBA plays its most important role in national investment planning. The National Transport Investment Plan covers a period of around ten years and is typically revised every four years, once per election cycle. In Sweden, investments in national and regional infrastructure are a Government responsibility, while local road networks and local public transport are (in principle) a municipal responsibility. This means that the government needs a tool to compare suggested investments across the country to each other, and this is where CBA plays an important role – or at least, is supposed to play an important role. To what extent CBA results actually affect decisions is a contested issue. An early study (Nilsson, 1991) found no impact at all, while a more recent study based on the latest investment planning process (Eliasson & Lundberg, 2012), found that significant impacts of CBA results on project selection. However, CBA results only seemed to affect civil servants' project selection – not projects that were selected directly by politicians. (Eliasson & Lundberg, 2012) draw the following conclusions, based on both interviews with planners and statistical analysis of the selection outcome:

- CBA results affected planners' selection of investments. An investment with a high benefit-cost ratio has a higher probability of being included in the Plan. This is particularly true for low and moderate benefit-cost ratios.
- CBA results seem to play a particularly important role as a screening tool, helping planners to avoid investments with negative net benefits. Hence, having a BCR>1 is the most important criterion, even if the magnitude of the BCR also affects selection probability.
- For the investments selected directly by politicians, however, there is no connection between high benefit/cost ratios and selection of investments.
- The mere fact that CBA would be used as a prioritization instrument made planners "trim" proposed investments by trying to reduce investment costs without significantly reducing benefits. In other words, the mere awareness that CBA would be used as a prioritization instrument made investment suggestions more cost-efficient.
- Planners also take other criteria than benefit-cost ratios into consideration, e.g. the importance placed on the investment by regional planning authorities. For example, one such criterion was that freight investments should be prioritized, which resulted in an implicit valuation of freight benefits twice the weight in the CBA.
- CBA methodology is better developed for road investments than for rail investments, and CBA results affect project selection more for road projects than for rail projects.

[3] In Swedish, the terms "socially efficient" or "socially profitable" almost coincide with term for "appraisal" or "cost-benefit analysis". CBA translates to *samhällsekonomisk kalkyl* (literally "social-economic calculus"), and the overall national transport policy principle is that the transport system should be *samhällsekonomiskt effektivt* (literally "socially-economically efficient").

The finding that “the mere awareness that CBA would be used as a prioritization instrument made investment suggestions more cost-efficient” is important. In fact, this may in fact be the most important effect of having CBA as an eventual selection criterion: it forces planners to focus on cost-efficiency at an early stage, and to some extent keeps bloated projects from leaving the drawing board. This is further illustrated in a more recent study by Börjesson, Eliasson, Odeck & Welde (forthcoming), which compared Norwegian and Swedish project selection for road investments. While CBA results strongly affected project selection in Sweden, there was no evidence of this in Norway. Consequently, there was a much larger share of socially unprofitable project candidates (BCR<1) in Norway. There was no difference between the “top end” of the BCR distributions of the two countries, however, which seems to be a clear indication of a selection process at an early stage in Sweden, where projects with low BCRs have a lower probability of surviving into the next selection stage.

The preparation of the national investment plan is carried out by the Transport Administration, while eventual decisions are made by the minister of infrastructure[4]. Proposed investments were collected into lists where each suggested investment was graded with respect to several criteria, in addition to the BCR. These other criteria change over time; in the latest plan preparation process, investments were also graded with respect to how they would affect *economic growth,* how they were *prioritized regionally*, whether benefits were mostly *regional or national* (ceteris paribus the latter was prioritized) and whether investments were located in a *major urban region* (in which case they were assigned a higher priority, since these regions were perceived to have more serious transport problems). All investments are then ranked by the Transport Administration, and a proposed investment plan is delivered to the Ministry of Infrastructure, which (usually after some amendments) makes the final decisions. The Transport Administration compared its eventual ranking with a strict BCR ranking, and each discrepancy between the rankings was motivated.

Hence, CBA results carried a lot of weight in the selection process – in particular, BCR>1 was an important criterion – but it was not the sole criterion. Based on interviews with planners, Eliasson and Lundberg identify the following reasons for discrepancies between CBA results and project selection:

- Some benefits are not captured (well enough) by standard CBA. Examples are improvements in the urban environment (e.g. through ring roads), capacity improvements in highly congested road systems (because of failures of static network models), and reductions of train delays.
- Too few alternatives are studied. Often only one suggested measure to address a specific "need", be it connecting two regions to each other or reducing the volume of through-traffic in a city center. If only one solution is suggested, and the problem is important, then it is hardly surprising that planners and politicians will accept investments even if they have low net benefits. What investments are included in the plan will then depend more on how severe a certain problem is than on the cost-efficiency of the suggested solution.
- Lack of planning context. Investments belong to a particular planning context. Often, they are framed in a strategy to develop a city or a region in a specific way, for example, regarding the

[4] In a European perspective, ministries are small in Sweden and instead agencies under the Government play a more active role in the infrastructure planning process. Hence, the Transport Administration, a governmental agency, performs many tasks which in the UK would be performed by the Department for Transport.

built environment. This planning context is not directly captured by the CBA. This may explain the fact that several highly profitable investments are excluded from the Plan: it may be that they are not addressing "needs" that are prioritized in the overall strategic planning of the regions.

- CBA results come too late in the planning process. When an investment has long been planned and politicians feel committed to it, a late, negative CBA result will carry less weight. An important criterion was how far the project had come in the planning process. Letting regions' priorities affect investment selection makes sense if regions have better information about investments than the national level. But clearly, there is a risk that, in the words of (Mackie & Preston, 1998), "schemes may be difficult to reject because of the degree of political commitment they have accumulated."
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6. Recent and future methodological development

The Swedish government, through the Ministry and the Transport Administration, has always placed a lot of weight on appraisal methodology and its results. This weight seems currently to be increasing even more. Moreover, the government wants the appraisal methodology to be extended from investments to new application areas, especially operations and maintenance, but also allocation of scarce railway capacity. Clearly, this requires significant methodological development.

In addition to these new application areas, considerable efforts are being spent on “old” but unresolved issues, such as wider economic benefits, distributional impacts, estimating and valuing reliability benefits, and valuation of “slow mode” benefits. One recently concluded major effort was the Swedish Value of Time study, the results of which have recently been included in the ASEK guidelines.

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