
Summary:

Internationalisation in road transport of goods: safety outcomes, risk factors and measures

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The present study uses several methods to examine safety outcomes, risk factors and measures associated with increasing internationalisation in road transport of goods. A literature review indicates that foreign heavy goods vehicles (HGV) drivers generally have twice the risk of domestic drivers. Analysis of Norwegian accident data indicates that in comparison with Norwegian HGVs, foreign HGVs have three times the risk of being involved in a single vehicle accident, twice the risk for a head-on collision, and nearly twice the risk of a collision with a vehicle driving in the same direction. Foreign professional drivers in Norway also seem more likely to trigger fatal accidents than Norwegian drivers. Based on our data, we conclude that two risk factors in particular seem to be important: (1) experience with/ competence on Norwegian roads and (2) winter driving. Norwegian roads may be challenging for foreign drivers, e.g. regions with roads of a poorer standard than those normally found on the European continent, and hilly terrain (steep gradient). Foreign HGV drivers have higher risk in the west, central and north regions of Norway, where roads are more demanding. Results also indicate that compared to foreign drivers, Norwegian HGV drivers are better equipped, have more competence for and mastery of winter driving. Norwegian drivers also have a lower perception of risk related to winter driving. We highlight six measures which seem to be important for transport safety of foreign actors: 1) Increase heavy vehicle inspections, 2) Education/information on winter driving and Norwegian road conditions aimed at foreign drivers, 3) Clarify (and increase) the responsibilities of transport buyers, 4) Expand the authority of the NPRÅ, 5) Change the sanctioning opportunity from police reports to fines and 6) Increased cooperation between domestic authorities.

Background and aims

The European Union (EU) promotes a gradual lifting of restrictions on foreign hauliers involved in domestic road transport of goods (cabotage), and a major deregulation was scheduled in 2014. Due to complaints from several member states facing competition from new EU-countries with lower labour costs, this process was postponed. An important aspect related to such deregulation includes potential consequences for transport safety and accident risk factors.

A liberalization of the current road cabotage rules may further increase the share of foreign heavy goods vehicles (HGVs) on Norwegian roads, and previous research indicates that HGVs registered in foreign countries have up to 2.5 times higher accident risk than Norwegian HGVs on Norwegian roads (Nævestad, Hovi, Caspersen & Bjørnskau 2014). Little is however known about the causes of the differences in accident risk between different national groups.

The aims of the present study are to:

- 1) Examine safety outcomes of increasing internationalisation in (Norwegian) road transport of goods
- 2) Discuss the importance of potential risk factors.
- 3) Discuss potential measures to further increase the safety of road transport of goods.

The study is part of a larger research project aiming to assess the effect on accident risk of the increasing shares of foreign actors in road and sea transport of goods in Norway; and to provide a scientific knowledge base that Norwegian authorities can use to develop measures to reduce any increased risk identified. Information on the project: «Safe Foreign Transport» (SAFT) can be obtained on the website: www.toi.no/SAFT. The project is funded by the TRANSIKK program of the Norwegian Research Council.

Multi-method approach

The study employed five different methods to generate data needed to meet each of the three main study aims:

- 1) *Analysis of accident data.* We studied fatal accidents analysed by the Accident Analysis Groups (AAG) of the National Public Road Authority (NPRA), and accidents from Statistics Norway's (SN) database of police reported personal injury accidents to examine what kind of accidents foreign hauliers are involved in, and risk factors related to these accidents.
- 2) *Literature review.* We conducted a literature review on safety outcomes, risk factors and measures. The literature review included 25 studies that were relevant to at least one of the three aims of the study listed above.
- 3) *Qualitative interviews.* We conducted 11 qualitative interviews with 12 sector experts representing employers, employees and authorities, again to inform each of the three aims of the study.
- 4) *Field work.* We conducted field work with foreign drivers in Norway at various driver rest stops, terminals and parking lots, and with regulatory personnel and drivers involved in heavy vehicle inspections at an NPRA checkpoint.
- 5) *Small-scale survey.* We conducted a small-scale survey comparing foreign drivers from Central and Eastern Europe (CEE) (N=52), and Western Europe (WE) (N=17) with Norwegian drivers (N=61) and a second group of Norwegian II (N=224) drivers from three companies with good safety cultures. Foreign drivers were recruited at rest stops, while Norwegian drivers (N=61) were recruited through websites. The group of WE drivers was unfortunately too small to be useful for drawing any solid conclusions.

We also draw on NPRA inspection results and statistics from towing companies.

Foreign drivers have twice the risk of domestic drivers

In the literature review, we found eight studies indicating that the HGV accident risk varies by a factor of up to ten in European countries, and that the accident risk of foreign HGVs is approximately two times higher than that of domestic HGVs in the

studied European countries. Thus, it seems that increased internationalisation of road transport of goods in Norway has the potential to increase the number of HGV accidents. It must be noted, however, that Germany has a relatively low HGV related fatality risk (AECOM 2014), despite having probably the highest share of transport with foreign HGVs in Europe (35 %). Future studies of this issue should therefore compare risk and risk factors of foreign and domestic HGVs in Germany.

Analysis of AAG data from 2010-2013 indicates that 17 % of the professional drivers involved in fatal accidents in Norway (N=230), had a foreign nationality (while they account for 6 % of the travelled HGV kilometres in Norway). Results also indicate that foreign professional drivers in Norway seem to be more likely to trigger fatal accidents than Norwegian drivers (Figure S.1).

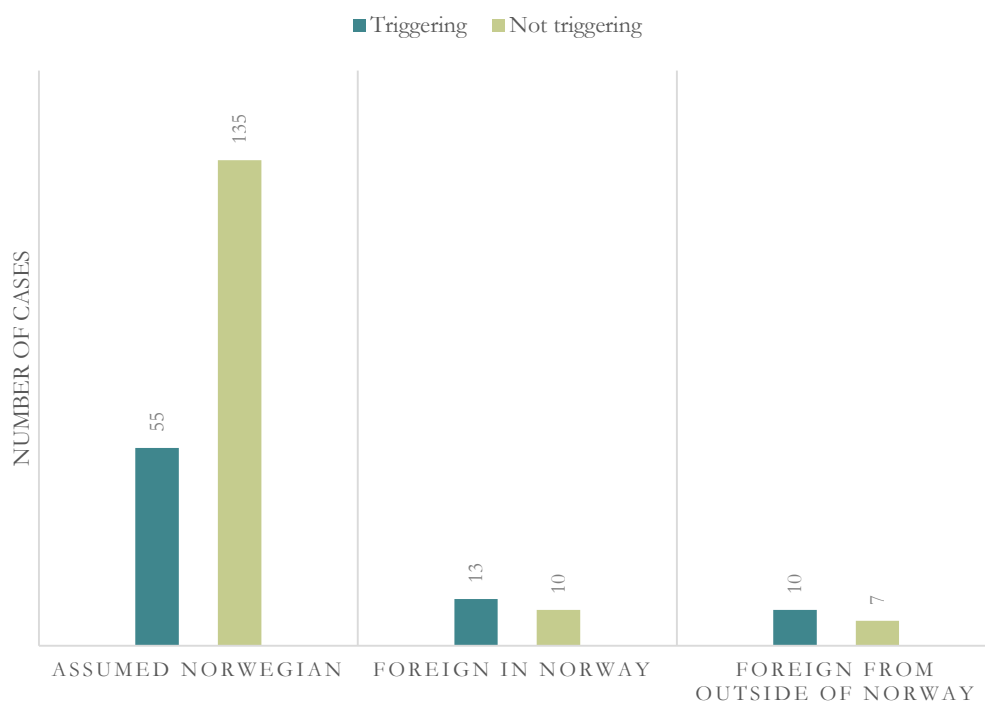


Figure S.1 Number of Norwegian and foreign professional drivers involved in fatal accidents on Norwegian roads between 2010 and 2013 who drove a vehicle classified by AAG as triggering.

Less than a third (29 %) of the Norwegian professional drivers drove “triggering” vehicles but more than half (58 %) of the foreign drivers did so. Of the 40 foreign professional drivers, 35 drove HGVs, while 5 drove buses. The drivers classified as “Foreign in Norway” have driven regularly in Norway for at least 10 years preceding the accidents.

Analysis of police reported traffic accidents with personal injuries from 2007-2012 indicates that Norwegian and foreign drivers also have a different risk of being involved in different accident types (Figure S.2).

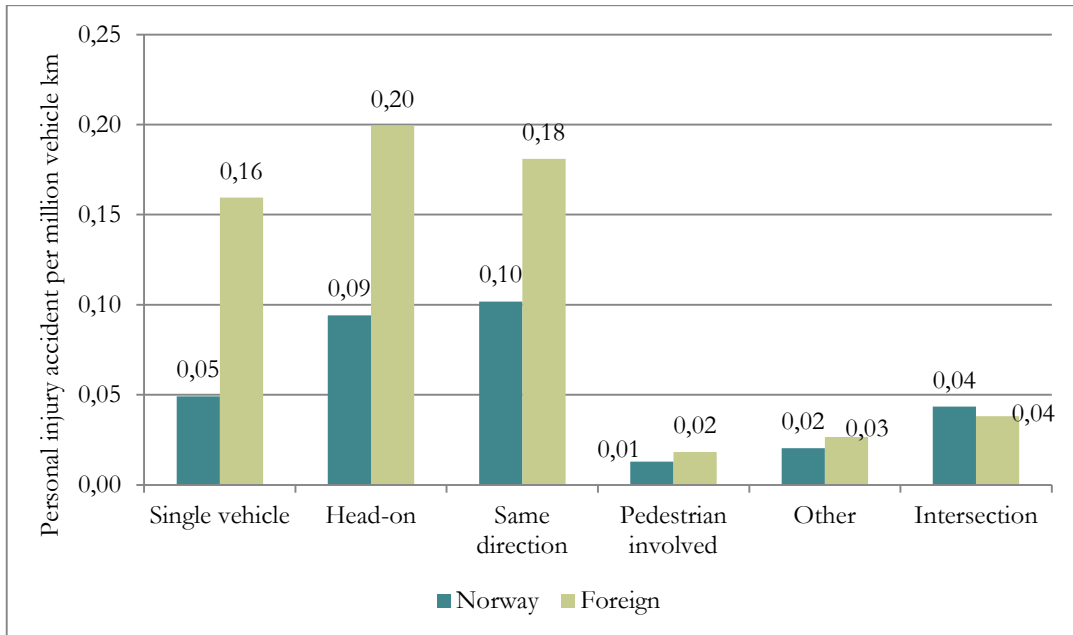


Figure S.2 The risk of different accident types for Norwegian (N=3320) and Foreign HGVs (396) involved in police reported traffic accidents with personal injury in Norway 2007-2012.

Foreign HGVs have a three times higher accident risk of single vehicle accidents than Norwegian HGVs, twice the risk of head-on collisions, and nearly twice the risk of collisions with vehicles driving in the same direction. The risk of being involved in intersection collisions is similar for Norwegian and foreign HGVs, probably because Norwegian HGVs have a higher share of their driving in densely populated areas with more intersections, while foreign HGVs have a higher share of their driving on main roads. Only the differences between Norwegian and foreign HGVs' risk of single vehicle accidents, head-on accidents and accidents with vehicles driving in the same direction are statistically significant (at the 5 % level).

Risk factors

We identify 12 potential risk factors related to internationalisation of the haulier industry in Norway, based on previous research and interviews: 1) winter driving, 2) drivers' transport safety behaviours, 3) company follow up of drivers' transport safety behaviours, 4) safety culture, 5) organization of transport assignments, 6) safety management, 7) competence, training and experience, 8) technology and equipment, 9) economy, competition and pay, 10) rules and enforcement, 11) working hours and fatigue and 12) the road and road environment. We are unable to conclude on the importance of several of these risk factors, either because we have not measured the relative importance of these risk factors in our survey, or because results from the different methods that the study employs diverge. Nevertheless we can say that two risk factors seem to be important: (1) experience with/competence on Norwegian roads and (2) winter driving.

Experience with and competence for Norwegian roads/conditions

According to the results of the literature review, Norwegian roads may be challenging for foreign drivers, e.g. regions with roads of a poorer standard (e.g. narrow, many

curves) than those normally found on the European continent, and hilly terrain (steep gradient).

In line with the assumption that the Norwegian road network is demanding for foreign drivers, previous research (Nævestad et al 2014) indicates that HGVs from non-Scandinavian countries have a three times higher accident risk than Scandinavian vehicles in the western, central and northern regions of Norway (where the roads are more challenging). HGVs from non-Scandinavian countries have twice the risk of accidents in western/central/northern Norway that they have in the south/east. In comparison there is little difference between accident risks for Scandinavian HGVs in these two parts of the country. Thus, we may assume that it is more difficult for foreign drivers to drive in some parts of Norway, perhaps because they lack the experience and competence of Norwegian drivers.

Interviewees underlined that Norwegian road conditions place strong demands on (foreign) drivers' competence. Driving safely is strongly dependent on driver' experience, which allows them to judge situations correctly, evaluate risks and adapt their speed to conditions. Because of their experience, the Norwegian drivers are able to recognize dangerous situations and judge risks correctly.

For the foreign drivers, on the other hand, the Norwegian roads may come as a surprise, interviewees suggested. Driving in hilly terrain requires a lot of driver competence and experience, for instance related to using motor brakes and adaptation of speed. Being foreign to the Norwegian road conditions, with varying standards and sometimes poor roads, is a disadvantage in itself, because you do not know what to expect, or how to adapt to the conditions.

In the small-scale survey we included a question to compare drivers' competence on winter loading by asking them to respond to the statement: "In the winter, I load the trailer so that I get maximum weight on the driving axle" (Figure S.3).

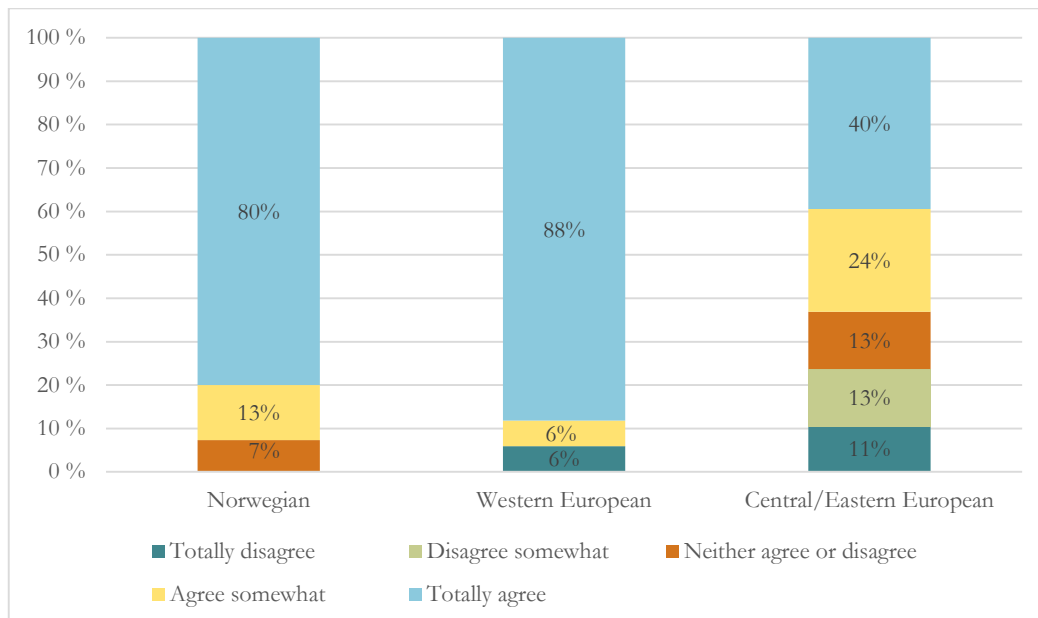


Figure S.3 National groups' distributions of answers to the statement: «In the winter, I load the trailer so that I get maximum weight on the driving axle» Per cent. Norwegian (N=61), Western European country (N=17), Central/Eastern European country (N=45).

80 % of the Norwegian and 88 % of the WE drivers correctly agreed with the statement, while only 40 % of the CEE drivers did. This indicates that the former groups have a better competence on loading for winter conditions.

Winter driving

Analysis of personal injury accident data indicates that a greater share of accidents involving HGVs from non-Scandinavian countries occur in the winter (62 %) than those involving HGVs from Scandinavian countries (53 %). In addition, HGVs from non-Scandinavian countries (38 %) have a greater proportion of their accidents on road surfaces with ice/snow/slippery conditions than the Scandinavian (29 %) vehicles have. This may indicate that foreign HGVs have a higher accident risk in the winter than Norwegian HGVs.

Interviewees agreed that winter driving is the main safety challenge related to foreign drivers in Norway. This challenge is multi-faceted. Foreign HGVs are less suited to Norwegian winter conditions as they often have two axles, providing them with a poorer grip than three axle HGVs, which can lift the rear “boggi” axle and increase the weight on the driving axle. Winter equipment (tyres, snow chains) has previously been a challenge, but it seems that this situation has improved.

Results indicate that, given their different exposure to winter roads, it seems that foreign drivers and especially drivers from CEE have a higher risk of being in need of towing assistance when driving on Norwegian winter roads than Norwegian drivers.

In the small-scale survey, we examined several aspects of winter driving (Figure S.4).

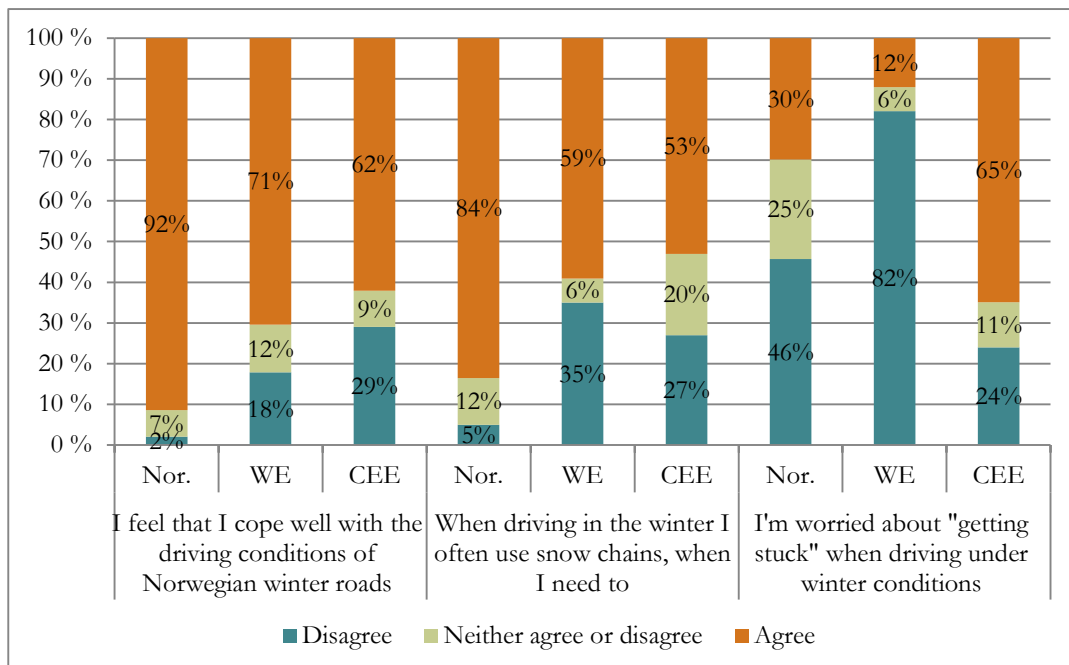


Figure S.4 National groups' distributions on three questions on feeling of mastery related to winter driving, snow chain use and perception of risk of "getting stuck" while driving under winter conditions. Per cent. Norwegian (Nor.) (N=61), Western European country (WE) (N=17), Central/Eastern European country (CEE) (N=45).

Figure S.4 indicates that Norwegian drivers have a stronger feeling of mastery of winter conditions than foreign drivers, especially compared to drivers from CEE. We also found that CEE drivers are more worried about “getting stuck” when driving under winter conditions than Norwegian drivers (Figure S.4). Interviewees believed that foreign HGV drivers have a considerably greater risk of “getting stuck” under winter conditions than Norwegian HGV drivers.

Drivers from CEE reported of a lower number of snow chains for their trucks/ trailers than Norwegian drivers, and it seems that the Norwegian drivers are more inclined than the two other groups to use snow chains when they need to. Also, the Norwegian drivers report a higher incidence of winter tyres on their vehicles when driving on winter roads. NPRA inspection data (2012-15) on winter equipment indicates that this has improved in recent years.

In 2011, the NPRA, “If Forsikring”, “Falck Redning AS” and “Viking” started a cooperation project to map where accidents occur on Norwegian roads. Figure S.5 shows the causes of damage for foreign (N=747) and Norwegian (N=2663) HGVs that were given towing assistance and registered in this project.

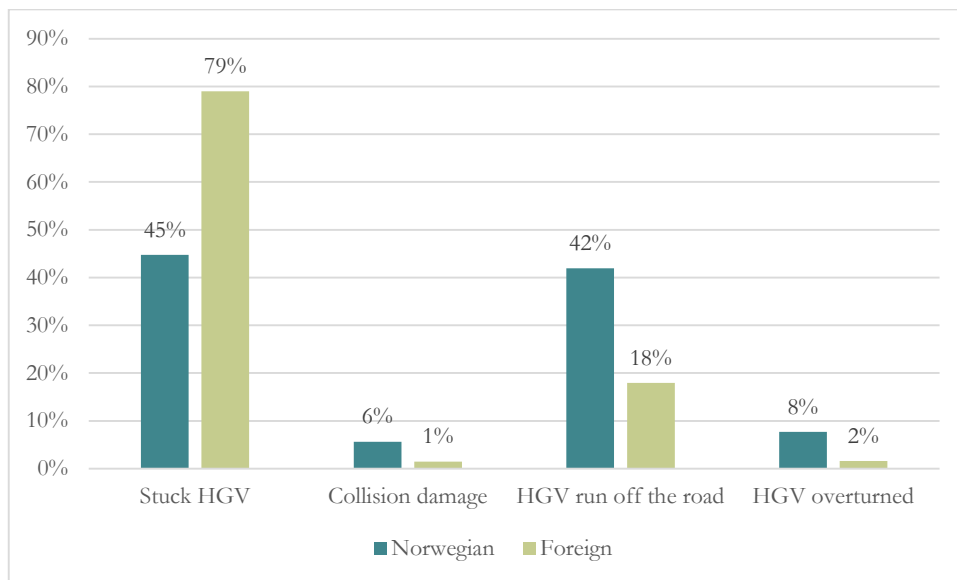


Figure S.5 Cause of damage for foreign (N=747) and Norwegian (N=2663) HGVs that were given towing assistance and registered in the “FOU-Bilberging” project from January 1st 2013 to November 2015. Source: Falck Redning AS.

Figure S.5 indicates that foreign HGVs are more likely to “get stuck”, while Norwegian HGVs are more likely to run off the road. This is in line with a hypothesis about behavioural adaptation that was suggested by the interviewees. According to this hypothesis, Norwegian HGV drivers feel safer and more confident while driving on winter roads, because of their equipment and their experience. They therefore drive faster. When they encounter problems on winter roads, they therefore tend to run off the road. The foreign HGV drivers on the other hand, drive slower because they have poorer tyres, older vehicles, possibly less experience and thereby feel less safe. As a consequence, they are more likely to get stuck on winter roads. It is important to note that this is merely a hypothesis.

It seems that foreign heavy vehicles are overrepresented among the vehicles that got “stuck” while driving on winter roads, as 33 % (N=590) the 1781 HGVs that were “stuck” on winter roads were foreign. In comparison, 11 % of the HGVs involved in

personal injury accidents in Norway were foreign. Foreign HGVs accounted for six per cent of the average domestic transport in Norway in 2009-2012.

Measures

We discuss 13 main categories of measures addressing risk factors for foreign actors transporting goods on Norwegian roads, based on the literature review, interviews and the small-scale survey: 1) Increase the number of heavy vehicle inspections, 2) Establish a national electronic register, 3) Enforce payment of fines, 4) Increase cooperation with EU/EEA countries, 5) Clarify rules and regulations, 6) Organize and increase cooperation between domestic authorities, 7) Increase the authority of some authorities, 8) Clarify (and increase) the responsibilities of transport buyers, 9) Target foreign drivers with information campaigns, 10) Introduce certification/approval systems, 11) Educate to improve competence for winter driving, 12) Establish technical requirements for driving in Norway, and 13) Make roads more self-explanatory for foreign drivers. We conclude that six of these measures in particular are important for transport safety:

1) *Increase heavy vehicle inspections.* Increased numbers of heavy vehicle inspections was suggested in the “Report on road cabotage in Norway” (2014), and this recommendation was followed by an increase in the budget for heavy vehicle inspections. Interviewees were relatively content with the effectiveness of the current HGV inspections, although they also highlighted issues that could be improved further. This measure is effective (Elvik 2002), and should be maintained/increased.

2) *Education/information on winter driving and Norwegian road conditions aimed at foreign drivers.* Giving foreign drivers’ education on winter driving may be useful, as we have seen that competence differs between Norwegian and foreign drivers. This training could include a mandatory course in driving on slippery roads (if it is designed to not lead to “over confidence”), information about how to load in the winter, fit snow chains, other equipment required for driving in the winter and so on. This education/information should also focus on how to drive safely in hilly terrain, how to avoid over heating of brakes and engine (and fires) and on how to drive safely on (poor) Norwegian roads in the western, central and northern parts of Norway. Driver education should be supplemented by information campaigns like the current “Trucker’s guide to driving in Norway”.

3) *Clarify (and increase) the responsibilities of transport buyers.* Clarifying and increasing the responsibility of the different parties involved in goods transport, especially the transport buyers seems to be a positive measure. If an accident happens, the driver is generally held responsible today, although transport safety regulations state that e.g. the forwarders have a “responsibility to contribute” to transport safety. Interviewees therefore stated that this regulation should be put to use in practice. Forwarders, transport companies in which drivers are employed, and those sending and receiving the goods, set the premises for transport safety, and it therefore seems fair to involve them and formalize their responsibility accordingly. The current, voluntarily “Trygg Trailer” campaign is an excellent example of how people involved in the transport (e.g. transport buyers, or those who send/supply the goods) may contribute to safe transport.

4) *Expand the authority of the NPRA* Interviewees argued in favour of giving the NPRA an increased authority to issue “on-the-spot-fines” (gebyr) for a larger range of violations than they have the authority to sanction today. This applies for instance

to violations of rules on driving time and rest periods. It seems unnecessary to have to report drivers to the police for smaller violations of these rules, and the NPRA is competent at inspecting this. Although the police can press charges, the NPRA cannot, but the NPRA does have the authority to impose fines on some violations, and this authority could be expanded to also apply to other “less serious violations”.

5) *Change the sanctioning opportunity from police reports to fines* A certain amount of the transport violations which are reported to the police are dismissed by the prosecutors, e.g. due to insufficient resources to investigate these cases. Thus, it seems like a good idea to change the sanctioning opportunity on certain transport violations from police report to on-the-spot-fine (“gebyr” “forenklet forelegg”). This applies both to the police and the NPRA.

6) *Increased cooperation between domestic authorities.* The quality of the cooperation between different inspection authorities varies. Developing a more formalized and increased cooperation between regulating authorities: NPRA, Labour Inspection Authority, the police, customs and tax authorities has therefore been suggested, including a joint inspection strategy. In February 2016 the NPRA announced that they are establishing a new organizational unit focusing on transport related crime. The unit is likely to start up by the first half of 2016. This is a positive measure, and we hope that it involves a formalized cooperation with other inspection authorities, including the personnel conducting heavy vehicle inspections.

Finally, we also discuss other measures that could be considered further, but which we do not emphasize as much as the six above mentioned measures. These are: technical requirements for driving in some parts of Norway in the winter, enforce payment of fines, increased cooperation with EU/EEA countries, clarification of rules, road design, introduce certification/approval systems and app-communication with foreign drivers in Norway.

Reporting effects in the small-scale survey?

The results of the small-scale survey yielded some findings that were counter-intuitive and appear to be at odds with previous research and other findings in this study. These findings were related to the safety commitment of managers and colleagues, training, self-reported accidents and self-reports of falling asleep behind the wheel, driving while fatigued, speeding and seat belt use of drivers in their companies. We found that CEE and WE-drivers report a very high level of safety, and receive very high scores for some safety culture items in their firms. In some cases, they exceed the scores of Norwegian firms (Norwegian II sample) with a documented history of targeted safety work and very low accident levels, which would be expected to outperform any random group of HGV drivers.

The results from the small-scale survey are also not supported by the estimations of HGV accident risk in this study, which show that the accident risk for HGVs from CEE-countries and WE-countries is significantly higher than that of Norwegian HGVs. We therefore hypothesize that the survey results are not straightforwardly comparable between national samples, and should be used with extreme caution. There may be several potential explanations for this. It is important to note that most of these are hypotheses that should be examined further in future research:

1) *Small samples.* The samples are small (in the case of WE-drivers, extremely small), and respondents may not be representative.

- 2) *Respondents in different countries have different points of reference.* The drivers may refer to different baselines or have different anchoring; if safety standards vary substantially between different nationalities or cultures, evaluative judgments could be passed relative to radically different expectations. Thus, respondents from different countries have different expectations to the safety commitment of their managers and their colleagues, and the safety level of their businesses.
- 3) *Experience with and trust in surveys.* Drivers from different nationalities or cultures may relate to surveys differently. Norwegian drivers are accustomed to being subjects of various tests and surveys. Drivers from other nationalities, however, may be less culturally attuned to these kinds of surveys, and react to them differently. It is conceivable, for instance, that promises of anonymity are not trusted.
- 4) *Awareness of comparison.* Drivers may be aware that they will be compared to other groups, and respond correspondingly. We intentionally omitted to inform the Norwegian sample that they would be compared to foreign drivers, as we believed this might compromise results. In the sample of foreign drivers, however, this was more complicated. In spite of the fact that they were not informed about the comparison, they would perhaps take this as a given, as they were approached in their capacity as foreign drivers in Norway. Since these two groups are competing in the same market, it is conceivable that this influenced responses.
- 5) *The items are not good enough.* When questionnaires generate results that are unexpected, and when actual objective differences (e.g. differences in accident risk) between groups not are reflected in survey results, we should also consider whether the items account sufficiently for the different contexts of the groups we compare.
- 6) *National culture and reporting.* Measuring safety culture and reporting culture by means of surveys (i.e. self-reports) is in one sense paradoxical, as giving straightforward answers is dependent on a culture which encourages the communication of negative issues (i.e. a good reporting culture). A previous study of safety culture in construction in Denmark, UK and The Netherlands found that Eastern European migrant workers generally rated their managers more positively than employees who were born in the respective countries. The study suggests that that Eastern European migrant workers' deference to authority may explain this result. Deference to authority is as a trait of national culture that may explain over-reporting of positive results. It may perhaps also explain under-reporting of negative results. Although these questions are interesting, it is impossible for us to conclude on this. These hypotheses should therefore be examined further in future research.

Questions for future research

The current study lacks data to conclude on the importance of several of the risk factors for foreign HGV accidents, and the different methods we used in some cases, provide divergent results on the risk factors. This indicates the need for more research, particularly in the following areas.

- 1) *Drivers' transport safety behaviours.* The literature review indicates that speed too high for the circumstances, failure to use seat belt and insufficient information gathering are the most important risk factors in fatal accidents triggered by drivers at work. Our analysis of fatal accident data also indicates that these factors are associated relatively more often with accidents triggered by foreign than by Norwegian

professional drivers, but the small-scale survey did not support this conclusion. More research is needed.

2) *Company regulation of drivers' transport behaviours.* The literature review also indicates that company regulation of drivers' transport safety behaviours is an important precondition for safe transport behaviours. More research is needed, because the present study has not compared the policies of the foreign and Norwegian companies on this issue.

3) *Safety culture.* According to the results of the literature review, it is likely that foreign drivers carry with them influences from the traffic safety cultures of their home country, influenced by traffic rules, the police enforcing the rules, road user interaction, driver licensing and driver education. We did not measure national safety culture adequately in the present study, although we suggest that national culture (deference to authority) may have influenced the way that respondents have answered. Deference to authority should be examined in future studies.

4) *Organization of transport assignments and safety management system.* The literature review indicates that organization of transport assignments and safety management systems are important for transport safety, but the present study has unfortunately not assessed the prevalence of this in foreign versus domestic hauliers and the consequences for safety.

5) *Economy, competition and pay.* The literature review results diverge when it comes to the issue of whether and how competition may influence the safety level in HGV transport. Even though there was little concrete knowledge about the prevalence of different pay systems among foreign drivers, interviewees stressed that commission pay among foreign drivers may be detrimental to transport safety. The small-scale survey indicates that fixed payment is more prevalent in both foreign groups of drivers compared with the Norwegian drivers in the sample. This is surprising.

6) *Technology and equipment.* The literature review, interviews and NPRA inspection data do not support the conclusion that the lower technical standard of foreign HGVs constitutes an important risk factor. However, interviewees suggested that foreign HGVs are generally less suited to Norwegian roads, especially in the winter, as the majority of them are semi tractors with only two axles compared to Norwegian tractors with three axles. The small-scale survey indicates that Norwegian drivers report to be more stressed because of technical problems with their vehicles or equipment than foreign drivers. This may be due to different expectations. More research is needed.

7) *Working hours and fatigue.* The literature review shows that HGV drivers have long working days (average of 10.6 hours), and that many HGV drivers spend considerable time on physical tasks (e.g. loading/unloading) in addition to driving. International research shows that between 36 % and 64 % professional drivers report to have fallen asleep behind the wheel one time or another. Analysis of fatal accident data indicates that time pressure, stress and fatigue, are the most usual "abnormal" conditions registered for foreign professional drivers involved in fatal accidents, just as is the case for the Norwegian drivers. AAG data indicate that fatigue is just as important, or more important in accidents triggered by foreign HGV drivers, as it is in accidents triggered by Norwegian drivers. The small-scale survey, on the other hand, indicates that foreign drivers, especially from CEE, are less inclined to have fallen asleep behind the wheel and to drive while fatigued than Norwegian drivers. The differences are surprisingly big and hard to explain.