Summary:

Value of time, safety and environment in passenger transport. Accidents - Valuation of statistical lives and limbs and the social costs of road accidents

The Norwegian valuation study has resulted in the following estimates of accident costs per casualty by injury severity: NOK 30.22 mill for a fatality, NOK 10.59 mill for a serious or severe injury, NOK 614,000 for a slight injury, and NOK 30,000 for a material damage. These values (accident costs) will include ex-post cost components (medical, material and administrative expenses, as well as output loss) plus the ex-ante valuation of statistical lives and limbs (the valuation of injury risk reduction). The updated ex-post cost components are obtained by a revision of the estimates underlying existing official values. The estimation of the ex-ante values of statistical lives and limbs have constituted the bulk of the work presented in this report. These estimates have been obtained through Internet based stated preference surveys. When it comes to the relative importance of the ex-ante value component in the total cost, it is calculated as follows: 86.45% of the fatality cost, 58.27% of the severe injury cost, 49.36% of the serious injury cost, and 76.15% of the slight injury cost.

Valuation of reduced fatality and injury risk (ex-ante economic valuation of statistical lives and limbs)

Stated preference - internet-based questionnaire survey

The ex-ante valuation of statistical lives and limbs has been based on stated preference methods, both choice experiments and contingent valuation.

Methodological challenges

We have consistently found that the greater the risk reduction, the higher the willingness to pay. This strengthens the validity of our estimates. Yet, the observed willingness to pay is far from being proportional to the risk reduction. This relationship may, however, reflect a reality in economic valuation: because of declining marginal utility we observe reduced willingness to pay per unit as the scope of the risk reduction is increased. It remains clear that the valuation of risk reduction involves considerable methodological challenges.

In our study, we have valued risk reduction from various perspectives and with differing methods and modelling approaches. We have tried to illuminate what elements, both in the valuation framework (scenarios), in the phrasing of the questions, and in the analysis, that may impact on (and explain) the final estimates. This broad approach has naturally resulted in a large range of values, reflecting primarily the fundamental methodological uncertainty. In the valuation of risk, the methodological uncertainty is considerably larger than the uncertainty associated with sampling bias, for instance. When comparing our study with other studies, the comparison must be made with regard to methodology and modelling. Our results from policy-based questionnaire versions, applying a scenario depicting a reduction of fatalities/injuries within a region, financed by taxes, are fairly in line with results from previous Norwegian studies, but somewhat higher than estimates from comparable foreign studies. We have also applied mode-specific questionnaire versions, where the valuation is pivoted to an actual trip, e.g., by car. This represents an innovative approach of our project, and although similar route choice studies have been performed, primarily outside Europe, we managed to generalize the approach to an Internet-based survey where the reference trip could have been carried out at any road section in Norway. Our estimates are considerably lower than estimates from the only former Norwegian attempt at valuing risk change in route choice. We consider our choice experiments from the mode-specific questionnaire versions to have worked quite well, and we emphasize the results from them in our proposals for adjusted unit prices for the transport sector.

Conclusions with regard to proposed unit prices

With multiple methods and multiple questionnaire versions, our suggestion of point estimates for the ex-ante valuation of statistical lives and limbs is primarily based on criteria related to the model goodness-of-fit indicators and the assessed theoretical validity. However, we find that both choice experiments in transport mode-specific questionnaire versions (particularly for trips by car) and contingent valuation in policy-based questionnaire versions score well on these criteria. From a route choice experiment for travel by car, including travel time, casualty risk, and toll payment, we estimate the value of a statistical life at NOK 22 million (€1 = approx NOK 8). From contingent valuation based on a scenario depicting reduction of road fatalities within a region, financed by tax payments, we estimate the value of a statistical life at NOK 39 million, when correcting for hypothetical overstatement accepting only stated willingness to pay for those being "definitely sure" about their hypothetical payment. Generally, the estimates from mode-specific questionnaire versions are below existing official values, while estimates from the policy-based questionnaire versions are above the existing values. Our conclusion with respect to a point estimate of the value of a statistical life is that the existing level in the official valuation for the transport sector, of about NOK 26 million, can be retained.

However, based on our analysis, we suggest adjusting the valuation of statistical injuries. While the value of a statistical serious injury is to be adjusted upwards, the value of a statistical slight injury is to be somewhat reduced. The term serious injury refers to all those victims classified as either seriously or severely injured. We have estimated the death rate equivalent of a statistical serious injury at about

20%, and we have applied this rate to set the value of a statistical serious injury to 20 % of the value of a statistical life. Regarding slight injuries, we have estimated a death rate equivalent of barely 1.8%, thus setting the value of a statistical slight injury to about 1.8% of the value of a statistical life. The following table summarizes our proposed ex-ante valuation components of the accident costs.

Table S.1: Ex-ante valuations of risk reduction from the valuation study, compared to existing official values (NOK-2009)

	Valuation study	Existing official values
Value of statistical life (VSL)	*26,126,880*	*26,126,880*
Value of statistical severe injury	*13,362,853*	*12,197,952*
Value of statistical serious or severe injury	*5,225,376*	*4,769,856*
Value of statistical serious injury	*4,019,520*	*3,669,120*
Value of statistical light damage	*467,342*	*638,976*

TØI report 1053C/2010

Revision of ex-post accident costs

Ex-post accident costs include four main components:

1. Medical costs; consisting of all costs related to medical treatment of transport casualties, including the costs of transport from the accident site to a medical centre or hospital.
2. Material costs; consisting of costs of repairing material damage caused by accidents, and possibly replacement of vehicles that cannot be repaired.
3. Administrative costs; consisting of all the extra resources applied for administration due to accidents, both public and private administration.
4. Loss of output and productive capacity; consisting of the value of lost output or productive capacity as a result of persons permanently or temporarily leaving the workforce.

Cost figures are updated from 1991 level to 2009 level. The update is based on readily available data sources. It has not been feasible within this project to collect new primary data as a basis for updating the cost figures. The following table summarizes the proposal for new unit values for ex-post accident costs:

Table S.2: Ex-post accident costs (sum of medical, material, administrative, and output loss), calculated per casualty, NOK-2009

Costs	Injury severity				Sum
	Fatality	Serious/ Severe	Slight	Material	
Per actual casualty	6,826,603	660,082	58,961	19,371	32,579
Per reported casualty	6,826,603	5,361,365	146,345	29,564	51,067

TØI report 1053C/2010

When it comes to adding ex-post accident costs to the ex-ante valuations of statistical lives and limbs, the net output loss (instead of the gross output loss) is used for the calculation of the total fatality cost. This is to avoid double counting, since it is reasonable to assume that people's willingness to pay for reduced

fatality risk includes an appreciation of their own consumption. The net output loss is approximately 60% of the gross output loss, thus we multiply NOK 6,826,603 by a factor of 0.6, yielding NOK 4,095,962.

Recommended accident costs

Based on the data collected and processed in this project, we have come to recommended values as shown in the table below for the loss of life and health as a result of accidents in transport.

Table S.3: Accident costs (NOK-2009) per casualty by injury severity

Type of injury / Type of cost	Costs					
	Fatality	Severe injury	Serious/Severe injury	Serious injury	Slight injury	Material damage
Ex post costs *	4,095,962	9,570,090	5,361,365	4,124,127	146,345	29,564
Ex ante costs **	26,126,880	13,362,853	5,225,376	4,019,520	467,342	0
Total accident costs	30,222,842	22,932,943	10,586,741	8,143,647	613,687	29,564
Total accident costs (rounded)	30,220,000	22,930,000	10,590,000	8,140,000	614,000	30,000

TØI report 1053C/2010

* Per casualty weighted average of road traffic accidents with or without motor vehicles involved. The ex-post costs include medical, material, administrative costs and costs due to output loss (net output loss for fatalities) - all per reported case. These are adjusted from NOK-2008 to NOK-2009 applying the consumer price index (www.ssb.no).

** Based on valuations of the reduced risk of fatality, hard injury, and slight injury, respectively. The valuation of statistical hard injuries is distributed to a value for a statistical severe injury and a value for a statistical serious injury applying the rate of existing official valuations.

Compared to existing official values for the transport sector, this proposal yields a slightly lower total unit cost for a fatality, a slightly higher total unit cost for a serious/severe injury, and a lower total unit cost for a slight injury. When it comes to the relative importance of the ex-ante value component in the total cost, it is calculated as follows: 86.45% of the fatality cost, 58.27% of the severe injury cost, 49.36% of the serious injury cost, and 76.15% of the slight injury cost.

For future price adjustment of unit costs (from NOK 2009 levels), we propose to apply the current official approach: The total accident costs of fatalities and injuries are adjusted using wage indices from Statistics Norway; the total unit cost of material damage is adjusted using the consumer price index (more precisely, the index for maintenance and repairs).

Uncertainty of estimates

There is uncertainty in the estimated ex-post accident costs as well as in the ex-ante valuations of reduced fatality and injury risk. Regarding the latter component, value estimates based on stated preference methods can be considered as particularly dependent upon the valuation context and the methodological approach. For a given method and context, the statistical uncertainty in the ex-ante value estimates is relatively limited, with a confidence

interval of about ± 10%. In this project, we have presented valuations applying several approaches, yielding a huge range of value estimates. Still, for operational purposes, we suggest a relative uncertainty margin of (at least) ± 20%.