Traffic and traffic safety in Central and Eastern European Countries

S. Oppe & M.J. Koornstra

D-92-15

Traffic and traffic safety in Central and Eastern European Countries

Paper prepared for 17th International Study Work on Traffic Engineering and Safety: Road Traffic; Finding a new Balance, Warsaw, 7-12 September 1992

D-92-15
S. Oppe & M.J. Koornstra
Leidschendam, 1992
SWOV Institute for Road Safety Research, The Netherlands

SWOV Institute for Road Safety Research
P.O. Box 170
2260 AD Leidschendam
The Netherlands
Telephone 31703209323
Telefax 31703201261

TRAFFIC AND TRAFFIC SAFETY IN EASTERN EUROPEAN COUNTRIES.

1. The development of traffic and safety in western economic countries.

It has been proved for western economic countries that the development of traffic and traffic safety can be described by macroscopic models in de long run (from 1950 to 1990 and for the USA from 1925 to 1990). Furthermore, that these developments are closely connected. In a number of publications from SWOV, evidence has been given for the nature of these developments and there theoretical background. For recent publications refer to Oppe and Koornstra (1990), Oppe (1991a and b) and Koornstra (1991). We will give a short summary here.

The development of traffic (measured as the total number of vehicle kilometres for a country in a particular year) can be described by a sigmoid shaped curve, such as the logistic function.

The development of the fatality rates or injury rates (number of fatalities or injuries per vehicle kilometre) can be described by exponential functions with a negative slope. Such functions are well-known in learning psychology. Therefore, the development of these rates may be regarded as learning curves, resulting from the way in which society as a whole learns to deal with the problems of traffic safety.

The total number of fatalities and injuries result from the combination of the continuously increasing sigmoid-shaped function for the amount of traffic and the continuously decreasing function for the rates by multiplication. The rise and fall of the total numbers noticed for many countries around 1970 can be explained from these two monotone developments.

It has been shown that the development of the number of fatalities is a function of the derivative of the development of traffic. There is a fixed relation between the slope parameter of the logistic function for traffic and the slope parameter of the exponential function for the fatality rates. Furthermore, it is shown that this improvement of safety, measured by means of the decline in the fatality rates, follows the speed of growth of traffic volume with a delay of about ten years.

Apart from these general macroscopic trends, there are systematic deviations due to periodical economic trends. A period of traffic growth larger than expected (typically with a duration of ten-to-twelve years) will be followed by an equal period of smaller growth.

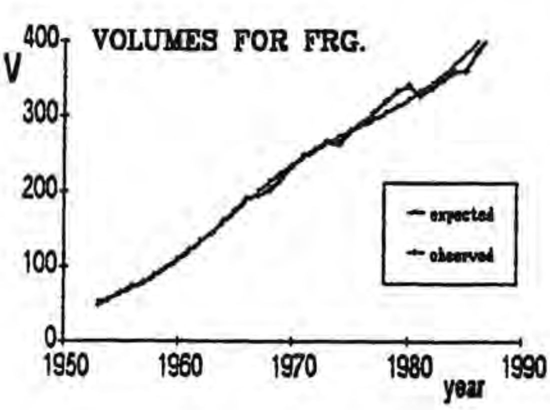


Fig. 1a Observed and expected veh. km's for the FRG.

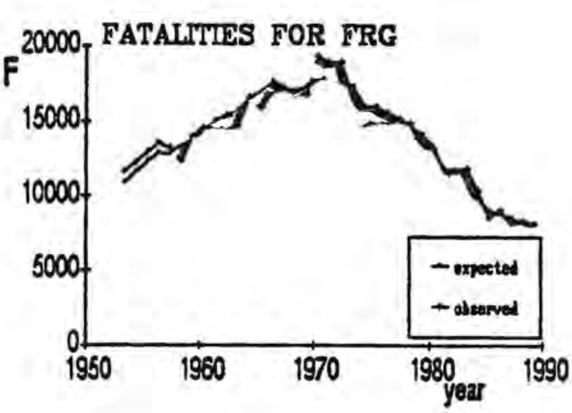


Fig. 1b Observed and expected fatalities for the FRG.

An increase in traffic growth that is larger than expected, results in a direct increase in fatalities relative to the expectation from the macroscopic trend, with a zero or short delay. If the traffic growth is smaller than expected, then the number of fatalities will decrease directly.
The combination of these two trends, a macroscopic trend in the development of fatalities following the macroscopic development of traffic with a delay of approximately ten years, combined with an economic wave directly mirrored in the number of fatalities, explains more than 90% of the variance in the number of fatalities. Fig. 1 gives an example of observed and expected numbers for the Federal Republic of Germany (FRG).

2. The development of traffic and safety in Eastern European countries.

Analyses of the type mentioned above cannot be executed for the Eastern European countries, because of lack of data. Apart from data about recent years of the International Road Traffic and Accident Database (IRTAD), two main sources are available at SWOV. The data from the International Road Federation (IRF) and the United Nations Statistics of Road Traffic Accidents in Europe. These databases have no year to year data before 1960. Data about the total amount of vehicle kilometers is almost completely missing for the Eastern European countries.

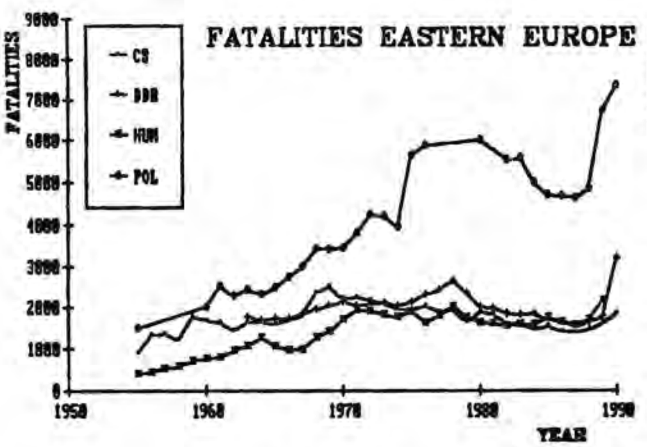


Fig. 2a Fatalities in four Eastern European countries.

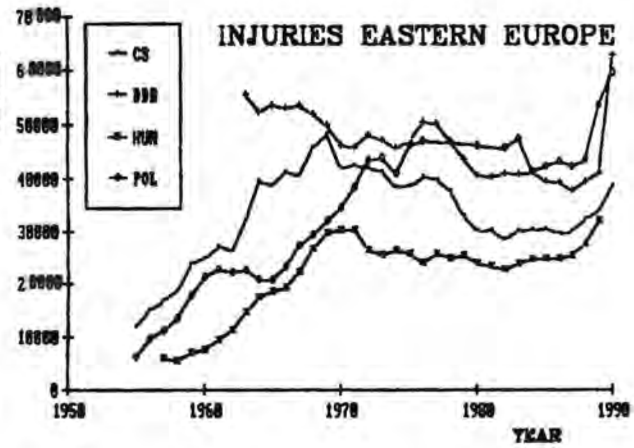
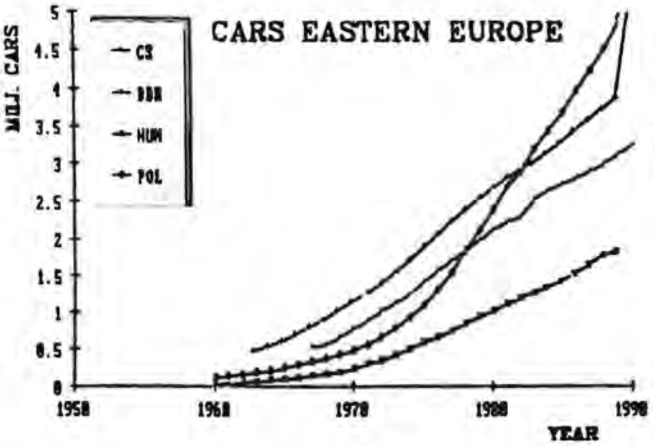


Fig. 2b Injuries in four Eastern European countries.

The data that is used concerns the number of killed and injured people, the number of cars and the number of inhabitants for Czechoslovakia, the formerly called DDR, Hungary and Poland. The data is available from 1960 onwards on a yearly basis till 1990 for Poland and till 1989 for Hungary; from 1963 onwards for the DDR and for Czechoslovakia from 1967 onwards, both till 1990. Some datapoints are missing, some of these have been interpolated. The category of cars used in our analyses concerns the passenger cars, including taxis, but excluding lorries, buses and motorcycles. The replacement of the number of vehicle kilometers by the number of passenger cars leads to the same conclusions under the assumption of proportionality. This assumption seems reasonable for the FRG, with a constant value of 14730 veh. km. per car. There are indications that in recent years this proportionality is also found for the Eastern European countries, with a constant comparable to that of the FRG.

Figure 2a represents the data on fatalities for the four countries. The numbers for Poland are considerably higher than for the other countries, which numbers are of the same order. For all countries the number of fatalities tends to increase in 1989 and 1990. Figure 2b represents the data on injuries. From this figure it can be concluded that the level of the numbers of injured people do not agree with those for the fatalities, probably due to a difference in definition of injury. Therefore, the further analyses are restricted to fatalities.



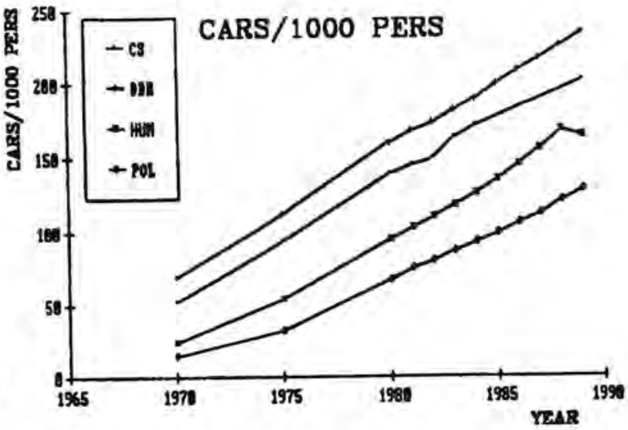


Fig. 3a Number of cars in millions for four countries.

Fig 3b Number of cars per capita in four countries.

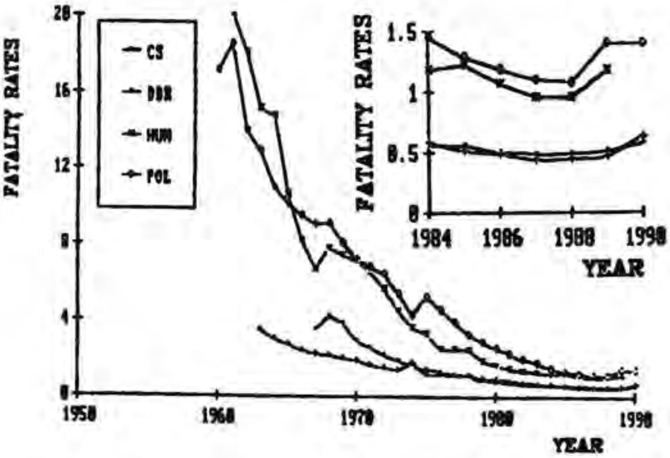


Fig. 4 Fatality rates per 1000 cars for four Eastern European countries.

Figure 3a represents the development in the number of cars. For Poland a steep increase can be noted around 1975. The number of fatalities tended to decrease since 1970 for Czechoslovakia as in many other countries and since 1980 for the DDR, Hungary and Poland. This decrease is followed by a sharp increase since 1989. Figure 3b gives the number of cars per capita. It is clear that the DDR and Czechoslovakia have the highest rates, followed by Hungary and Poland.

Figure 4 gives the fatality rates (number of fatalities per car). A steadily decreasing trend is noticeable in all four curves as was to be expected. The order is the reverse of that in Figure 3b, meaning that the heavier motorized countries are safer per car. In 1989 the total number of passenger cars in all four countries together is equal to the number in the FRG around 1970. If we compare the total number of 12271 fatalities in these countries with the number of +/- 19000 in the FRG, then we find that these Eastern European countries (also having more inhabitants) are much safer now than the FRG was in 1970. There is a similarity between the DDR and Czechoslovakia, being the two most safe countries, and between Hungary and Poland as the two least safe countries. However, the difference in unsafety between these two pairs of countries becomes smaller in time. The fatality rates seem also to rise after 1988. This is in agreement with the rise in the total number of fatalities for these countries in that year. We know from recent statistics (Brühning, 1991) that the fatalities in Eastern Germany even increased by 78.5% in 1990. The most important question therefore is: what is the price in safety that have to be paid by the Eastern European countries in the recent future?

3. Theoretical predictions.

One of the most vulnerable scientific exercises is making predictions. We do not know the future. For social sciences the situation is much more difficult than for the natural sciences. The future of the society will be completely different from the past, and particularly so in Eastern Europe. Still we think that on the bases of the theoretical framework, as presented in paragraph 1, a general outline can be given, under the assumption that there will not be a worldwide economical depression or serious threats of war.

We assume that the developments in the Eastern European countries before 1988 were in general similar to those in the western countries, but at a lower speed and/or with a lower saturation level for traffic volume. Evidence for this assumption is indeed found in paragraph 2. From 1988 onwards, a transition took place to a development of the same type, but at a higher speed and/or with a higher saturation level for traffic volume than the previous development. The following can then be argued from the conclusions in paragraph 1.

Figure 5a represents the original development in the growth of the number of cars with a maximum of four million cars for a country such as Czechoslovakia. Furthermore, the new trend at a higher speed (similar to the original growth-rate in Poland and Hungary), with a maximum of five million cars. In 1988 a transition is assumed to take place from the slower development to the faster one, which will be completed around 1995. It is assumed that this process does not influence the other traffic modes considerably. A sudden increase in the number of fatalities and probably also in the fatality rate is to be expected in the beginning. Signs for both developments are already noticeable.

It has to be argued that not only the increase in the number of cars is important, but also in their use. It is not imaginary that there also is an increase in the number of vehicle kilometers per car. For that reason the development may be more explosive than estimated from the increase in the number of cars only. Figure 5b gives the changes for the fatality rates related to the transition. The figures for the original curve agree again with those for Czechoslovakia. The new curves have a speed similar to that for Poland in the original situation. We notice a direct increase without delay as expected by the theory, but the increase is over a much longer period than the transition for car growth. This is caused by the delay between effective safety measures to be taken in addition to the originally planned measures, to cope with the new problems. If we realize that this delay is normally ten years, then the plotted curve might even be too short. However, it is possible that an effective policy, using the experience gathered in western countries, may speed up the process. Figure

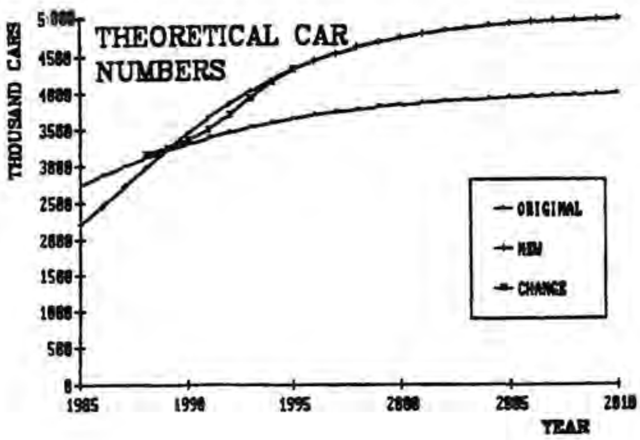


Fig. 5a Theoretical car numbers in case of a transition to a higher rate system.

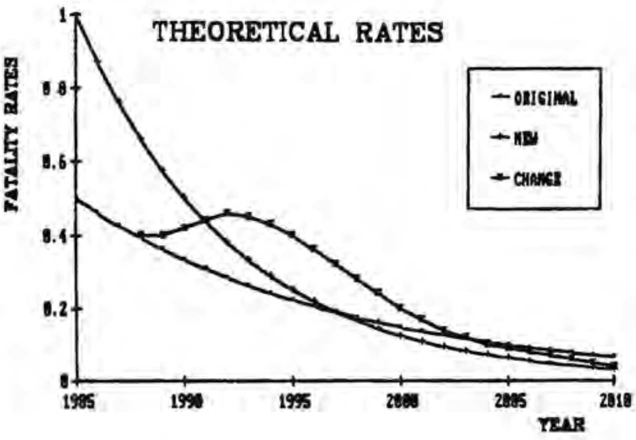


Fig. 5b Theoretical increase in fatality rates resulting from a transition.

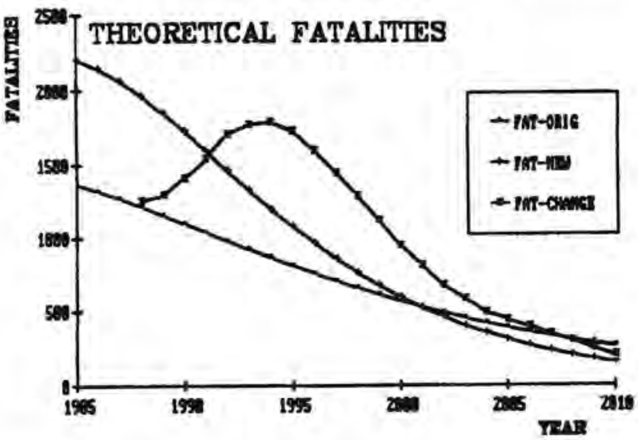


Fig. 5c Theoretical fatalities resulting from the combination of an increased car use and an increased fatality rate.

5c gives the results of both developments in terms of fatalities again at a scale comparable to Czechoslovakia. This curve shows a considerable increase in the number of fatalities, due to a higher number of vehicle kilometers together with a higher fatality rate per kilometre.

4. Lessons to be learned.

As mentioned before, a sudden increase in traffic has a direct negative effect on safety. Therefore, it would be better to slow down such an increase, e.g. by increasing the tax-rates related to the use of the road (the amount of vehicle kilometers driven) considerably or progressively.
A second measure is to invest as much as possible in the improvement of the road infrastructure. The more kilometers are driven on motorways, the safer the situation. In the western countries there has been a reactive

policy with regard to the improvement of the road network in the past. An anticipatory approach would be much better. This not only concerns the network of motorways, but also circular roads around urban areas etc.
One of the problems in western countries is that the insurance companies do not really benefit from safety reductions, because in the long run these savings result in smaller insurance premiums. Therefore, it is sometimes argued that a governmental insurance system would be better. This could be realized by including insurances in the tax-rates. Savings resulting from higher safety standards can be used to invest in a further improvement in safety. In such a system safety benefits have also economic advantages for the society as well as for the individual roadusers.
Recently, in western countries there is a need for a more consistent traffic and traffic safety system. E.g., in the Netherlands a comprehensive plan is introduced in which the safety aspect is an integral part of the traffic development plan. Measures with regard to mobility are explicitly evaluated on their safety consequences. This concept of "Duurzaam Veilig" (solid safety) is based on a number of elementary principles, such as:

- uniformity in the lay-out of the road network;
- a small number of self-explaining road types;
- strict rules for admission and behaviour on high speed primary roads;
- measures to assure low speeds on roads with mixed functions;
- separation of traffic modes that are incompatible;
- priority for other functions than transport on roads in living areas.

Such a traffic system should grow over a long period, in small steps, consequently applying the main rules for improvement, aimed at a safe system in the long run. An example of such a change in policy is that a black spot programme should not focus on the improvement of individual locations, but on the functions of the elements in the network in the first place. Measures aimed at structural improvements of parts of the network with many (possibly lower ranked) black spots should get priority. A number of optimal improvements at various isolated locations may create an incoherent road network in the long run.
Another important aspect of the long term planning is the relation between the road network and the public transport system. In Eastern Europe there is considerably more railway transport than in Western Europe (Strobel, 1991). In many western countries public transport systems were neglected over a long period. Recently, there is a changing attitude towards public transport systems which are now stimulated again. Substitution of road traffic by public transport will be one of the measures to get the congestion problems at the roads under control. The Eastern European countries should not make the same errors that the West has made in the past, but modernize and improve their rail network system. Therefore, from the beginning onwards, high tax-fares, in order to discourage private car use, should be accompanied by low fares for public transportation, in order to offer an alternative to potential car-users now and to anticipate on the vital function of the railway system in the future.

It is an appealing thought to consider the opportunities in Eastern European countries to benefit from the experience in Western European countries, where the lessons have been learned the hard way in the past.

5. References.

Brühning, E. Traffic safety in Eastern and Western Europe at the beginning of the nineties. Contribution to the International Study Week in Warsaw 1992, BASt, 1991.

Koornstra, M.J. Evolution of mobility and road safety. Proceedings of the Second Int. Conf. on new ways for improved road safety and quality of life. Eds.: Hakkert, A.S. and Katz, A., Technion, Haifa, 1992.

Oppe, S. and Koornstra, M.J. A mathematical theory for related long-term developments of road traffic and safety. In: Proceedings of the Eleventh ISTTT, New York, Elsevier, 1990.

Oppe, S. The development of traffic and traffic safety in six developed countries. Accid. Anal. & Prev. 23:401-412, 1991.

Oppe, S. Development of traffic and traffic safety:global trends and incidental fluctuations. Accid. Anal. & Prev. 23:413-422, 1991.

Strobel, H. On the structural change of mobility demand in Middle and East Europe. In: Proceedings of the third ISIRT Round Table, Toulouse 1991.