Critical view on cost-benefit analyses

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Critical view on benefit-cost analyses

- the case of transportation infrastructure planning

Presentation at the Concept Symposium 2012
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My points of criticism

- **Inevitable forecast uncertainty**
- **Biased traffic forecasts**
- Arbitrary valuation of time
- Monetizing of environmental impacts
- Discounting away long-term negative environmental impacts
- Ethical bias against the poor and future generations
- Undermining political objectives of changing current trends of traffic growth

Time savings and construction costs are the main benefits and costs in CBAs of transport infrastructure projects

The Silkeborg motorway in Denmark as an example

Benefits in million DKK

- Time savings 5023
- Air pollution and noise 61
- Barriers and risks 40
- Traffic accidents 341

Costs in million DKK

- Construction costs 4166
- Operation costs 450
- CO2 emissions 17

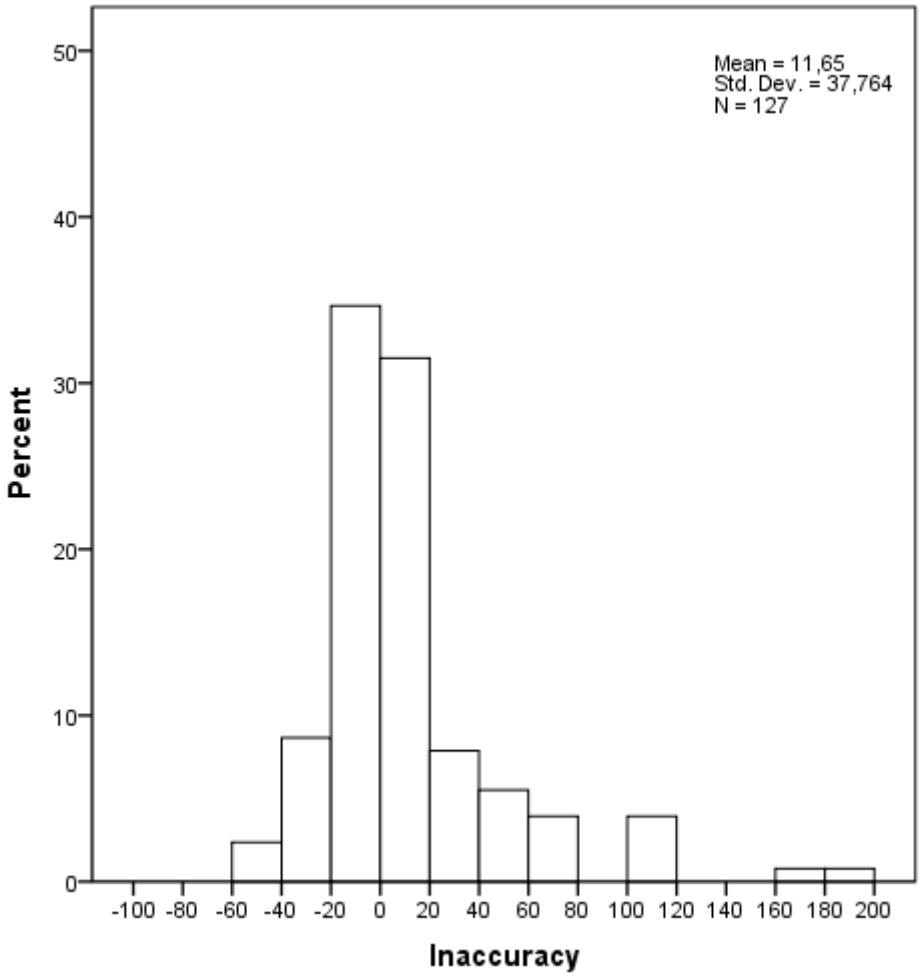
(Discount rate: 6% annually)

Cost-benefit analysis of transport projects is no exact science – they include considerable subjective elements and scope for bias

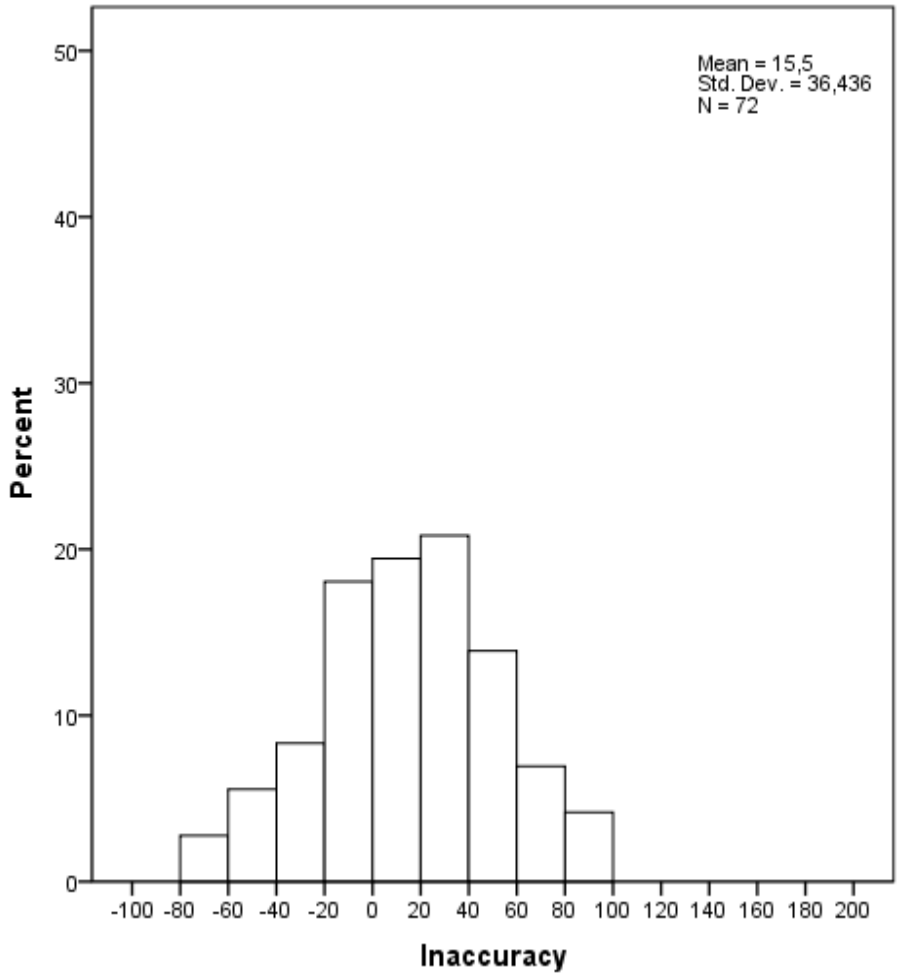
- In 2005, the valuation of **time savings** for journeys to work varied by a factor of 10 between two EU neighbor countries (Austria and Hungary)
- The valuation of **a 'statistical life'** varied by a factor of 10 between Finland and Slovakia, and by factor 2 between Norway and Denmark
- The valuation of **CO_2 emissions** varied by a factor of 5 between Sweden and Finland
- Large variation between EU countries in **discounting rate levels** – in four countries it was below 4%, in three countries it is above 7%
- No regional pattern in the variations in discounting rate levels
- In addition, a strong **tendency of over-optimistic analyses** in terms of traffic forecasts and estimates of construction costs

Forecast inaccuracies among a sample of road projects in Denmark, Norway, Sweden and the UK

(Source: Nicolaisen, 2012)



Traffic



Construction costs

Inaccuracy in traffic predictions is **inevitable** – due to the openness of the social systems to which they refer

- **Closed systems**: Causal mechanisms operate in isolation and independent of each other (e.g. in an experiment within natural science). Outcomes of proposed interventions **can** be predicted
- **Open systems**: Many different causal mechanisms operate in combination and with relative strengths varying geographically and over time. Outcomes of proposed interventions can **not** be predicted
- **Partially closed systems**: the scope for prediction is clearly lower than in closed systems, but still higher than in entirely open systems. **Crude** predictions of the **impact** of a given causal mechanism can be made (but not predictions of future **situations**)

Using traffic models to predict the **general, 'background' traffic growth** is a quest for an impossible exactness

- The traits of development dealt with in such forecasting (based on the so-called 'strategic' models) belong to a highly open system where prediction is simply very difficult, if possible at all
- Many of these traits depend on, among others,
  - unpredictable geopolitical conditions (e.g. future oil supply and price)
  - contested political decisions (land use policies, whether or not road pricing will be implemented etc.)
- Projections for the general traffic growth run the risk of becoming self-fulfilling

Using traffic models to predict the **impacts** of proposed infrastructure projects

- Because of the inevitable uncertainty about the 'general' (or background) level of traffic growth, it is also impossible to predict with any reasonable degree of accuracy how high the future traffic will be on a new piece of infrastructure
- Predicting the **impact** of the proposed project, e.g. the construction of additional lanes on a motorway, is in principle less problematic, although such predictions cannot either be very accurate
- Whereas predictions about future traffic **situations** require knowledge about a large number of factors influencing the amount of traffic, **impact** predictions 'only' require knowledge of how the relevant causal mechanism tends to operate

Predictions of traffic **impacts** of infrastructure projects must necessarily be crude

- Changes in travel speeds as well as the number of people affected by these changes will be different in a high-growth than in a low-growth scenario for general traffic growth
- The ‘elasticity’ between road capacity increase and traffic growth has been found to vary considerably (short-term from 0.3 to 0.5; long-term from 0.5 to 1.0)
- Findings from theoretical and empirical studies about the ‘elasticities’ between infrastructure changes and traffic growth must be adapted to the planning situation at hand, based mainly on qualitative interpretation involving contextual human judgment

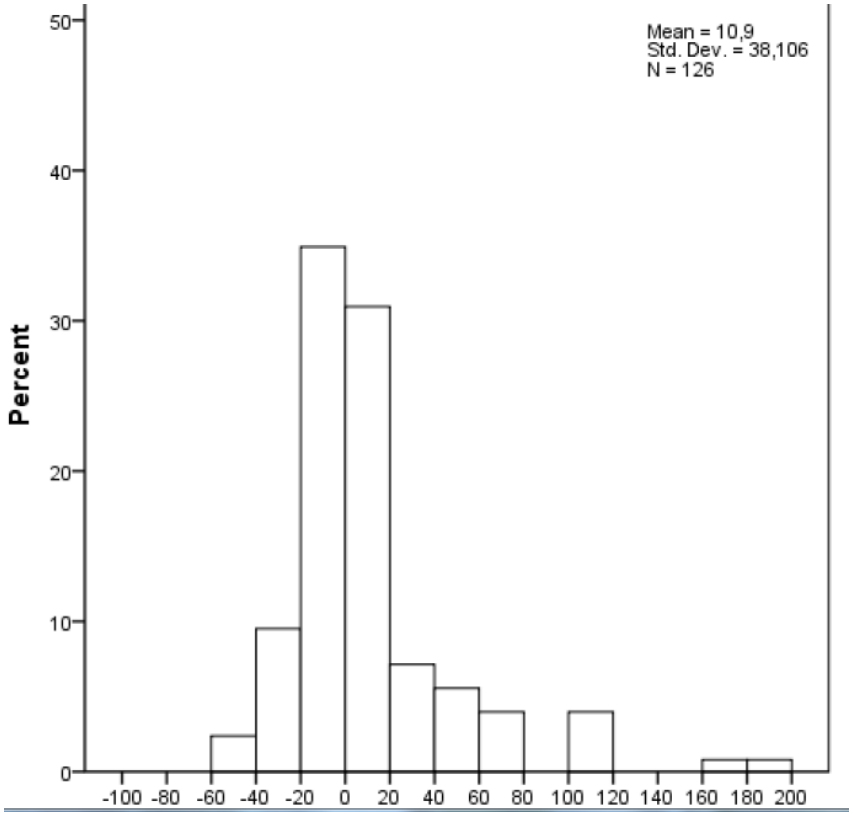
Input data for transport project CBAs are not only inaccurate, but often also **biased**

Transport Modelling: Towards Operational Standards in Europe

MOTOS Handbook containing guidelines for constructing national and regional transport models

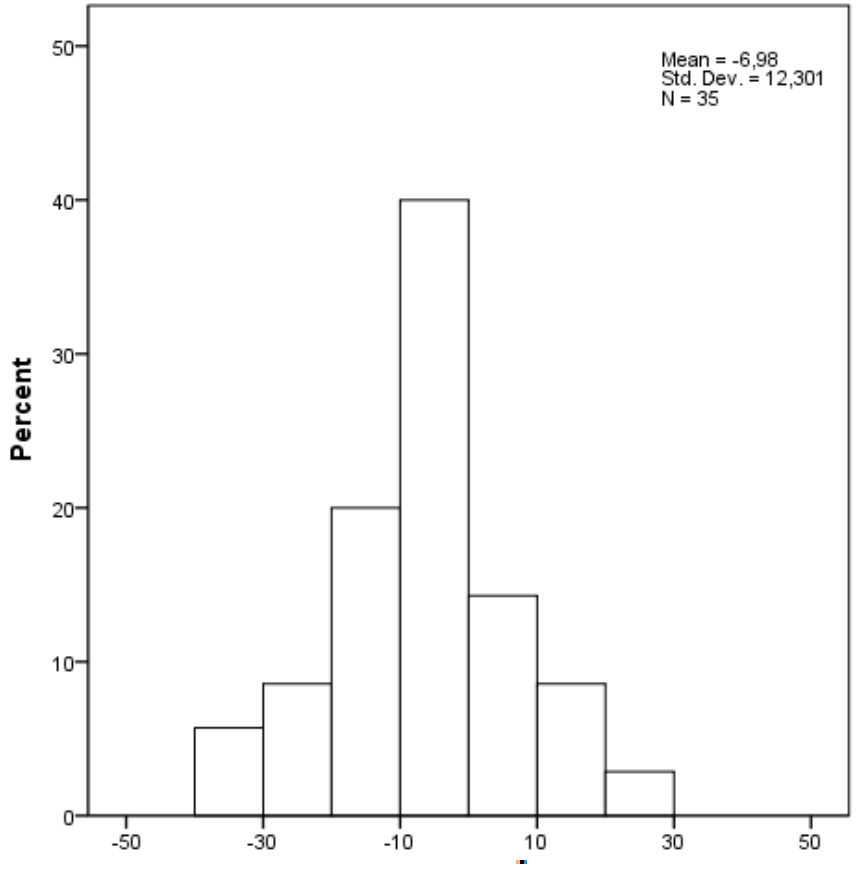
'Many traffic models overlook induced traffic despite empirical evidence of the importance of this' (MOTOS, 2007, Part 3, p. 24)

Traffic forecasts for a sample of completed Scandinavian and British road projects tend to be underestimated…



			Statistic	Std. Error
Accuracy	Mean		10,90	3,395
	95% Confidence Interval for Mean	Lower Bound	4,19	
		Upper Bound	17,62	

…. whereas the forecasts for ‘no-build’ alternatives tend to be overestimated…



			Statistic	Std. Error
Accuracy	Mean		-6,9821	2,07922
	95% Confidence Interval for Mean	Lower Bound	-11,2076	
		Upper Bound	-2,7566	

If the samples of the previous slides are representative, the difference in road traffic volumes between ‘build’ and ‘no-build’ alternatives is on average underestimated by some 15-20%

- Most likely, such underestimation is a result of ignoring induced traffic
- This can cause a dramatic bias in the cost-benefit analyses of road projects
- Even with a difference in forecasted traffic of only 5% between a ‘build’ and ‘no-build’ alternative, the consequence to the CBA results of ignoring induced traffic can be severe, as shown in the case of Nordhavnsvej (next slide)

Example: the Nordhavnsvej project in Copenhagen

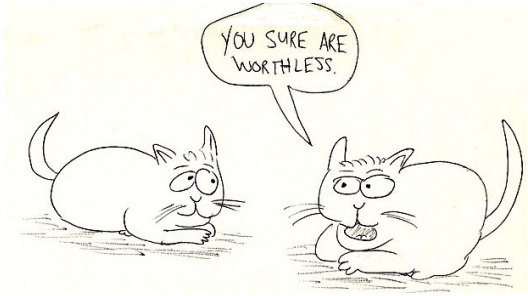
Impact factor	Model including induced traffic	Model ignoring induced traffic
AADT on main link	22,820	21,740
Total travel time savings (mil. DKK)	2,749	4,589
Changes in fuel consumption (tons)	483	-284
Changes in CO_2 emissions (tons)	1,525	-897
Changes in noise level (weighted score)	167	162
Changes in safety (accidents involving personal injury)	-0.3	-1.2
Net present value (mil. DKK)	**403**	**2,157**
Internal rate of return (%)	5.6	8.1
Benefit ratio per invested capital unit	0.2	1.1

Arbitrary valuing of time savings represents additional uncertainty and bias

- Empirical studies in DK indicate that people value time savings twice as high per minute if the saving is 20 minutes as if it is only three minutes
- Still, CBA operates with a fixed value per minute
- British studies indicate an average time saving of road projects of 1 – 3 minutes per traveler
- Tiny time savings can hardly be utilized in any meaningful way for neither work nor leisure purposes
- Valuation of time must be re-thought as ICT enables people to work while traveling

Bias against nature/the environment

- CBA is based on a strictly anthropocentric view on the relationship between humans and non-human nature
- Nature is considered to have no value beyond its value as resource and playground for humans and is assumed to have unlimited capacity to bear growth in consumption and production



- Willingness-to-pay measurements in connection with environmental impacts are notoriously unreliable due to :
  - Insufficient knowledge
  - Some respondents reject on grounds of principle that public environmental qualities is something for which individuals should have to pay
  - Free rider/let other people pay
  - Non-committing to state a high willingness to pay
  - People have different ability to pay

Bias against future generations

- The principle of discounting future impacts implies a '**short-termism**' where consequences to future generations are considered insignificant
- Long-term negative environmental consequences are discounted down to negative present values much smaller than the originally calculated negative values
- In the Nordhavnsvej case, the additional CO_2 emissions resulting from the project were calculated to reduce the Net Present Value by only **0.05%**
- The justification for discounting future consequences is based on an assumption of continually rising consumption levels: If we will be ten times richer in the future, paying a cost of 1000 Euro will impact our welfare much less than paying the same amount of money today
- But exponential economic growth at a rate corresponding to CBA discounting rates is highly unlikely in a century perspective

Bias against the poor

- The principle of willingness-to-pay gives the highest influence on decisions to those whose ability to pay is highest: the 'votes' are counted in banknotes, not ballot papers
- Negative impacts on, and needs among, population groups with a low ability to pay are considered insignificant
- CBA ignores inequalities in the distribution of burdens and benefits among population groups

Accepting the assumptions of cost-benefit analysis of transport projects involves an implicit acceptance of the ethical and political values favored by these assumptions

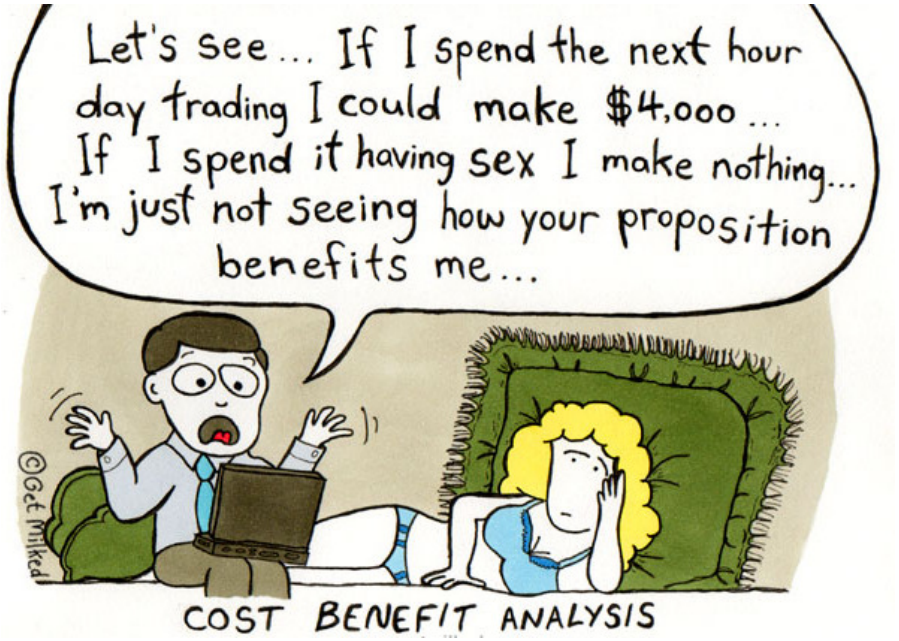
- The tendencies of overestimating benefits and underestimating negative environmental consequences generally tend to legitimize too high spending of society's resources on road construction
- CBA serves as a legitimating of a market-based development within a sector where the adopted political goals imply that the hitherto dominating, demand-led 'predict and provide' approach should be replaced by strategies meeting accessibility needs in other ways than through facilitating more traffic
- CBA generally promotes a deregulatory agenda under the cover of scientific objectivity

Conclusions

- CBA for transportation projects requires exact traffic forecasts and construction cost estimates, but in practice such forecasts are inevitably inaccurate and often biased
- Arbitrary monetizing of time and environmental impacts
- Ethical bias against the poor and future generations
- Undermining political objectives of changing current trends of traffic growth
- Inappropriate for assessing whether or not to build a proposed project of a particular category (e.g. a road project) in a specific geographic context
- Less inappropriate if the task is to compare different alternative ways of designing an already decided concept solution (e.g. layout A, layout B or layout C for a proposed new road)
- Other, less biased assessment methods exist! (e.g. stakeholder-differentiated MCA)

Thank you for spending your time listening!

(considering how it might have been spent alternatively…)



Suggested reading:

- Næss, P., Nicolaisen, M. S. & Strand, A. (2012): "Traffic forecasts ignoring induced demand: a shaky fundament for cost-benefit analyses." *European Journal of Transport and Infrastructure Research*, Vol. 12, pp. 291-309
- Næss, P. & Strand, A. (2012): "What kinds of traffic forecasts are possible?" *Journal of Critical Realism*, Vol. 11, pp. 277-295
- Næss, P. (2006): "Cost-benefit analyses of transportation investments: neither critical nor realistic." *Journal of Critical Realism*, Vol. 5, pp. 32-60.