Institute of Transport Economics
Norwegian Centre for Transport Research

Summary:

What can explain the decline in the number of traffic fatalities and serious injuries in Norway from 2000 to 2012?

TØI Report 1299/2014
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Oslo 2014, 132 pages Norwegian language

The number of traffic fatalities and seriously injured road users declined considerably in Norway between 2000 and 2012. The decline observed during this period was larger than in any other period of the same duration after 1970. The objective of the study presented in this report is to identify factors explaining the decline and, if possible, quantify the contributions of these factors to the decline in the number of fatalities and serious injuries. A broad survey of factors influencing road safety has been made. The study indicates that the two most important factors that have contributed to the decline in the number of fatalities and serious injuries is the increasing market penetration of various safety features on cars and the tendency, seen most clearly after 2006, for the mean speed of traffic to go down. Other factors that have contributed include a change in the age distribution of riders of large motorcycles (mean age has increased), a decline in the number of young drivers involved in accidents, a decline in the number of accidents involving children as pedestrians or cyclists, a decline in the number of accidents involving young moped riders, the construction of motorways and other roads with median barriers, and increased use of speed cameras.

Like many other highly motorised countries, Norway has experienced a sharp decline in the number of traffic fatalities and the number of seriously injured road users in recent years. It is likely that some of the factors contributing to this development are common to many countries. However, no study has been made to identify the factors that have contributed to improving road safety and estimate the contributions of these factors. The objective of the study presented in this report was to identify and estimate the effects of factors that may have contributed to the decline in traffic fatalities and serious injuries in Norway from 2000 to 2012.

Traffic fatalities and seriously injured road users in Norway 2000-2012

The number of traffic fatalities in Norway declined from 341 in 2000 to 145 in 2012. There was a particularly large reduction in the last half of the period, from 255 in 2008 to 145 in 2012.

The number of fatalities and seriously injured road users declined from 1606 in 2000 to 844 in 2012.

As the annual changes in the number of fatalities and serious injuries are to some extent random, analyses were based on trend lines fitted to the data. Trend lines were

fitted both for the total number of killed or seriously injured road users and for specific groups of road users, such as car occupants. Figure S.1 shows the recorded number of fatalities and serious injuries each year and two trend lines.

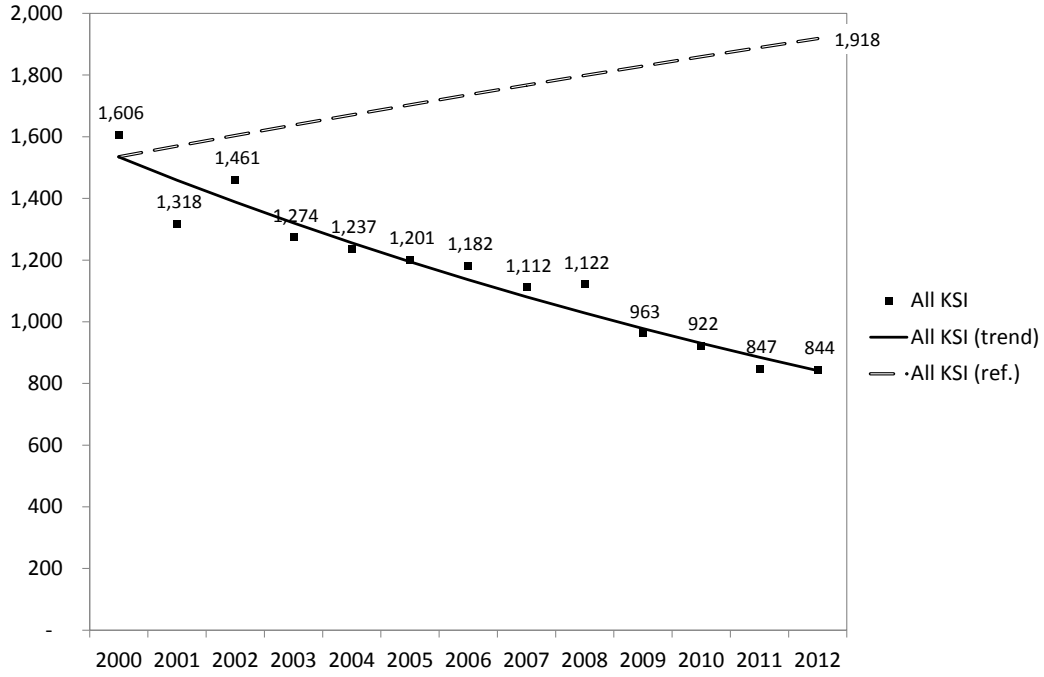

Figure S1: Number of killed or seriously injured (KSI) road users in Norway 2000-2012, exponential trend line fitted to the annual numbers and predicted number of killed or injured road users if everything except traffic volume had remained unchanged from 2000.

The solid line is the trend in the number of killed or seriously injured road users. According to this trend line, there has been a 45% reduction of the number of killed or seriously injured road users from 2000 to 2012. The dotted line shows how the number of killed or injured road users would have changed if everything except traffic volume had remained unchanged from 2000. Traffic growth is associated with an increased predicted number of killed or seriously injured road users, but the increase is not strictly proportional to the increase in traffic volume. The decline in the number of killed or seriously injured road users from the (counterfactually) predicted number for 2012 is 56%.

Study method

The number of traffic fatalities and serious injuries is influenced by a large number of factors. Reliable data are available only for a few of the potentially relevant factors. Hence, no analysis can hope to account for the entire decline in traffic fatalities and serious injuries, as many of the factors that may have contributed to this are not systematically recorded, too subtle to be meaningfully quantified or not known at all. To claim that a certain factor has contributed to reducing the number of fatalities and serious injuries, the following question must be answered:

How would the number of fatalities and serious injuries have developed in the absence of the factor?

This is clearly a difficult question to answer. History does not produce a counterfactual development; it only produces a single time-series which is the result of all factors influencing it. Yet, it is the question about counterfactual development that must be answered in order to identify the contributions of various factors to reducing the number of fatalities and serious injuries.

For most factors that have been included, the approach taken in this study was to reconstruct the contribution a certain factor made to the total kilometres of travel during the study period. As an example, it was estimated 11 % of all vehicle kilometres of travel produced by cars in 2000 were produced by cars that had electronic stability control. By the year 2012, this share had increased to 69 %. The increasing share of cars having electronic stability control is therefore one of the factors that may have contributed to reducing the number of fatalities and seriously injured road users.

To estimate the contribution from the increasing share of traffic performed by cars with electronic stability control, it was assumed, counterfactually, that this increase would not have taken place. In other words, it was assumed that the share of vehicle kilometres performed with electronic stability control would have remained at 11 % throughout the period. Had this been the case, the number of killed or seriously injured car occupants would have been higher than indicated by the trend fitted to the annual numbers, since this trend reflects the effects of, among other things, the increasing share of cars that have electronic stability control.

The trend in the changes in the number of killed or seriously injured road users was not identical for all groups of road users. Some groups of road users had a more favourable development than the overall trend. For these groups, the net contribution from the more favourable development was estimated by comparing the trend for the group concerned to the overall trend and estimating the difference.

A model for estimating the combined effects of all factors was developed in order to avoid double counting of effects. As an example, the increasing share of cars that have seat belt reminders was not included as a factor, since the effect of increased wearing of seat belts (irrespective of why wearing rate increased) was estimated separately. The point is that the effect of an increase in the use of seat belts captures the effect of anything that produced this increase, such as the more widespread use of seat belt reminders.

Factors whose effects were estimated

Effects were estimated for three main groups of factors:

1. Traffic growth from 2000 to 2012, a factors which, all else equal, would be expected to be associated with an increase in the number of fatalities and serious injuries.
2. Road safety measures introduced from 2000 to 2012, including new vehicle safety features, road-related safety measures, and police enforcement.
3. Changes in demography or the exposure of certain groups of road users, producing more favourable trends for these groups than the overall trend.

Table S.1 shows the estimated decline in the number of fatalities and serious injuries attributable to the factors included in the analyses.

Table S.1: Estimated reduction in the number of fatalities and seriously injured road users and the share (percentage) of the reduction attributable to the factors listed.

	Small vehicles	Heavy vehicles	MC/moped	Pedestrians	Cyclists	Total
Vehicle safety features	113.2 (51%)					113.2 (34.3%)
Speed reduction	59.9 (27%)	2.6 (85.3%)	15.5 (22%)	11.1 (51.9%)	7.4 (55.3%)	96.4 (29.2%)
Large MC (20-44 years)			38.5 (54.6%)			38.5 (11.7%)
Young drivers in single accidents	20.2 (9.1%)					20.2 (6.1%)
Motorways and median barriers	12.9 (5.8%)	0.4 (12.7%)	4.9 (6.9%)			18.2 (5.5%)
Children as pedestrians or cyclists				10.2 (48.1%)	6 (44.7%)	16.2 (4.9%)
Increased seat belt wearing	13.8 (6.2%)					13.8 (4.2%)
Less involvement of young moped riders			10.9 (15.4%)			10.9 (3.3%)
Speed cameras; section control	2 (0.9%)	0.1 (2%)	0.8 (1.1%)			2.8 (0.9%)
Total	222.1 (100%)	3.1 (100%)	70.5 (100%)	21.3 (100%)	13.4 (100%)	330.3 (100%)

The total reduction of the number of fatalities and seriously injured road users explained by the factors whose effects could be estimated is 330. According to the trend line fitted to annual data, there was a decline from 1534 killed or seriously injured road users in 2000 to 842 in 2012 (fitted values). Hence, about 48 % of the decline (330 out of 692) could be explained by the factors that could be quantified.

Two factors were estimated to have contributed to increasing the number of killed or seriously injured road users in the period: traffic growth and a small reduction of police enforcement. Figure S.2 shows the estimated contributions of various factors to the decline in the number of killed or seriously injured road users in Norway from 2000 to 2012.

Point B at the bottom of the figure shows the trend line. Section C shows the contribution to the reduction of the number of killed or seriously injured road users from the factors that could be quantified. These factors are their estimated contributions were listed in Table S.1. Section D shows the residual changes in the number of killed or seriously injured road users, i.e. the changes that are not explained by the factors whose effects the study estimated. Point A shows the predicted number of killed or injured road users if everything except traffic volume had remained unchanged from 2000. Finally, the section between points A and E show the estimated effects of reduced police enforcement from 2000 to 2012. The reduction in police enforcement refers to traditional enforcement performed by police officers. Speed camera enforcement increased during the period, see Table S.1.

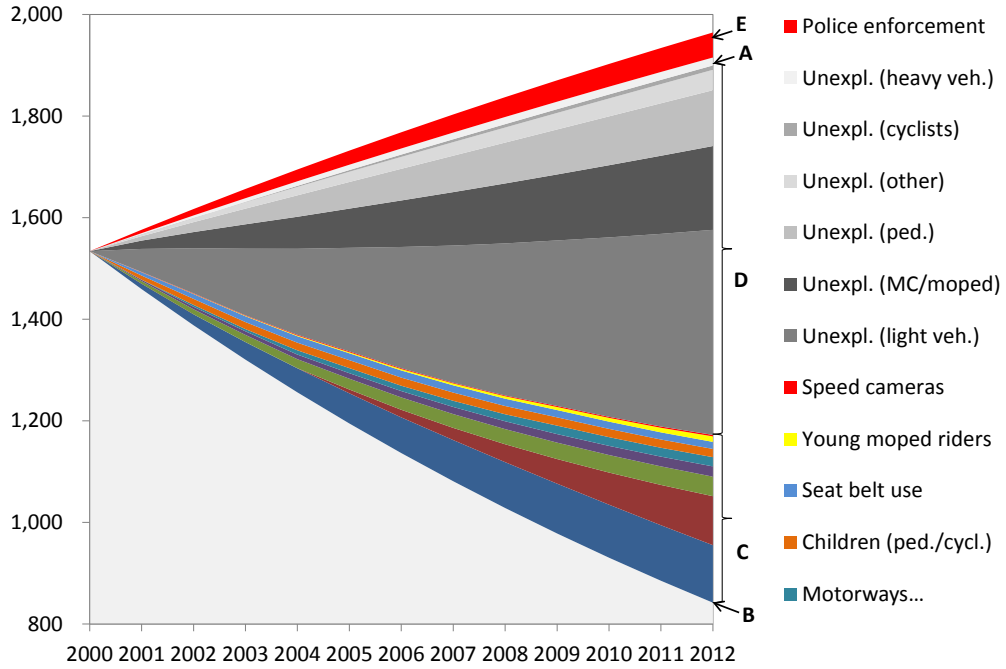

Figure S.2: Contributions from various factors to changes in the number of killed or seriously injured road users in Norway from 2000 to 2012.

Other factors that may have contributed

A large number of factors could not be included in the quantitative analysis, principally because there were not sufficient data to estimate their effects or because these effects were not sufficiently known to support estimates.

There have been several ***minor improvements on roads***. In 2002, data were collected on many of these improvements from the regional offices of the Public Roads Administration. The data collected were quite detailed, but they refer only to the year in which they were collected. Nevertheless, the data were used to develop illustrative estimates of the potential contributions from:

- Converting junctions to roundabouts
- Upgrading pedestrian crossings
- Road lighting
- Guardrails and safety zones
- Treatment of horizontal curves
- Changes in speed limits

Except for the changes in speed limits in 2001, the estimates must be regarded as hypothetical. However, they still indicate a realistic order-of-magnitude of the potential effects. For the measures listed above, a reduction of the number of killed or injured road users of about 45 in 2012 has been estimated.

Demographic changes and urbanisation: Demographic changes may have been favourable for road safety during the period 2000-2012, but it was only possible to estimate the contribution from a particularly strong decline in the number of killed or seriously injured road users in some road user groups. The number of young people living in rural areas has gone down. The age composition of riders of large motorcycles has changed. The number of older drivers is increasing.

Pedestrian protection: Cars may have improved with respect to characteristics that may protect pedestrians in case of accidents.

Demerit points: A demerit point system was introduced in Norway in 2004. Changes were made in the system in 2011. The system then became stricter for young drivers. The effects of the changes made in 2004 has not been evaluated. It cannot be ruled out that the system has reduced the number of accidents involving young drivers, but any effect is too poorly known to be quantified.

Driver training: Driver training was reformed in 2005. These reforms have been evaluated, but it is not clear what their effects have been. It was difficult to implement a rigorous research design, as the reforms applied to the whole country and no comparison groups could therefore be defined.

Campaigns: There have been many road safety campaigns in the period covered by this study. Effects on accidents have been found for at least one of these campaigns, the "Speak out!" campaign as implemented in the Western counties of Norway. The effects of this campaign in other parts of the country are, however, too poorly known to be estimated. The effects of the campaign are partly included in the estimate of the decline in the accident involvement of young drivers.

Economic fluctuations: An analysis was made of the relationship between fluctuations of the business cycle and the number of killed or seriously injured road users. It was found that during economic recessions, the number of killed or seriously injured road users is reduced more strongly than during better economic times. However, for the period 2000-2012 as a whole, the net effect of business cycle fluctuations was very close to zero.

Improved emergency medicine: Emergency medicine and the response times of emergency services may have improved after 2000, but too little is known about these improvements to quantify them.

Choice of trend function: The trend function was based on data for the period 2000-2012 only. Had a longer period been used to determine the trend, it is likely that the trend would have been flatter. This suggests that part of the decline in the number of killed or seriously injured road users from 2000 to 2012 could be the result of random fluctuations.

It has been estimated that about 25% of the decline in the number of killed or seriously injured road users can be attributed to the co-incidence of an abnormally high number at the beginning of the period and an abnormally low number at the end of the period.