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Safety outcomes of internationalization of domestic road haulage: a review of the literature

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Abstract

The European Union (EU) promotes gradual lifting of restrictions on foreign hauliers involved in domestic road transport of goods (cabotage), and a major deregulation was scheduled to 2014. Due to complaints from several member states facing competition from new EU-countries with lower labour costs, this process was postponed until 2015. An important aspect related to such a deregulatory reform includes potential consequences for transport safety and accident risk factors. The main aims of the current paper are therefore to examine the potential transport safety outcomes of increasing internationalization of domestic road haulage, and to examine potential accident risk factors of foreign hauliers. This is done by reviewing the research literature. This paper shows that the HGV accident risk varies with a factor of up to ten in European countries, and that the accident risk of foreign HGVs are approximately two times higher than that of domestic HGVs in the studied European countries. The paper points to several risk factors and concludes that better data on accident risk and risk factors must be gathered in order to enable European authorities to correctly analyse and respond to this important traffic safety challenge.

1. Introduction

European market pressures have led to an increase in the shares of foreign hauliers in the Norwegian transport sector in recent years, and today about six percent of the goods transport on Norwegian roads is done by foreign hauliers (Nævestad, Hovi, Caspersen & Bjørnskau 2014). Most of this is international transport, in and out of Norway. The involvement of foreign hauliers in domestic transport of goods within Norway (cabotage) is profoundly limited by Norwegian regulations. A liberalization of the current road cabotage rules may, however, further increase the share of foreign heavy goods vehicles (HGVs) on Norwegian roads.

Cabotage, meaning the national carriage of goods for hire or reward carried out by non-resident hauliers on a temporary basis in a host Member State, is governed by EU-Regulation (EC) 1072/2009 as of 14 May 2010. The purpose of this regulation was to reduce empty trips after unloading of international transport operations. According to the regulation, every haulier may perform up to three cabotage operations within a seven day period starting the day after the unloading of the international transport.

Since the 1980s the European Union (EU) has introduced deregulatory measures of the freight market. As part of the accomplishment of the common market, the European Commission has pushed for a removal of market barriers to liberalize EU-Regulation (EC) 1072/2009 and allow cabotage. This major deregulation of domestic road transport of goods in the EU/EEA area was scheduled to take place in January 2014. Due to complaints from several member states facing competition from new EU-countries with lower labour costs the planned liberalization of the cabotage legislation was postponed to 2015, when a newly elected EU-commission will be in place. Social dumping and national competitiveness were the main concerns raised by member states, while little attention was given to the issue of

transport safety (cf. European Parliament 2013). In 2008, over 4.800 people were killed in accidents involving HGVs in 23 EU-countries (DaCoTa 2010).

Given the low level of wages in those countries that recently became members of the EU, it is likely that a possible lift of cabotage restrictions will increase the share of Eastern European lorries in Norway. Norway is not member of the EU, but as a member of the European Economic Area (EEA), Norway commits to implementing EU-legislation on economic competition. This includes the potential removal of restrictions on cabotage in the road sector.

The main aims of the current paper are to examine the potential transport safety outcomes of increasing internationalization of domestic road haulage, and to examine potential accident risk factors of foreign hauliers. This is done by reviewing the research literature. The focus is on Norway and European countries in general.

This paper shows that the HGV accident risk varies with a factor of up to ten in European countries, and that the accident risk of foreign HGVs and cars are approximately two times higher than that of domestic HGVs and cars in the studied European countries. The paper discusses at least four factors that may explain the differences, and concludes that especially national traffic safety culture and competence/experience seem to be important risk factors that should be examined in future research. It is argued that better data on risk differences and risk factors must be gathered in order to enable European authorities to correctly analyse and respond to the important traffic safety challenge introduced by foreign HGV drivers.

2. Literature review

2.1 Search terms and sources

A literature search was conducted in order to acquire an overview of the research literature on safety outcomes of increasing internationalization of road transport of goods. The searches were primarily conducted in June and August, 2013, and supplementary searches were conducted in October, 2014. The searches included four scientific online libraries: Sciencedirect, Ovid, Google Scholar and Trid. General searches in Google were also conducted. The searches in the scientific databases included terms like "cabotage", "deregulation", "liberalization", "competition", "foreign", "out placement" "goods transport", "freight transport", "road freight industry", "foreign hauliers", combined with the terms "traffic safety", "safety" "risk" and "accidents". Some of these key terms were also translated into Norwegian, to search for documents written in Norwegian.

As we know that Germany and France are the European countries with the highest shares of cabotage in Europe (Eurostat 2014), we also used German search terms, e.g. "Risiko", "ausländisch", "Lastkraftwagen". In 2005, 35 % of the HGV transport (in tonnes-km) on the German motorway system was operated by foreign HGVs (Wieland 2005). Unfortunately, we did not find relevant German

results comparing the HGV accident risk of German and foreign HGVs in Germany. Neither did the searches using French search terms like “risque”, “étranger” and “camions” provide relevant results. The lacking relevant results in German and French may to some extent be a result of language barriers, but we also searched specifically for research literature on France and Germany, using English terms (e.g. “cabotage in Germany” “foreign HGVs in Germany”). Below, we give an example from the Sciedirect database searches, to how we conducted the searches and the results that they generated.

The Sciedirect database searches combined the concepts "cabotage", "deregulation", "liberalization" or "competition", combined with one of the terms "traffic safety", "safety" and "accidents". in "title, abstract and key words" in all sources for all years. The first search in Sciedirect, using the term "cabotage" combined with one of the three safety related terms generated no results. Similar searches using the terms "deregulation", "liberalization" and "competition" combined with one of the terms "traffic safety", "safety" and "accidents" generated 400 results. The titles of these publications were read, and when titles were considered relevant the abstracts of the publications were also read. As a result, we found five seemingly relevant publications in the Sciedirect searches: two on air transport, two on freight transport and one on bus transport.

The scarcity of the peer reviewed journal results indicate that few peer reviewed studies focus on the safety outcomes of cabotage liberalization and internationalization of domestic road haulage. Searches in other search engines (e.g. www.google.com) revealed, however, that this is an important traffic safety and policy issue in European countries. Apart from generating several relevant EU funded research reports, these searches generated relevant studies from countries like Great Britain, the Netherlands, Greece Finland and Norway, and three additional peer-reviewed articles, two of them comparing accident risk.

Finally, the literature search was also supplemented by research literature that we already knew about, and which we perceived as relevant to the aims of the study. These were not uncovered by the searches. All in all the literature search generated 20 studies that were relevant to either both or one of the two aims of the study. These are presented in table 1 below.

2.2 Overview of relevant publications

In table 1, we provide key information on the 20 most relevant and recent publications focusing on safety outcomes of increasing internationalization of domestic road haulage, and potential accident risk factors of foreign hauliers.

Table 1: Publications focusing on safety outcomes of increasing internationalization of domestic road haulage (1. Aim of the study), and potential accident risk factors of foreign hauliers (2. Aim of the study).

Author	Country	Year	Focus	Relevance	Safety outcomes estimated?	Risk factors suggested?
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Nævestad, Hovi, Caspersen & Bjørnskau	Norway	2014	Prevalence and risk of foreign HGVs in Norway	High to 1. and 2. aim.	Yes. Compares accident risk of national groups.	Yes, e.g. winter driving/competence.
AECOM	Europe	2014	Structure of EU road haulage sector	High to 1. and 2. aim	Yes, compares HGV accident risk in European countries	Yes, discusses causes based on previous research.
Danton, Kirk, Rackliff, Hill, Gisby, Pearce & Dodson	UK	2009	Safety challenges of foreign HGVs in UK	High to 1. and 2. aim.	Yes, 10 % of HGVs in accidents are foreign, but exposure data are lacking.	Yes, analysis of accidents involving foreign drivers
Vlakveld, Stipdonk & Bos	Netherlands	2012	Training and accident risk of Middle and Eastern European drivers	High to 1. and 2. aim	Yes, but exposure data are lacking.	Yes, competence is discussed but dismissed
Yannis, Golias & Papadimitriou	Greece	2007	Accident risk of foreign and domestic drivers in Greece	High to 1. and 2. aim	Yes compares foreign and native drivers risk under different conditions	Yes, area type, junction and lighting conditions.
Leviäkangas	Finland	1998	Accident risk of Russian car drivers and HGVs in Finland	High to 1. and 2. aim	Yes, compares accident risk.	Yes, traffic culture and winter driving, focusing on competence/experience and equipment.
DaCoTa	Europe	2010	Accident risk and characteristics of HGV accidents in Europe	High to 1. aim and medium to 2. Aim.	Yes, compares HGV accident risk in European countries	To some extent, as it provides accident characteristics
Alvarez-Tikkakoski, Solakivi, Lorentz & Olaja	Finland and the Baltic Sea region	2011	Market conditions for the safety of the HGV industry	Medium to 1. aim and medium to 2. Aim.	Yes, the overall safety level in HGV industry	Yes, the best and safest companies survive competition
Elvik	International	2006	Literature survey and meta-analysis of deregulation and transport safety	High to 1. aim.	Yes, safety outcomes of deregulation	No
Tillman	Sweden	2012	Carrier selection criteria- Scandinavian and Eastern European hauliers	Medium to 1. aim.	Evaluates a scenario without cabotage restrictions in Sweden. Safety could be included as a carrier selection criterion.	No
Sørensen	Denmark	2009	HGV – bicycle interaction in European cities	High to 2. aim.	No	Yes, foreign drivers lack experience with bicycles.
Norwegian Public Roads Administration (NPRA)	Norwegian	2013	Control results of 17.000 HGVs in Norway	High to 2. aim	No	Yes, technical state of Norwegian and foreign HGVs in Norway

Policy Research	Netherlands	2013	Consequences of road cabotage liberalization	Medium to 2. aim.	No. To be addressed in a separate report	Intensity of enforcement
Sternberg	Sweden	2013	Scope and consequences of road cabotage	Medium to 2. aim.	No.	Enforcement and interpretation of cabotage rules
European Parliament	EU	2013	Implementation of road cabotage, economic and social impacts	Medium to 2. aim.	No.	Enforcement and interpretation of cabotage rules
Bjørnskau & Nævestad	International	2012	Safety culture among road users	Medium to 2. aim	No	Yes, discusses national traffic safety culture
Ward	International	2010	Traffic safety culture	Medium to 2. aim	No	Yes, discusses national traffic safety culture
SARTRE	European	1994	Road safety attitudes of European car drivers	Medium to 2. aim	No	Yes, discusses national road safety attitudes
Warner, Özkan, Lajunen & Tzamalouka	European	2011	Driver behaviour of European car drivers	Medium to 2. aim	No	Yes, discusses national differences in driver behaviour

3. Opportunities for foreign hauliers in road transport of goods

3.1 Change in legal framework conditions

The 2009 regulation of road cabotage was introduced as the previous Council regulations of cabotage were considered too vague and ambiguous. The preceding Council Regulation from 1993 states for instance that foreign hauliers may operate national road haulage services in another member state, *on a temporary basis* (Council Regulation 3118/93). However, distinguishing between temporary and permanent transport services was not easy in practice, as precise definitions were missing (ECORYS 2006). Moreover, because of its vague formulation, the preceding cabotage regulation was very difficult to enforce in the respective member countries (ECORYS 2006). Although the new cabotage regulation is clearer than the former, the EU-member states choose somewhat different approaches when it comes to the implementation and enforcement of the regulation (European Parliament 2013). Moreover, Sternberg (2013) concludes that the new directive 1072/2009 has created a considerable grey zone concerning cabotage, which are exploited by foreign hauliers.

3.2 Lower labour costs

In May 2004, EU got 10 new member states: Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia. On January 1. 2007, the so called EU-27 was established, bringing in the new members states of Bulgaria and Romania. When Croatia was included in the European Union July 1. 2013, EU acquired its 28. member state.

The European Union is founded on the principle of a European Single Market. The introduction of the new middle and eastern European EU members states in the preceding decade put, however, pressure to this principle. The labour costs of the new EU-member states are on average very low compared with the western European countries. The average hourly labour costs in Norway is for instance thirteen times that of Bulgaria (Eurostat 2013). When the most important framework condition influencing the competitive abilities of road transport companies is the level of wages (Hovi & Hansen 2011), road transport companies of middle and eastern Europe are likely to give detrimental competition to haulage companies in western Europe. As a consequence, western European countries have largely resisted the introduction of a single European road goods transport market.

Polish hauliers are for instance the largest provider of cabotage services in the EU, with increased competition from Romanian and Bulgarian drivers (European Parliament 2013). Several commentators have predicted the demise of the western European lorry driver. Tillman (2012) asserts that in the case of less complicated "from A to B" shipments, Swedish transport buyers would use cheaper eastern European hauliers, while they would use local hauliers in more complicated shipments. Discussing the consequences of road cabotage liberalization, Policy Research (2013) concludes that, in the Netherlands it is likely that vehicles registered in lower wage level countries will perform more cabotage operations. Correspondingly, they conclude that easing restrictions on cabotage will not lead to opportunities for Dutch registered vehicles. In the Netherlands, as in other western European countries, several industry organizations are calling for the government to intervene to limit the negative socio-economic effects of cabotage (European Parliament 2013).

3.3 Increasing number of foreign heavy goods vehicles

Foreign heavy goods vehicles account for about 6 % of the average domestic transport in Norway today, and the share has been increasing in recent years (Nævestad et al 2014). If cabotage legislation is liberalized, this share is likely to increase with potential consequences for road safety

Following the Norwegian lorries, which conducted 94 % of the traffic work on Norwegian roads, Swedish, Danish and Baltic/Polish HGVs comprised a considerable share of the traffic. Swedish HGVs drove 33 million km, Danish HGVs drove 25.5 million km and Polish/Baltic HGVs drove 24.5 million km in Norway in average per year.

It seems that a redistribution of actors transporting goods on Norwegian roads are taking place. The Nordic countries have all experienced a reduction in traffic in

Norway in recent years. On the other hand, EU nations outside the Nordic region have improved their position. Especially lorries from Poland and the Baltic states have strengthened their position. The traffic in Norway with lorries from Poland and the Baltic states has increased by 64 % in four years (Nævestad et al 2014).

4. Potential transport safety outcomes of increasing internalization of domestic road haulage

Although the accident risk of heavy vehicles is low, they carry a high risk of injuring other road users, because of their mass (Assum & Sørensen 2012). About one in three deaths in Norway are caused by a collision with heavy vehicles (Haldorsen, 2010).

4.1 Accident risk of foreign HGVs in Norway.

1) Approach/methodology. Nævestad et al (2014) survey the exposure of Norwegian and foreign HGVs in Norway, and analyses these results in light of data on personal injury accidents to calculate and compare the accident risk of Norwegian and foreign HGVs in Norway. The authors use the lorry surveys of Statistics Norway and Eurostat and the border crossing statistics of Statistics Norway to estimate the vehicle kilometres of Norwegian and foreign HGVs on Norwegian roads. According to the Eurostat statistics directive, all European countries are obliged to carry out annual representative Lorry surveys on HGV transport in their own country and their domestic HGV's assignments abroad. The exposure data in Nævestad et al's (2014) study is based on a combination of the national Lorry Survey in Norway and Eurostat data from similar surveys in European countries. Together these surveys cover all foreign and domestic lorry trips between municipalities and counties that are conducted within, to and from Norway.

These data sources give basis for establishing OD (origin-destination) matrices for domestic and foreign trips. However, as the destinations of international transport assignments done by foreign HGVs only are given at county level in the Eurostat data, the route choices and vehicle km of foreign HGVs in Norway have been estimated by means of the network module in the national freight transport model for Norway. Route choice was based on minimising generalised costs.

The exposure data is matched with accident data from Statistics Norway's data on police reported injury accidents to calculate and compare the accident risk of Norwegian and foreign HGVs in Norway. The risk estimates are based on data from 3531 police reported road accidents with personal injuries in Norway in the period 2007-2012. The accidents involved 3716 HGVs distributed among different groupings of vehicle registration countries.

2) Results. Accident risk is defined as the number of injury accidents per million vehicle km. The average accident risk of HGVs in Norway is 0,34 accidents per million vehicle km. The authors conclude that HGVs registered in foreign

countries have higher accident risk than Norwegian HGVs on Norwegian roads. Norwegian (0.32) and Danish (0.35) HGVs have the lowest accident risk. The accident risk of HGVs from the rest of the EU15 (0.91) is over 2,5 times higher than the accident risk of Norwegian vehicles. Polish and Baltic vehicles (0.68) have the second highest accident risk, followed by Swedish vehicles and vehicles from other EU-27 countries. The accident risk for all national groups are statistically significantly different from the Norwegian at the 5 %-level, except the Danish and other EU27 countries.

The authors point to two risk factors, which to some extent may shed light on the differences. The first is winter driving. HGVS from non-Scandinavian countries have a greater proportion of their accidents in the winter (Oct.-March) (62 %) compared with HGVs from Scandinavia (53 %). The second risk factor is that HGVs from non-Scandinavian countries have three times higher accident risk than Scandinavian HGVs in the west/central/northern regions of Norway. The foreign HGVs have only twice the risk of the domestic in the southern/eastern regions of Norway. The authors propose that foreign HGVs have higher risk in the western/central and northern regions, as these areas have poorer road standard and more demanding driving conditions.

3) *Limitations.* The authors stress that the results must be interpreted with some caution, due to the following factors: 1) About ten percent of the HGVs in the accident statistics had unknown nationality. These were added to the Norwegian HGVs in the risk estimations. 2) All in all, there were relatively few foreign vehicles involved in accidents, 3) The risk estimation is based on vehicles' nationality, and there is a possible differences between vehicles' and drivers' nationality, 4) The report focuses on the risk of personal injury accidents, which probably is different from the risk of material damage accidents, 5) The risk of serious accidents is influenced by the roads chosen, and foreign HGVs drive longer distances on roads with good standard compared with Norwegian HGVs 6) Different types of HGVs probably have different accident risks, but the study lacks exposure data for HGV types, 7) The risk of triggering accidents may be different from the risk of being involved in accidents, and the study only focuses on HGVs involved in accidents 8) The authors know little about the actual causes of the accidents and the differences between the national groups.

4.2 Foreign HGV drivers in the Netherlands

1) *Approach/methodology:* In November 2011 the Dutch parliament passed a resolution stating that the number of registered crashes involving drivers from middle- and eastern European countries was increasing. The resolution also stated that it should examined whether this was due to a lower quality of the driving courses in middle- and eastern European countries. In their study of this issue, Vlakveld, Stipdonk & Bos (2012) compare driver training curriculums in European countries. To examine and compare accident risk, the authors undertook a crash analysis and an analysis of Dutch traffic offense data.

2) *Results:* Vlakveld, Stipdonk & Bos (2012) conclude first, that international research has not proved a relationship between the quality of driver training and accident risk, and that the third Directive on driving licences - (Directive 2006/126/EC), establishes common minimum requirements in all European countries (Vlakveld, Stipdonk & Bos 2012).

Second, the authors studied accidents and traffic offenses involving foreign HGV drivers on Dutch roads. They stress that the accident data were poor for the recent years, and that the offense data were biased, as the Dutch police focus especially on foreign HGV drivers. Moreover, as they lacked exposure data on the actual distances travelled by HGV drivers with different nationalities, they were unable to assess whether the increase in accidents involving drivers from middle- and eastern European countries was due to their increased participation in Dutch traffic, higher accident risk, or both.

3) *Limitations:* The study of Vlakveld, Stipdonk & Bos (2012) illustrates the importance of data quality for analysing and developing measures against important traffic safety challenges. In the English summary, they conclude that “No data is available on the distance travelled on Dutch roads per nationality”. Thus, their primary recommendation is that the registration of road crashes must be improved substantially and that exposure data must be developed. As Nævestad et al (2014) do, Vlakveld, Stipdonk & Bos could probably have used Eurostat data as a basis of estimating traffic work of foreign HGVs in the Netherlands. However, as the Netherlands is a transit country, estimates for vehicle km’s of foreign HGVs would probably be uncertain.

4.3 Fatalities per million population in European countries

1) *Approach/methodology:* The DaCoTa project provides thorough descriptions and analyses of road safety and accidents in 27 European countries in the period 1999-2008. These data are collected in the Community Road Accident Database (CARE), which is based on the national accident databases maintained by all EU member states, taking the differences between national systems for recording accidents into account (DaCoTa 2010). The statistics include descriptions of accidents related to different modes of travel, not just HGVs. Because of different levels of injury underreporting in European countries, fatal accidents are one of the few comparable data among EU Member States. The DaCoTa study uses fatal accidents per million population as a measure of exposure.

2) *Results:* The number of people killed in accidents involving HGVs in the EU-23 countries decreased with 36,1 %, from 7.559 fatalities in 1999 to 4.832 in 2008. The project also shows that the risk of a fatal accident involving HGVs differs substantially within European countries. The risk of a fatal accident involving HGVs is for instance ten times higher in Slovakia (36,3) than in Slovenia (3,5). Countries with low risk of fatal accidents with HGVs are for instance UK (6,2), Sweden (7,8), Denmark (11,3), Germany (7,6), Netherlands (6,5). Countries with high risk of fatal accidents with HGVs are apart from Slovakia, Poland (30,3) Latvia (23,9), Estonia (24,6). Comparing for instance eastern European countries

with Scandinavia, we see that the risk of fatal HGV accidents is three times higher. The risk in Poland and Slovakia is over 30 per million population, while it is substantially less than 10 per million in Denmark and Sweden (DaCoTa 2010).

3) *Limitations:* The substantial differences in the risk of fatal accidents involving HGVs per million population suggest that an increased exposure of e.g. Polish and Slovakian HGVs could lead to an increased accident risk. However, two criticisms could be raised against this conclusion. First, we may ask how suitable population is as a measure of exposure. Ideally, accident risk estimates should use HGV activity (e.g. vehicle km's) as a measure of exposure, and define risk for instance as the number of accidents occurring per million vehicle km's. Other measures of HGV activity that can be used are million hours used or million tonnes transported. The number of million inhabitants in a country does not necessarily reflect HGV activity, as some countries may transport larger shares of their goods by rail, sea and air, and so forth.

Second, although some countries have high HGV accident risks, it is not given that HGV drivers from these countries are more likely to be involved in accidents in lower risk countries. HGV accident risk is not just a consequence of driver characteristics, although research indicates that risk factors related to the driver are important in HGV accidents (Nævestad & Phillips 2013). We return to this discussion below.

4.4 Fatalities per billion HGV km in European countries

1) *Approach/methodology.* Traffic safety is one of several issues that AECOM (2014) discusses in a comprehensive report analysing data on the structure of the road haulage sector in the European Union. The focus is on the risk of international driving and causal factors of incidents. AECOM calculates the number of fatalities involved in a HGV incident per billion HGV km in European countries, based on accident statistics from the European Road Safety Observatory and exposure data from Eurostat.

2) *Results.* Comparing the number of fatalities involved in HGV incidents per billion HGV km driven in each of the European countries, AECOM concludes that the HGV fatality risk in general is higher in Eastern European countries than it is in western European countries. The average risk of all EU members states is 31.5 fatalities involved in a HGV incident per billion HGV km. Romania has by far the highest HGV fatality risk, with 177.3 fatalities per billion HGV km driven. Poland had the second highest fatality risk (59.9), followed by Belgium, Greece, Finland, Austria, Denmark, Portugal and the Czech Republic. The risk in these countries was above EU average. Luxembourg has the lowest risk, with 3.8 fatalities per billion HGV km, followed by Slovenia, United Kingdom, Germany (21.3), Italy (24.9), Spain, Ireland, France (31.4). The risk in these countries was below EU average. Examining the road users who were killed in these accidents, AECOM concludes that in 50 % of the accidents, car occupants were killed, followed by pedestrians (15 %), HGV occupants (15 %), motorcycle riders (7 %), pedal cyclists (6 %), LGV occupants (4 %), moped riders (2 %) and other (1 %). Finally, based on

SafetyNet research, it is concluded that the driver generally is to blame in these accidents, and that information and communication failure are central causes.

3) *Limitations*: The main strength of this publication is that it estimates accident based on vehicle km. It is essential to control for HGV km, as a country may have a high number of HGV accidents without having a high HGV accident risk. However, this study suffers from the same limitation as the DaCoTa study discussed above, as it compares HGV accident risk across countries instead of examining the risk of national groups of HGV drivers within countries.

As noted, it is not given that foreign HGV drivers from high risk countries have the same risk as in their home country when they drive in lower risk countries. HGV accident risk is influenced by a related to other road users, transport companies' safety measures, economic competition, authorities' regulation, the physical road environment, police enforcement, standard of the vehicles and so forth. In accordance with this argument, we see for instance that Germany has a relatively low HGV related fatality risk, and a high share of foreign HGVs (35 %) (Wiesman 2005). However, Nævestad et al (2014) find considerable risk differences among domestic and foreign HGVs in Norway, and Leviäkangas (1998) found that the accident risk of Russian drivers in Finland corresponded to the risk in their home country.

4.5 Russian drivers in Finland

1) *Approach/methodology*: Leviäkangas (1998) examines the accident risk of foreign car and HGV drivers, mostly Russian, in southeast Finland in the period 1992-1995. The study estimates accident risk based on police reported traffic accidents and origin-destination studies carried out on Finnish-Russian border stations, focusing on three main roads. The focuses on vehicle nationality, assuming that this corresponds to driver nationality.

2) *Results*: The study shows that the accident risk of Russian drivers in Finland are substantially higher than the accident risk of domestic drivers. The risk of Russian drivers is about two to three times higher than the risk of Finnish drivers. Taking into account the number of automobiles and the number of people killed relative to the population, the study concludes that the car accident risk in Russia is six times higher than in Finland. All in all, Leviäkangas concludes that the accident risk of Russian drivers in Finland is comparable to their accident risk in their home country. He suggests that differences in traffic culture may explain these national differences.

The study also compares heavy vehicle risk (including buses), although there are few heavy vehicles in the sample. This risk estimation shows that the accident risk of Russian HGVs on one of the roads in the study is double the risk of Finnish HGV drivers. This difference is in line with the results reported by Nævestad et al (2014). Leviäkangas also concludes that the winter season is especially risky for foreign drivers. He suggest that this is due to insufficient winter driving skills and

winter equipment. In contrast to Finland, neither winter tires or winter training during license obtainment are mandatory in Russia.

3) *Limitations*: Leviäkangas primarily focuses on passenger car drivers, and it is not given that the risk differences between foreign and domestic car drivers are transferrable to HGV drivers. However, although the sample is small, Leviäkangas also estimates and compares the accident risk of HGV drivers, and find that the risk of foreign drivers is two times that of domestic drivers. This is approximately the same as for passenger car drivers. Another limitation of the study is that the risk estimation does not discern between different road environments, like the study we discuss below does.

4.6 Foreign drivers in Greece

1) *Approach/methodology*: Yannis et al (2007) estimates and compares the accident risk of foreign and domestic passenger cars drivers in various road environments in Greece. The studied road environments are: area type (inside/outside urban area), junction (yes/no) and lighting conditions (day/night). The authors use hierarchical log-linear analysis to analyse police reported injury accidents from the period 1985-2001 from the national accident database of Greece. Lacking exposure data, the authors use the induced exposure method, comparing drivers who were “at fault” and “innocent”.

2) *Results*: Generally, the study shows that the accident risk of the foreign drivers were nearly twice that of Greek drivers. The drivers compared are Greek, Albanian, EU-15, and other nationalities. The analysis shows that Greek drivers (1.08) have a lower accident risk than the foreign drivers under all conditions, followed by Albanians (1.41), EU15 (1,5) and drivers from “other nationalities” (1.93). Drivers with “other nationalities” had the highest accident risk under all conditions. All foreign drivers had an increased risk inside urban areas. Although, the study did not find a significant interaction between more than one roadway parameter, accident fault risk and driver nationality, different road environments influenced the risks of the national groups differently, especially inhabited areas and junctions. Lighting conditions and uninhabited areas did not. The study concludes that because the risk and safety challenges of different groups of foreign drivers were different, reducing the risk of different national groups of foreign drivers require different safety interventions.

3) *Limitations*: The main strength of this study is that it compares accident risk in various road environments. Few other studies do that, except for Nævestad et al (2014), comparing accident risk in Norwegian regions. The main limitation of the study is that it focuses on passenger car drivers in general, and not HGV drivers. However, as Leviäkangas (1999) study indicates, the accident risk of foreign HGV drivers and foreign car drivers in a country seems to be fairly similar.

4.7 A meta study of deregulation and transport safety

During the last three decades commercial transport has been economically deregulated in many countries, meaning that formal regulations limiting entry to the business have been removed (Elvik 2006). The main purpose of economically deregulating a business area is to stimulate competition. Even a deregulated transport sector will, however, normally be subject to a number of regulations concerning anti-trust laws, safety standards for vehicles, safety regulations for traffic operators and regulations of working conditions for employees (Elvik 2006). In general, safety regulations of a business remain in force even though the business is deregulated.

1) Approach/methodology. The main purpose of Elvik's (2006) literature review and meta-study is to quantify the safety outcomes of deregulation of transport in the road, rail, aviation and sea sector. Elvik identified 41 studies in the literature search, and 25 of these were included in a meta-analysis of evidence from evaluation studies on the safety effects of deregulation of transport. 16 studies were not included in the meta-analysis, primarily as they did not report the statistical precision of their estimates of effect. The study included 30 estimates of effect related to road transport.

2) Results: Elvik (2006) concludes that economic deregulation does not seem to hamper safety. The meta-study's summary estimate of effect indicates that no statistical changes in road safety occurred because of deregulation. However, the study states that the impact of deregulation on transport safety should be monitored closely in the future, as the process of deregulation is fairly new in many countries.

3) Limitations: This is a high quality meta-analysis of several empirical studies. The conclusion is based on the estimation of the reported individual effects into general summary estimates of effect, and for all modes of transport, the individual estimates of effect were highly heterogeneous. Thus, perhaps the safety outcomes of deregulation are contingent on different contexts. Moreover, the meta-analysis is of the safety outcomes of economic deregulation in general, and not specifically increasing internationalization, although this may be a consequence of deregulation in transport. Thus, perhaps the studies on the accident risk of foreign HGVs and cars in Norway, Finland and Greece are more relevant to the aims of the current study.

4.8 Foreign HGVs in Great Britain

1) Approach/methodology. The number of foreign HGVs in Great Britain increased with 150 % between 1992 and 2003 (Danton, Kirk, Rackliff, Hill, Gisby, Pearce & Dodson 2009). Unlike the rest of Europe, British road users keep to the left side of the road. Foreign HGVs are therefore likely to present a safety challenge on British roads, as these vehicles are designed for driving on the right side of the road, and as their foreign drivers are accustomed to driving on the right side of the road.

In order to study the accident risk of foreign HGV drivers, the authors analyse HGV accidents involving foreign HGVs on British roads. The latter is done as part of the On the Spot Project (OTS) which is a project involved in investigating and analysing about 500 real world collisions in Britain each year. The project involves all collision types including all road users.

2) *Results*. Reviewing the national data for Great Britain, the authors found that of the 10.466 injury accidents involving a HGV, 9 % (952) involved a foreign registered HGV. In the on the spot (OTS) dataset, 9,6 % of all the 3.504 accidents were with HGVs and 19 % of these HGVs were foreign. Most of the reviewed accidents with foreign HGVs were on the main arterial routes with higher speed limits, and the majority of the HGVs in accidents were performing an overtaking or lane change manoeuvre when they collided. The most important contributory factors were that the HGV-drivers “failed to look properly”, which is closely related to the considerable “vehicle blind spots” of the foreign HGVs on British roads. The latter was a contributory factor in 76 % of the collisions involving the foreign HGVs.

3) *Limitations*: An obvious limitation of this study is that it does not estimate and compare the accident risk of foreign and domestic HGVs on British roads, although the study concludes that about one in ten HGVs involved in accidents are registered in a foreign country. Unfortunately, the authors do not provide an estimate of the traffic work of foreign HGVs on British roads.

5. Potential risk factors of foreign hauliers involved in domestic road transport of goods

Above, we saw that the HGV accident risk varies with a factor of up to ten in European countries, and that the accident risk of foreign HGVs are approximately two times higher than that of domestic HGVs in European countries. In the following, we will discuss possible explanations to this. We have grouped these into four categories: 1) safety culture, 2) competence, training and experience 3) technology and equipment and 4) framework conditions.

5.1. Safety culture

In the last few years, traffic safety scholars have started studying the role that *traffic safety culture* may play in explaining and reducing risks in road transport (Nævestad & Bjørnskau 2012). It is widely recognized that safety culture is important for safety in organizational settings in hazardous industries (Nævestad, 2010), and the concept is applied to an ever increasing range of sectors and industries. Early results suggest that the safety culture concept may have great potential for improving traffic safety (AAA, 2007; Ward et al., 2010).

Leviäkangas (1998) suggests that the risk difference between foreign and domestic drivers in Finland may be explained by differences in traffic culture, which he

defines as the sum of all factors that affect the skills, attitudes and behaviours of drivers as well as the equipment (i.e. vehicles).

Differences in national safety culture could be a possible explanation to the above mentioned differences in HGV accident risk in different European countries (DaCoTa 2010). In addition to being influenced by professional safety culture learned through professional driver training, it is likely that foreign drivers carry with them influences from the traffic safety cultures of their home country. Factors influencing national traffic safety culture include traffic rules, the police enforcing the rules, road user interaction, driver licensing and driver education (Nævestad & Bjørnskau 2012). However, it is not given that HGV drivers from countries with high HGV accident risk are more likely to be involved in accidents in lower risk countries.

Page 2001 (in Ward, 2010) studies national traffic safety cultures by comparing predicted accident rates, based on variables known to influence accident rates, with actual accident rates in different countries. The difference was partly inferred to be an effect of national traffic safety culture. Comparisons of national traffic safety culture have also been made in the large EU-funded research project "SARTRE", which reported national differences among European car drivers' attitudes towards road safety (SARTRE, 1994). A recent study also found significant differences in driver behaviour between Finnish, Swedish, Greek and Turkish drivers (Warner, Özkan, Lajunen and Tzamalouka, 2011). This and other findings suggest it is important to account for differences in national traffic safety culture, and ultimately safety behaviour, in accounting for differences in accident risk.

Merrit (2000) found that national culture exerts an influence over the professional culture and safety behaviour of airline pilots, in spite of the internationalization, the comprehensive regulation and extensive training involved in commercial aviation. Thus, it is not unreasonable to expect differences in national culture to give rise to varying traffic safety behaviours and conflicts with increasing implications for accident risk.

5.2 Competence, training and experience

The third Directive on driving licences - (Directive 2006/126/EC), establishes common minimum requirements for driver training in all European countries. The training of lorry and bus drivers is also regulated by EU-directive 2003/59/EC on the initial qualification and periodic training of trucks and buses' drivers, which entered into force on 10. September 2003. The goal of the Directive is to:

"(...)enhance road safety in Europe by ensuring a common level of training, and the achievement of the necessary skills and competences for professional drivers to drive their vehicles. It establishes mandatory level of initial qualification and periodic training for professional drivers in the European

Union. The training is organised by training centres approved by the Member States."¹

In spite of common training standards across Europe, European countries offer different national and local challenges with repercussions for traffic safety. Norway offers two central challenges to foreign drivers: winter driving and hilly terrain.

Foreign lorry drivers' lack of competence on Norwegian roads has been identified as a significant safety problem, especially when it comes to winter driving (Engene & Underthun 2012). Both Nævestad et al (2014) and Leviäkangas (1998) find that foreign drivers in Norway and Finland respectively have a higher share of their accidents in the winter. Norwegian professional drivers must undergo a mandatory course in winter driving to get their professional drivers licence. Such courses are not required in other European countries further south, making it even harder for foreign drivers to cope with Norwegian winter conditions.

The Norwegian Public Roads Administration's (NPRA) information campaign "Trucker's guide to driving in Norway" states that: "Norway is a difficult country to drive in, with many winding roads and a lot of snow during winter. These are normal conditions since most of the country consists of mountainous terrain." (NPRA 2012: 6). The guide was per 2012 translated into nine languages.

The investigation report following the near-catastrophic Oslofjordtunnel-fire 23.06.2011 suggests that foreign lorry drivers often do not know how to drive safely in the hilly Norwegian terrain, increasing the risk of overheated engines or brakes (Safetec 2011, cf. Nævestad & Meyer 2014). This report concludes that foreign lorry drivers tend to drive too fast down the steep Oslofjord tunnel, as they are not accustomed to such steep tunnels. They are thereby more prone to overheating the brakes of their vehicles, which may lead to tunnel fires. Norway is the country in the world with most subsea road tunnels (>30) and over 1000 road tunnels.

It is important to note that several of the challenges met by foreign HGV drivers in Norway also can be found in other European countries. Roads and tunnels with steep inclination are found in both Nordic countries and alpine countries. Winter driving is also a common challenge in Nordic and alpine countries. As a consequence, the Norwegian minister for transport has, together with his colleagues in Sweden, Switzerland and Austria, taken an initiative to make winter training mandatory for HGV drivers in certain EU/EEA countries

While winter driving and steep inclination provide challenges for foreign HGV-drivers in Norway, large shares of bicyclists may challenge foreign HGV-drivers in countries like Denmark and the Netherlands. A review of bicycle-lorry interaction in European cities has, for instance, pointed to the fact that foreign lorry drivers in Denmark may have a lower awareness of bicycles in the city transport system, and that this may lead to accidents (Sørensen 2009). Several solutions to this challenge is discussed, including allowing only drivers with local knowledge to drive on these roads (Sørensen 2009).

¹ http://ec.europa.eu/transport/road_safety/users/professional-drivers/report_12_07_2012_en.htm

5.3. Technology and equipment

It has been suggested that foreign lorries in Norway suffer from several shortcomings compared with Norwegian lorries, and that these shortcomings increase the accident risk of foreign lorries being used on Norwegian roads. Safetec (2011) concludes, in a risk analysis of the subsea Oslofjord tunnel, that:

"The analysis has identified a category of the heavy vehicle traffic which stands out when it comes to risk. Many foreign trailers are only equipped with two axles, with reduced engine effect and a low total permitted weight. When these vehicles are heavily loaded in hilly terrain, the pressure on the vehicle increases. Scandinavian vehicles are often equipped with three axles, and a more powerful engine, making it less likely that they are over loaded in hilly terrain. Age and wear and tear on the vehicle is also a factor, as older vehicles are more prone to fuel leakages than newer vehicles are." (Safetec 2011: 17).

It has also been claimed that foreign transport companies often have more relaxed standards when it comes to the technical state of their vehicle fleet, compared with Norwegian transport companies, and that they may lack mandatory equipment (Safetec 2011: 18; Bergene & Underthun 2012).

However, the Norwegian Public Roads Administration (NPRA) concluded in August 2013 that they did not find substantial differences between the technical state of Norwegian and foreign HGVs after controlling 17 000 HGVs from January to August 2013 (NPRA 2013). Sixty percent of the controlled HGVs were Norwegian, while forty percent were foreign. It is, however, uncertain whether the defects on the foreign HGVs were more serious than the defects on the Norwegian HGVs.

In a HGV inspection manual, the Norwegian police and the NPRA state that foreign HGVs often lack suitable snow chains and winter tyres (Norwegian Police, NPRA 2012). The NPRA also states that tyres with hard rubber are popular among foreign transport companies, as they are cheap and hard-wearing. However, they also require far longer braking distances on winter roads.²

5.4. Framework conditions

According to Bjørnskau and Longva (2009), the safety performance and the safety culture of a given transport sector can be explained by referring to framework conditions as competition, rules/regulation, type of transport (e.g. goods or passengers) and the cost of accident. Comparing safety culture and safety levels in different transport systems, Bjørnskau and Longva (2009) found that aviation pilots achieved the highest score on the safety culture index used in the study, followed by rail drivers. Bus drivers exhibited the poorest safety culture in their

² <http://bil.aftenposten.no/bil/Derfor-kjorer-vogntogene-av-veien-15286.html>

study. These differences are attributed to the framework conditions of the different transport systems.

Competition. As noted competition is an important framework condition for HGV safety, although researchers may disagree on whether the consequences are positive, negative or neutral. The report of Alvarez-Tikkakoski et al concludes that economic downturn and harder competition in the Baltic Sea region has led to an improvement in the safety level of the haulage sector in the period 2007-2011. It is suggested that this is a result of economic and financial difficulties forcing the poorly performing operators to completely exit the market rather than just bend the safety rules and regulations of the industry. On the other hand, Johnsen, Lindstad and Nicolaisen (2002) argue that their literature review shows that hardened competition in the road sector has increased driver fatigue and stress.

The main limitation of Alvarez-Tikkakoski's study is that it primarily is based on 32 interview, and the authors look at accident risk for HGVs in general, and do not discern between domestic and foreign hauliers. Thus, they are unable to conclude whether the improvements in the safety level of the Baltic Sea haulage sector in the period 2007-2011 is due to a larger or smaller share of foreign HGVs.

Rules/enforcement is a crucial framework conditions for transport safety, as they set minimum safety standards. The enforcement of these rules is just as important. We have seen that EU-Regulation (EC) 1072/2009 is interpreted and enforced differently in different EU countries (European Parliament 2013, Policy Research 2013, Sternberg 2013).

Moreover, discussing enforcement directed against foreign lorry drivers in Norway, Safetec (2011) states that it is problematic to enforce payment from foreign drivers and foreign transport companies. Thus, this important risk group face few consequences when they fail to adhere to safety rules. This challenge has also been mentioned by interviewees in a study of fatal accidents triggered by professional drivers in Norway (Nævestad & Phillips 2013).

6. Concluding remarks

The aims of the current paper were to examine the potential transport safety outcomes of increasing internationalization of domestic road haulage, and to examine potential accident risk factors of foreign hauliers.

We have seen that the HGV accident risk varies with a factor of up to ten in European countries, and that the accident risk of foreign HGVs are approximately two times higher than that of domestic HGVs in the studied European countries. Thus, it seems that increased internationalization 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), and probably the highest share of foreign HGVs in Europe (35 %) (Wiesman 2005). Future studies of this issue could therefore compare risk and risk factors of foreign and domestic HGVs in Germany.

The paper discusses four potential accident risk factors of foreign hauliers, which could explain why foreign HGVs have higher accident risk than domestic HGVs. First, the paper suggests that 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.

Second, in spite of common training and education standards across Europe, European countries offer different national and local challenges with repercussions for HGV safety. In Norway and Finland this is especially related to winter driving.

Third, although some research suggest that foreign HGVs in Norway are in a poorer technical state than Norwegian HGVs, the Norwegian Public Roads Administration conclude that they did not find substantial differences between the technical state of Norwegian and foreign HGVs after controlling 17 000 HGVs from January to August 2013.

Fourth framework conditions as competition and rules/enforcement influence the safety level in HGV transport. We have also seen that the safety outcomes of deregulation/competition are debated, and that there are several key challenges related to enforcing rules against foreign HGV drivers in Norway.

Both exposure and accident data for HGVs seem to be poor in some European countries. Better data on risk differences and risk factors must be gathered in order to enable European authorities to correctly analyse and respond to this important traffic safety challenge.

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7. References

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