Final report

Evaluation study on Speed Limitation Devices

SPECIFIC CONTRACT
MOVE/A3/350-2010 IMPACT ASSESSMENTS AND EVALUATIONS (EX-ANTE, INTERMEDIATE AND EX-POST) IN THE FIELD OF THE TRANSPORT

Ex-post evaluation of Directive 92/6/EEC on the installation and use of speed limitation devices for certain categories of motor vehicles in the Community, as amended by Directive 2002/85/EC

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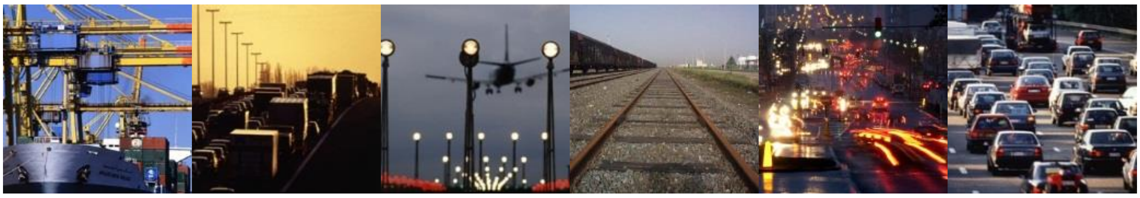

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Contents

Glossary

Average speed	This is the average speed of the traffic flow or an individual
Bus	M2 and M3 vehicles. In this report the term 'buses' refers to both buses and coaches.
EU15	Belgium, Denmark, Germany, Ireland, Spain, France, Italy, Luxembourg, the Netherlands, Austria, Poland, Portugal, Finland, Sweden, UK
EU19	Belgium, Czech Republic, Denmark, Germany, Ireland, Greece, Spain, France, Italy, Luxembourg, Netherlands, Austria, Poland, Portugal, Romania, Slovenia, Finland, Sweden and United Kingdom
EU24	EU-19 + Estonia, Latvia, Hungary, Malta and Slovakia
EU27	27 EU Member States at 1 January 2013 (without Croatia that entered the EU at 1 July 2013)
HCV	Heavy Commercial Vehicles covering HGVs and buses as laid down in the Speed Limitation Directive. Refers to vehicle categories N2/N3 and M2/M3
HGV	Heavy Goods Vehicle, refers to vehicle categories N2 and N3
ISA	Intelligent Speed Assistance/Adaptation
LCV	Light Commercial Vehicle, refers to the vehicle category N1 and M1 that are commercially used
LGV	Light Goods Vehicle, refers to vehicle category N1
M1 vehicle	A vehicle designed and constructed for the carriage of passengers and comprising no more than eight seats in addition to the driver's seat
M2 vehicle	A vehicle designed and constructed for the carriage of passengers, comprising more than eight seats in addition to the driver's seat, and having a maximum mass not exceeding 5 tonnes.
M3 vehicle	A vehicle designed and constructed for the carriage of passengers, comprising more than eight seats in addition to the driver's seat, and having a maximum mass exceeding 5 tonnes.
N1 vehicle	A vehicle designed and constructed for the carriage of goods and having a maximum mass not exceeding 3.5 tonnes.

N2 vehicle	A vehicle designed and constructed for the carriage of goods and having a maximum mass exceeding 3.5 tonnes but not exceeding 12 tonnes.
N3 vehicle	A vehicle designed and constructed for the carriage of goods and having a maximum mass exceeding 12 tonnes.
Posted speed limit	The speed limit for a road as posted on the traffic signs. These limits differ per Member State and road type.
Speed limiter	On-board device that automatically limits the speed of a vehicle to a certain maximum speed as set in the device
Speed limitation device	Same as Speed limiter
Speed Limitation Directive	Directive 92/6/EEC on the installation and use of speed limitation devices for certain categories of motor vehicles in the Community, as amended by Directive 2002/85/EC
Speed deviation	Statistical measure for the speed dispersion (standard deviation of speed)
Speed dispersion	Measure for the differences in speeds between individual vehicles that are part of the traffic flow or the variation in speeds for all vehicles over a road segment
Speed distribution	The arrangement of speeds driven according to their frequency of occurrence on the road
Speed profile	The variation in speed over time of a specific vehicle
Time series	A sequence of data points, measured typically at successive times, spaced at (often uniform) time intervals.
Time series analysis	A method that attempt to understand time series, often either to understand the underlying context of the data points (Where did they come from? What generated them?), or to make forecasts (predictions). A time series analysis can be used to recognize specific trend breaking points in (the values of) a dependent variable.

Summary

Context, objective and methodology

The installation of speed limiters and Intelligent Speed Adaption Systems (ISA) is believed to be an effective way to improve road safety and to reduce emissions and traffic noise. It addresses specifically unadapted driving speed, which is one of the main causes of traffic accidents, particularly on motorways. Speed policies can be regarded as being complementary to other policies that affect other causes of accidents or emissions, such as vehicle and energy technology, alcohol use or unsafe infrastructure.

Directive 92/6/EEC required speed limitation devices to be installed on large Heavy Goods Vehicles HGVs and buses (N3 and M3 vehicles). In 2002, this "Speed Limitation Directive" was amended by Directive 2002/85/EC, which obliged all Heavy Commercial Vehicles (HCVs), so also N2 and M2 vehicles, to be equipped with speed limiters. Directive 2002/85/EC requires the Commission to evaluate its road safety and traffic impacts. In this context, the European Commission commissioned Transport and Mobility Leuven, CE Delft, TRT and TNO to carry out this evaluation study.

Speed limiters and ISA can contribute to key policy objectives of the 2011 White Paper on Transport, in particular moving closer to zero fatalities in road transport in 2050 and reducing GHG emissions in 2050 by 60% compared to 1990 level. Speed policy can be regarded as necessary, but on its own not sufficient for meeting these targets. The main argument for the EU to keep playing a role in speed policy appears to be to ensure a level playing field for all commercially used vehicles across Member States.

The overall objective of this study is to assist the European Commission with the ex-post evaluation of the "Speed Limitation Directive" and to explore and assess options for revising the Directive (ex-ante evaluation). These options include changing the maximum speed applied for HCVs, extending the scope of the Directive to Light Commercial Vehicles (LCVs, including Light Goods Vehicles and small buses, respectively N1 and M1 vehicles) and/or introducing requirements for the installation of various types of ISA. The analysis builds on a literature review, a survey among stakeholders and Member States, interviews, a stakeholder workshop and extensive data analysis and modelling.

Ex-post evaluation

According to the survey carried out in this project, no particular problems have been encountered in the implementation of the Speed Limitation Directive with few exceptions related to administrative and technical costs. All Member States that replied to the questionnaire (63% of all EU Member States) applied the maximum speeds set out in the Directive and regularly check the vehicles' compliance. In most cases this is done during roadside inspections and/or during yearly roadworthiness tests.

The impacts of the Directive on actual vehicle speeds are hard to estimate due to data limitations. When comparing the scarcely available historical data on traffic speeds, no clear effect of the Directive on the speed distribution could be found. The statistical analysis of the evolution of the accident risk of HCVs gave no clear evidence of the impact of the Directive on traffic safety,

mainly due to data limitations. However, the speed distribution without speed limiters of 10 years ago might not be representative for a situation today without speed limiters.

Therefore a second approach was applied, based on relationships between the speed distributions and accident rates and the impact of speed limiters on the speed distributions. Hence, based on real data, more theoretical speed distributions were assumed as well as the effect of speed limiters on these distributions. Using these speed distributions with and without speed limiters, the impacts on safety and emissions were calculated. This analysis showed that the Directive had a positive impact on traffic safety. Overall the impacts are estimated to be a reduction of 9% of fatal accidents on motorways with HCVs involved, 4% of serious injuries and 3% of injury accidents. The total reduction in the number of annual fatalities due to the Speed Limitation Directive is estimated at about 50 a year. These results should be regarded as indicative. Unfortunately, data is lacking to distinguish the road safety impacts of introducing speed limitation devices specifically in vehicle categories N2 and M2.

The effects on emissions were estimated by comparing speed profiles. This analysis showed that for the EU as a whole the introduction of speed limiters resulted in a reduction of the total CO2, NOx and PM emissions of HCVs of about 1%.

The evaluation of the market impacts focused on the possible impacts on a shift between HCVs and LCVs, the transportation costs, vehicle design and enforcement and fraud. For none of these impacts clear evidence of problems were found. With respect to shifts towards LCVs, some countries did see this shift, but this could also be caused by other regulations and other influences. Fraud was not seen as a problem by the interviewees, but did come up as a problem in the literature from outside the EU.

Ex-ante evaluations

Four scenarios for HCVs were evaluated and four for LCVs. Unfortunately, data is lacking to evaluate the impacts of extending the scope of the Directive to commercially used M1-vehicles. Therefore, the LCV scenarios were limited to LGVs (N1 vehicles). The results for N1 vehicles can however be expected to be representative for commercially used M1 vehicles, given that the parameters determining the safety and emission impacts are largely the same.

The analysis shows that overall the ISA scenarios have the highest reductions on road safety for both HCVs and LCVs, in particular when the system is not just informative but also gives active feedback (Voluntary ISA). For both HCVs and LCVs the scenario with such an ISA system shows a reduction in the number of accidents in the EU with HCVs/LGVs involved of about 25% for fatal accidents, 18-19% for seriously injury accidents and 11% for all injury accidents. This corresponds to a reduction in the number of fatalities per year of about respectively 150 (ISA for HCVs) and 600 (ISA for LCVs).

Decreasing the speed limits to 80 and 90 km/h for HGVs and buses, respectively, leads to a decrease in fatal accidents with HCVs involved of about 5%. A similar reduction percentage was found for the scenario with speed limiters for LGVs set at 100 km/h. These rates are lower than for the ISA scenarios because speed limiters do only affect motorway traffic and rural roads with relatively high posted speed limits; ISA systems have an impact on safety on all roads. Because the absolute number of accidents is larger for these road types, ISA systems have a larger overall effect on road safety. It should be noticed, however, that speed limiters are an effective way to improve traffic safety on motorways: it allows for 16% to 28% reduction of fatal accidents with LGVs involved (corresponding to 40 to 70 fatal accidents a year).

The emission impacts are rather different from the safety impacts: the speed limiters can have a high impact on emissions, especially on motorways, while the effect of ISA is in most cases close to zero. The highest emission reductions for the HCVs are found when the speed set with the speed limiters is lowered to 80 and 90 km/h for HGVs and buses, respectively. In that case both pollutant and CO2 emissions decrease with approximately 4% to 6% of the emissions by HCVs on non-urban roads in the EU27 (corresponding to a reduction of about 9 Mt of CO2). For LCVs, the highest emission reductions are found for the scenario with a speed limit set at 100 km/h with emission reductions on all non-urban roads of about 4-5% for CO2 (about 2 Mt of CO2) and PM emissions and even 14% for NOx. With a speed limiter set at 110 km/h, emissions reductions are less than half as high.

The extension of speed limiters to LGVs is generally seen as a way to reduce vehicle operating and maintenance costs. In combination with the CO2 emission limits for LCVs it could also lead to engine power downsizing resulting in additional CO2 reduction. Concerning compliance costs, the Directive extension would imply measures for the retrofitting of the existing fleet and ad-hoc enforcement policies will have to be applied in order to avoid frauds and illegal behaviours.

Further decreasing the speed for HCVs can be expected to result into a shift towards the less restricted LCVs and possibly lead to a positive effect with respect to the operating costs. The LCV scenarios with speed limiters are considered by some stakeholders and operators as a step towards a more levelled playing field in road transport. However, speed is not the only factor influencing the choice of the commercial vehicle size. When just N1-vehciles would be included, there might be a shift from LGVs to M1 vehicles, which is an argument to include commercially used M1 vehicles also to some extent.

No major market impacts are considered for the ISA scenarios, both for HCVs and LCVs.

Policy discussion and conclusions

The results of the ex-ante evaluations suggest that there is no need to change the speed set with the speed limiters for HCVs. There is also not much support among stakeholders and Member States for doing so.

On the other hand, based on the ex-ante evaluations, there are several options for improving the effectiveness of the Speed Limitation Directive, in particular:

To improve traffic safety, requiring all commercial vehicles to be equipped with an ISA system that provides tactile feedback to the driver (for HCVs combined with the existing speed limiter).

For reducing emission, introducing speed limiters for LCVs is an effective measure.

In the evaluation carried out in this study it was not feasible to simulate scenarios with subsets of N1 or M1 vehicles covered by the Directive. However, to ensure a level playing field and to avoid unintended shifts, e.g. between N1 and M1 vehicles, policy options for including certain types of M1 vehicles could be considered. This topic is recommended as subject for further study.

Résumé

Contexte, objectif et méthodologie

L'installation de limiteurs de vitesse et de systèmes d'adaptation intelligente de la vitesse (ISA) est un moyen jugé efficace pour améliorer la sécurité routière et réduire les émissions et les bruits du trafic. Elle vise avant tout la vitesse de conduite inadaptée, qui représente l'une des principales causes d'accidents de la route, particulièrement sur les autoroutes. Les politiques en matière de vitesse peuvent être considérées comme étant complémentaires aux autres politiques visant les autres causes d'accidents ou d'émissions, comme la technologie automobile et énergétique, la consommation d'alcool ou les infrastructures peu sûres.

La directive 92/6/CEE sollicitait l'installation de dispositifs de limitation de vitesse sur les poids lourds et les autobus (véhicules N3 et M3). En 2002, cette « directive de limitation de la vitesse » a été modifiée par la directive 2002/85/CE, qui exigeait que tous les véhicules utilitaires lourds, donc également les véhicules des catégories N2 et M2, soient équipés de limiteurs de vitesse. La directive 2002/85/CE demande à la Commission d'évaluer son impact sur la sécurité routière et la circulation. Dans ce contexte, la Commission européenne a chargé Transport and Mobility Leuven, CE Delft, TRT et TNO de mener cette étude d'évaluation.

Les limiteurs de vitesse et l'ISA peuvent contribuer aux principaux objectifs stratégiques du Livre blanc sur le transport de 2011, en particulier en s'approchant du niveau « zéro accident mortel » sur les routes en 2050 et en réduisant de 60 % les émissions de GES en 2050, par rapport aux chiffres de 1990. La politique en matière de vitesse peut être considérée comme nécessaire, mais ne suffit pas à elle seule pour atteindre ces objectifs. L'argument principal en faveur du maintien du rôle joué par l'UE dans la politique en matière de vitesse est visiblement de garantir l'harmonisation des règles pour tous les véhicules utilisés à des fins commerciales au sein de tous les États membres.

L'objectif général de cette étude consiste à seconder la Commission européenne dans l'évaluation ex post de la « directive de limitation de la vitesse » et d'explorer et examiner les possibilités de remanier la directive (évaluation ex ante). Parmi ces possibilités figurent notamment la modification de la vitesse maximale appliquée aux véhicules utilitaires lourds, l'élargissement du champ d'application de la directive aux véhicules utilitaires légers (y compris les véhicules commerciaux légers et les petits autobus, respectivement les véhicules des catégories N1 et M1) et/ou l'introduction d'exigences visant à installer plusieurs types d'ISA. L'analyse s'appuie sur un examen de la littérature existante, une enquête menée auprès des parties prenantes et des États membres, des entretiens, un atelier réunissant les parties concernées et une analyse et une modélisation approfondies des données.

Évaluation ex post

D'après l'enquête menée dans le cadre de ce projet, aucun problème particulier n'a été rencontré lors de la mise en œuvre de la directive de limitation de la vitesse, à quelques exceptions près, concernant les frais administratifs et techniques. Tous les États membres qui ont répondu au questionnaire (63 % de l'ensemble des États membres de l'UE) ont appliqué les vitesses maximales établies dans la directive et contrôlent régulièrement la conformité des véhicules. Dans la plupart

des cas, ces vérifications ont lieu lors de contrôles routiers et/ou lors des contrôles techniques annuels.

Les incidences de la directive sur les vitesses réelles des véhicules sont difficiles à estimer en raison des limites des données. La comparaison des rares données historiques disponibles sur les vitesses de circulation n'a révélé aucun effet notable de la directive sur la distribution de vitesse. L'analyse statistique de l'évolution du risque d'accident des véhicules utilitaires lourds n'a montré aucun signe évident de l'influence de la directive sur la sécurité du trafic, essentiellement en raison des limites des données. Toutefois, la distribution de vitesse observée il y a 10 ans sans limiteurs de vitesse n'est sans doute pas représentative de la situation actuelle sans limiteurs de vitesse.

C'est pourquoi une seconde approche a été adoptée, basée sur les relations entre les distributions de vitesse et les taux d'accidents et l'impact des limiteurs de vitesse sur les distributions de vitesse. Dès lors, en fonction de données réelles, davantage de distributions de vitesse théoriques ont été envisagées, ainsi que l'impact des limiteurs de vitesse sur ces distributions. En utilisant ces distributions de vitesse avec et sans limiteurs de vitesse, les effets sur la sécurité et les émissions ont été calculés. Cette analyse a montré que la directive avait un impact positif sur la sécurité routière. Globalement, on estime que cet impact a permis de réduire les accidents mortels sur autoroute impliquant des véhicules utilitaires lourds de 9 %, les blessures graves de 4 % et les accidents entraînant des blessés de 3 %. On estime qu'il y a environ 50 accidents mortels en moins par an, grâce à la directive de limitation de la vitesse. Ces résultats doivent toutefois être considérés comme indicatifs. Malheureusement, peu de données existent permettant d'identifier l'impact de l'introduction de dispositifs de limitation de la vitesse sur la sécurité routière, surtout pour les catégories de véhicules N2 et M2.

Les effets sur les émissions ont été estimés en comparant les profils de vitesse. Cette analyse a montré que, pour l'ensemble de l'UE, l'introduction de limiteurs de vitesse a entraîné une diminution de 1 % du total des émissions de CO2, NOx et de particules des véhicules utilitaires lourds.

L'évaluation des effets sur le marché s'est focalisée sur les impacts possibles sur un passage des véhicules utilitaires lourds aux véhicules utilitaires légers, les frais de transport, la conception des véhicules et l'application et la fraude. Aucun signe évident de l'existence de problèmes n'a été constaté pour ces impacts. En ce qui concerne le passage aux véhicules utilitaires légers, certains pays l'ont effectivement observé, mais cela pourrait également découler d'autres réglementations ou influences. Les personnes interrogées n'ont pas identifié la fraude comme un problème, mais celle-ci s'est avérée problématique dans la littérature issue de l'extérieur de l'UE.

Évaluations ex ante

Quatre scénarios ont été évalués pour les véhicules utilitaires lourds, et également quatre pour les véhicules utilitaires légers. Malheureusement, rares sont les données qui permettent d'évaluer les impacts de l'élargissement du champ d'application de la directive sur les véhicules de catégorie M1 utilisés à des fins commerciales. Par conséquent, les scénarios relatifs aux véhicules utilitaires légers ont été limités aux véhicules commerciaux légers (véhicules N1). On peut néanmoins s'attendre à ce que les résultats pour les véhicules N1 soient représentatifs pour les véhicules M1 utilisés à des fins commerciales, étant donné que les paramètres servant à déterminer les impacts sur la sécurité et les émissions sont en grande partie identiques.

L'analyse montre que, globalement, les scénarios ISA génèrent les plus fortes réductions en matière de sécurité routière, aussi bien pour les véhicules utilitaires lourds que pour les véhicules utilitaires légers, particulièrement lorsque le système n'est pas simplement informatif, mais donne également un feedback actif (ISA volontaire). Tant pour les véhicules utilitaires lourds que pour les véhicules utilitaires légers, le scénario prévoyant un système ISA de ce type montre une réduction du nombre d'accidents dans l'UE impliquant des véhicules utilitaires lourds/légers de 25 % pour les accidents mortels, de 18 à 19 % pour les accidents entraînant de graves blessures et de 11 % pour tous les accidents entraînant des blessures. Ces chiffres correspondent à une réduction du nombre d'accidents mortels par an d'environ 150 (ISA pour véhicules utilitaires lourds) et 600 (ISA pour véhicules utilitaires légers).

Baisser la limitation de vitesse à respectivement 80 et 90 km/h pour les poids lourds et les autobus entraîne une diminution d'environ 5 % des accidents mortels impliquant des véhicules utilitaires lourds. Ce même pourcentage de diminution a été observé dans le scénario impliquant des limiteurs de vitesse réglés sur 100 km/h pour les véhicules commerciaux légers. Ces taux sont plus bas que pour les scénarios ISA, car les limiteurs de vitesse n'ont d'influence que sur le trafic sur autoroute et sur les routes de campagne dont les limitations de vitesse sont relativement élevées ; les systèmes ISA influencent la sécurité sur toutes les routes. Étant donné que le nombre absolu d'accidents est plus élevé sur ces types de routes, les systèmes ISA ont un impact global plus important sur la sécurité routière. Il convient néanmoins de noter que les limiteurs de vitesse constituent un moyen efficace d'améliorer la sécurité routière sur autoroute : ils permettent de réduire les accidents mortels impliquant des véhicules commerciaux légers de 16 à 28 % (ce qui correspond à 40 à 70 accidents mortels par an).

Les effets sur les émissions sont quelque peu différents des effets sur la sécurité : les limiteurs de vitesse peuvent exercer un impact important sur les émissions, en particulier sur les autoroutes, tandis que l'impact de l'ISA est dans la plupart des cas proche de zéro. Les plus fortes réductions d'émissions pour les véhicules utilitaires lourds sont observées lorsque la vitesse fixée avec les limiteurs de vitesse est réduite à 80 et 90 km/h pour les poids lourds et les autobus, respectivement. Dans ce cas, tant les émissions de polluants que de CO2 diminuent, avec environ 4 à 6 % des émissions des véhicules utilitaires lourds sur des routes non urbaines dans l'Europe des 27 (ce qui correspond à une réduction d'environ 9 mt de CO2). En ce qui concerne les véhicules utilitaires légers, les plus fortes réductions d'émissions sont observées dans le scénario impliquant une limitation de vitesse fixée à 100 km/h, avec des réductions d'émissions sur toutes les routes non urbaines d'environ 4 à 5 % pour le CO2 (environ 2 mt de CO2) et les particules, et même 14 % pour le NOx. Lorsque le limiteur de vitesse est fixé à 110 km/h, les réductions d'émissions sont moins de deux fois moins élevées.

L'application des limiteurs de vitesse aux véhicules commerciaux légers est généralement perçue comme un moyen de réduire les coûts de fonctionnement et de maintenance du véhicule. Conjuguée aux limitations des émissions de CO2 pour les véhicules utilitaires légers, elle pourrait également entraîner une diminution de la puissance du moteur, favorisant ainsi une réduction supplémentaire des émissions de CO2. En ce qui concerne les coûts de mise en conformité, l'extension de la directive impliquerait l'adoption de mesures relatives à l'adaptation de la flotte existante et des politiques d'application ad hoc devront être mises en œuvre afin d'éviter les fraudes et les comportements illicites.

Limiter davantage la vitesse pour les véhicules utilitaires lourds peut sans doute entraîner un transfert vers les véhicules utilitaires légers et probablement générer un effet positif sur les coûts de fonctionnement. Les scénarios impliquant des véhicules utilitaires légers munis de limiteurs de vitesse sont considérés par certains intervenants et opérateurs comme une étape vers une meilleure harmonisation dans le secteur du transport routier. Cependant, la vitesse n'est pas le seul facteur qui influence le choix de la taille du véhicule utilitaire. Si seuls les véhicules N1 sont inclus, on pourrait assister à un passage des véhicules commerciaux légers aux véhicules M1, ce qui constitue un argument pour intégrer également les véhicules M1 utilisés à des fins commerciales dans une certaine mesure.

Aucun impact majeur sur le marché n'a été envisagé pour les scénarios ISA, tant pour les véhicules utilitaires lourds que pour les véhicules utilitaires légers.

Discussion sur la politique et conclusions

Les résultats des évaluations ex ante suggèrent qu'il n'est pas nécessaire de modifier la vitesse fixée par les limiteurs de vitesse pour les véhicules utilitaires lourds. En outre, cette possibilité ne reçoit pas beaucoup de soutien de la part des parties prenantes et des États membres.

En revanche, sur base des évaluations ex ante, il existe plusieurs options visant à améliorer l'efficacité de la directive de limitation de la vitesse, en particulier :

- Améliorer la sécurité routière, ce qui demande que tous les véhicules utilitaires soient équipés d'un système ISA qui fournit un feedback tactile au conducteur (pour les véhicules utilitaires lourds, en association avec le limiteur de vitesse existant).
- Pour réduire les émissions, l'introduction de limiteurs de vitesse pour les véhicules utilitaires légers constitue une mesure efficace.

Lors de l'évaluation réalisée dans le cadre de cette étude, il n'était pas possible de simuler des scénarios impliquant des sous-ensembles de véhicules N1 ou M1 englobés dans la directive. Néanmoins, afin d'assurer une harmonisation et d'éviter les changements non souhaités, par exemple entre les véhicules N1 et M1, des options visant à inclure certains types de véhicules M1 pourraient être prises en compte. Ce thème devrait idéalement faire l'objet d'une prochaine étude.

Zusammenfassung

Kontext, Ziel und Methodologie

Die Installation von Geschwindigkeitsbegrenzern und Intelligent Speed Adaption Systems (ISA) (Intelligenten Geschwindigkeitsanpassungssystemen) wird als effektiver Weg zur Erhöhung der Verkehrssicherheit bei gleichzeitiger Reduzierung von Emissionen und Verkehrslärm angesehen. Sie zielt spezifisch auf das Problem unangepasster Geschwindigkeit, eine der Hauptursachen von Unfällen im Straßenverkehr, insbesondere auf Autobahnen. Geschwindigkeitsstrategien können als komplementär zu anderen Strategien erachtet werden, das heißt als ergänzend zu Strategien, die sich auf andere Unfallursachen oder Emissionen wie Fahrzeug- und Energietechnologie, Alkoholmissbrauch oder unsichere Infrastruktur auswirken.

Die Richtlinie 92/6/EEC erforderte die Installation von Geschwindigkeitsbegrenzern in großen Lastkraftwagen (LKW) und Bussen (Fahrzeugklassen N3 und M3). Im Jahr 2002 wurde diese „Geschwindigkeitsbegrenzungsrichtlinie" ergänzt durch die Richtlinie 2002/85/EC, die die Ausstattung aller schweren gewerblichen Nutzfahrzeuge, also auch aller Fahrzeuge der Klassen N2 und M2, mit Geschwindigkeitsbegrenzern verbindlich vorschrieb. Zudem verlangt die Richtlinie 2002/85/EC von der Kommission, ihre Auswirkung auf die Bereiche Verkehr und Verkehrssicherheit zu evaluieren. In diesem Zusammenhang hat die EU-Kommission die Transport & Mobility Leuven, CE Delft, TRT und TNO mit der Durchführung dieser Evaluationsstudie beauftragt.

Geschwindigkeitsbegrenzer und ISA-Systeme können zur Erreichung wichtiger Strategieziele des Transport-Weißbuchs von 2011 beitragen, insbesondere im Hinblick auf die Ziele „Null Verkehrstote im Straßentransport bis 2050" und die Reduzierung von THG-Emissionen bis 2050 auf 60% des Standes von 1990. Die Geschwindigkeitsstrategie kann als notwendig, jedoch nicht alleinig ausreichend zu Erreichung dieser Ziele angesehen werden. Das Hauptargument dafür, dass die EU auch weiterhin eine Rolle im Rahmen der Geschwindigkeitsstrategie spielen sollte, scheint die Gewährleistung eines ausgewogenen Spielfeldes für alle gewerblich genutzten Fahrzeuge über die einzelnen Mitgliedsstaaten hinweg zu sein.

Ziel dieser Studie ist es, die EU-Kommission im Rahmen der Ex-Post-Evaluation der „Geschwindigkeitsbegrenzungsrichtlinie" zu unterstützen und Optionen im Hinblick auf die Revision der Richtlinie zu untersuchen und zu bewerten (Ex-Ante-Evaluation). Diese Optionen schließen die Änderung der Höchstgeschwindigkeit für schwere gewerbliche Nutzfahrzeuge, die Ausdehnung des Geltungsbereichs der Richtlinie auf leichte gewerbliche Nutzfahrzeuge (inkl. Kleinlastwagen und Kleinbusse, respektive Fahrzeuge der Klassen N1 und M1) und/oder die Einführung von Vorgaben für die Installation verschiedener Arten von ISA-Systemen. Die Analyse basiert auf einer Übersicht über die vorhandene Literatur, einer Umfrage unter Interessengruppen und Mitgliedsstaaten, Interviews, einem Workshop für Akteure auf diesem Feld sowie umfassender Datenanalyse und -modellierung.

Ex-Post-Evaluation

Laut den Ergebnissen der Umfrage, die im Zusammenhang mit diesem Projekt durchgeführt wurde, war man – abgesehen von wenigen Ausnahmen hinsichtlich administrativer und technischer

Kosten – auf keine besonderen Probleme im Rahmen der Einführung der Geschwindigkeitsbegrenzungsrichtlinie gestoßen. Alle Mitgliedsstaaten, die sich an der Umfrage beteiligt haben (63% aller EU-Mitgliedsstaaten), haben die in der Richtlinie fixierten Höchstgeschwindigkeiten eingeführt und überprüfen deren Einhaltung durch die betreffenden Fahrzeuge regelmäßig. In den meisten Fällen geschieht dies im Zuge von Verkehrskontrollen und/oder der jährlichen TÜV-/Verkehrstauglichkeits-Untersuchungen.

Die Auswirkungen der Richtlinie auf die tatsächlichen Fahrzeuggeschwindigkeiten sind aufgrund der begrenzten Datenverfügbarkeit nur schwierig einzuschätzen. Beim Vergleich mit den nur spärlich vorhandenen historischen Daten zur Verkehrsgeschwindigkeit konnte kein eindeutiger Effekt der Richtlinie auf die Geschwindigkeitsverteilung festgestellt werden. Die statistische Analyse der Entwicklung des Unfallrisikos von schweren gewerblichen Nutzfahrzeugen ergab – vor allem aufgrund der begrenzten Datenverfügbarkeit – keinen klaren Beweis für Auswirkungen der Richtlinie auf die Verkehrssicherheit. Möglicherweise ist jedoch die Geschwindigkeitsverteilung ohne Geschwindigkeitsbegrenzer, so wie sie sich vor 10 Jahren darstellte, nicht bezeichnend für eine heutige Situation ohne Geschwindigkeitsbegrenzer.

Aus diesem Grund wurde eine andere Herangehensweise umgesetzt, basierend auf Beziehungen zwischen den Geschwindigkeitsverteilungen, Unfallraten und dem Einfluss von Geschwindigkeitsbegrenzern auf die Geschwindigkeitsverteilungen. Folglich wurden, basierend auf realen Daten, eher theoretische Geschwindigkeitsverteilungen sowie der Effekt von Geschwindigkeitsbegrenzern auf diese Verteilungen angenommen. Mit Hilfe dieser Geschwindigkeitsverteilungen mit und ohne Geschwindigkeitsbegrenzer wurden die Auswirkungen auf Sicherheit und Emissionen berechnet. Diese Analyse zeigte, dass die Richtlinie einen positiven Einfluss auf die Verkehrssicherheit hatte. Insgesamt wurden die Auswirkungen geschätzt auf eine Reduzierung von 9% bei tödlichen Autobahnunfällen mit Beteiligung schwerer gewerblicher Nutzfahrzeuge, 4% bei Unfällen mit Schwerverletzten und 3% bei Unfällen mit Verletzten überhaupt. Es wird geschätzt, dass die Anzahl der Todesfälle pro Jahr infolge der Geschwindigkeitsbeschränkungsrichtlinie um etwa 50 gesenkt werden konnte. Diese Ergebnisse sollten als bezeichnend angesehen werden. Leider fehlen die nötigen Daten um abzugrenzen, welche Auswirkungen sich durch die Einführung von Geschwindigkeitsbegrenzern spezifisch bei den Fahrzeugklassen N2 und M2 ergeben haben.

Die Effekte im Bereich der Emissionen wurden durch Vergleiche der Geschwindigkeitsprofile geschätzt. Diese Analyse zeigte, dass die Einführung von Geschwindigkeitsbegrenzern für die EU als Ganzes die Reduzierung der CO2-, NOx- und PM-Gesamt-Emissionen von schweren gewerblichen Nutzfahrzeugen um 1% zum Ergebnis hatte.

Die Evaluation der Marktauswirkungen konzentrierte sich auf die möglichen Auswirkungen auf eine Verschiebung zwischen schweren und leichten gewerblichen Nutzfahrzeugen, die Transportkosten, das Fahrzeugdesign, Maut und Betrug. Für keinen dieser Bereiche wurden klare Beweise für Probleme gefunden. Was eine Verschiebung hin zu gewerblichen en Nutzfahrzeugen angeht, so wurde diese Verschiebung in der Tat von einigen Ländern beobachtet, könnte jedoch auch durch andere Vorschriften oder Einflüsse verursacht sein. Betrug wurde bei den Befragten nicht als Problem gesehen, tauchte jedoch in außerhalb der EU verfasster Literatur als Problem auch.

Ex-Ante-Evaluationen

Evaluiert wurden je vier Szenarien für schwere und für leichte gewerbliche Nutzfahrzeuge. Leider fehlen Daten für die Evaluierung der Auswirkungen einer Ausdehnung des Geltungsbereichs der

Richtlinie auf gewerblich genutzte Fahrzeuge der Klasse M1. Die Szenarien für leichte gewerbliche Nutzfahrzeuge wurden daher auf Kleinlastwagen (Fahrzeuge der Klasse N1) beschränkt. Da jedoch die für die Auswirkungen auf Sicherheit und Emissionen entscheidenden Parameter weitgehend die gleichen sind, darf man erwarten, dass die Ergebnisse für Fahrzeuge der Klasse N1 repräsentativ für gewerblich genutzte Fahrzeuge der Klasse M1 sind.

Die Analyse zeigt, dass die ISA-Szenarien insgesamt sowohl bei schweren als auch bei leichten gewerblichen Nutzfahrzeugen die stärksten Auswirkungen auf die Verkehrssicherheit haben, insbesondere wenn das jeweilige System nicht nur rein informativer Natur ist, sondern auch aktiv Rückmeldung gibt (Voluntary ISA). Sowohl im Falle von schweren als auch leichten gewerblichen Nutzfahrzeuge zeigt das Szenario mit solch einem ISA-System eine Reduzierung der EU-weiten Unfallzahlen mit Beteiligung von schweren bzw. leichten gewerbliche Nutzfahrzeugen um etwa 25% bei tödlichen Unfällen, 18-19% bei Unfällen mit Schwerverletzen und 11% bei Unfällen mit Verletzen überhaupt. Dies entspricht einer Reduzierung der Anzahl der Todesfälle pro Jahr um 150 (ISA für schwere gewerbliche Nutzfahrzeuge) bzw. 600 (ISA für leichte gewerbliche Nutzfahrzeuge).

Die Senkung Höchstgeschwindigkeiten auf 80 bzw. 90 km/h für LKW und Busse führt zu einer Reduzierung der tödlichen Unfälle mit Beteiligung schwerer gewerblicher Nutzfahrzeuge um etwa 5%. Ein ähnlicher prozentualer Anteil zeigte sich für das Szenario mit einer Einstellung der Geschwindigkeitsbegrenzer von Kleinlastwagen auf 100 km/h. Diese Raten sind geringer als die für die ISA-Szenarien, da Geschwindigkeitsbegrenzer lediglich Autobahnen sowie Landstraßen mit relativ hoch festgelegten Höchstgeschwindigkeiten betreffen; ISA-Systeme hingegen wirken sich auf die Verkehrssicherheit auf allen Straßen aus. Weil die absolute Zahl der Unfälle auf diesen Straßentypen höher ist, haben ISA-Systeme einen insgesamt größeren Einfluss auf die Verkehrssicherheit. Es sollte jedoch beachtet werden, dass Geschwindigkeitsbegrenzer ein effektives Mittel zur Erhöhung der Verkehrssicherheit auf Autobahnen sind: Sie ermöglichen eine Reduzierung der tödlichen Unfälle mit Beteiligung von Kleinlastwagen um 16% bis 28% (was einer Zahl von 40 bis 70 tödlichen Unfällen pro Jahr entspricht).

Die Auswirkungen im Bereich der Emissionen hingegen unterscheiden sich deutlich von denen im Bereich Sicherheit: Geschwindigkeitsbegrenzer können, insbesondere auf Autobahnen, starke Auswirkungen auf Emissionen haben, während die Auswirkungen von ISA in den meisten Fällen gen Null gehen. Die stärksten Emissionsreduzierungen bei schweren gewerblichen Nutzfahrzeugen kann bei einer Einstellung der Geschwindigkeitsbegrenzer auf 80 bzw. 90 km/h bei LKW und Bussen festgestellt werden. In diesem Fall werden sowohl der Ausstoß von Schadstoffen als auch der von CO2-Emissionen durch schwere Nutzfahrzeuge auf nicht-städtischen Straßen in den EU27 um ca. 4% bis 6% gesenkt (was einer Reduzierung von 9Mt CO2 entspricht). Bei leichten gewerblichen Nutzfahrzeugen lassen sich die stärksten Reduzierungen im Falle des Szenarios einer Geschwindigkeitsbegrenzung auf 100 km/h festgestellt, was auf allen nicht-städtischen Straßen zu Emissionsreduzierungen von etwa 4% bis 5% bei CO2 (ca. 2 Mt CO2) und PM-Emissionen und sogar 14% bei NOx führt. Bei Einstellung der Geschwindigkeitsbegrenzer auf 110 km/h sind die erzielten Emissionsreduzierungen nicht einmal halb so hoch.

Aus Ausdehnung der Anwendung von Geschwindigkeitsbegrenzern auf Kleinlastwagen wird generell als ein Weg zur Reduzierung der Fahrzeugbetriebs- und -wartungskosten angesehen. In Kombination mit den CO2-Emmissionsgrenzwerten für leichte gewerbliche Nutzfahrzeuge könnte dies darüber hinaus zu einer tendenziellen Reduzierung der Motorleistung und somit einer zusätzlichen Reduzierung des CO2-Ausstoßes führen. Hinsichtlich des Kostenaufwands für die Einhaltung entsprechender Vorschriften würde die Ausdehnung der Richtlinie Maßnahmen in

Bezug auf die Nachrüstung der bestehenden Flotte beinhalten; daneben müssen ad-hoc Durchsetzungsstrategien zur Vermeidung von Betrug und illegalem Verhalten eingeführt und angewandt werden.

Eine weitere Reduzierung der Geschwindigkeit von schweren gewerblichen Nutzfahrzeugen lässt eine Verschiebung hin zu leichten gewerblichen Nutzfahrzeugen, die weniger Regeln unterliegen, erwarten und kann möglicherweise zu einem positiven Effekt in puncto Betriebskosten führen. Die Szenarien für leichte gewerbliche Nutzfahrzeuge mit Geschwindigkeitsbegrenzern werden von einigen Akteuren und Betreibern als Schritt hin zu einem ausgewogeneren Spielfeld im Straßentransport gesehen. Geschwindigkeit ist jedoch nicht der einzige Faktor, der die Wahl der Größe eines gewerblichen Nutzfahrzeuges beinflusst. Würden nur Fahrzeuge der Klasse N1 eingeschlossen, ergäbe sich eventuell eine Verschiebung von Kleinlastwagen hin zu Fahrzeugen der Klasse M1, was ein Argument dafür ist, gewerblich genutzte Fahrzeuge der Klasse M1 bis zu einem gewissen Grad ebenfalls einzubeziehen.

Was die ISA-Szenarien angeht, sieht man hier weder bei schweren noch bei leichten gewerblichen Nutzfahrzeugen bedeutende Auswirkungen auf den Markt.

Strategie-Diskussionen und Schlussfolgerungen

Die Ergebnisse der Ex-Ante-Evaluationen legen nahe, dass im Falle von schweren gewerblichen Nutzfahrzeugen keine Notwendigkeit für die Änderung der Einstellung der Geschwindigkeitsbegrenzer besteht. Auch findet ein solches Ansinnen wenig Unterstützung bei Akteuren und Mitgliedsstaaten.

Auf der anderen Seite sind, basierend auf den Ex-Ante-Evaluationen, diverse Optionen zur Optimierung der Effektivität der Geschwindigkeitsbeschränkungsrichtlinie gegeben, wie insbesondere:

- zur Erhöhung der Verkehrssicherheit durch Ausstattung aller gewerblichen Nutzfahrzeuge mit ISA-Systemen, die dem Fahrer taktiles Feedback geben (im Falle schwerer gewerblicher Nutzfahrzeuge in Kombination mit den bereits vorhandenen Geschwindigkeitsbegrenzern);
- zur Reduzierung von Emissionen durch Einführung von Geschwindigkeitsbegrenzern für leichte gewerbliche Nutzfahrzeuge, was in diesem Bereich eine effektive Maßnahme wäre.

Im Rahmen der Evaluation innerhalb dieser Studie war es nicht möglich, Szenarien mit durch die Richtlinie abgedeckten Untermengen von Fahrzeugen der Klassen N1 oder M1 zu simulieren. Um jedoch ein ausgewogenes Spielfeld zu gewährleisten und unbeabsichtigte Verschiebungen, beispielsweise zwischen Fahrzeugen der Klassen N1 und M1, zu vermeiden, könnten Strategie-Optionen zur Einbeziehung bestimmter Typen der Fahrzeugklasse M1 in Betracht gezogen werden. Es wird empfohlen, dieses Thema zum Gegenstand einer weiteren Studie zu machen.

1 Introduction

1.1 Background

Limiting the vehicle speed of road vehicles by installing speed limitation devices constitutes a measure to improve road safety, especially on motorways, and to reduce greenhouse gas emissions, pollutant emissions and traffic noise.

Excessive vehicle speeds are a main cause for road accidents, particularly on motorways. The European Truck Accident Causation (ETAC) Study[1] ranked a non-adapted speed first in top three of the main causes for motorway accidents with HGVs involved. Also for LCVs speed is an important cause for motorways accidents. In a recent study for Germany it is estimated that 28% of the accidents on German motorways with LCVs involved are caused by excessive speeds[2].

The potential contribution of speed reduction to greenhouse gas reduction was, among others, studied in the EU Transport GHG Routes to 2050 projects[3]. This study concluded that significant reduction of GHG emission could be achieved, particularly on motorways.

Mandatory speed limitation device are one of the policy options for reducing vehicle speeds. The first stage of an EU legislation on speed limitation devices was set by Directive 92/6/EEC which required speed limitation devices to be installed on N3 vehicles (heavy goods vehicles –HGVs - with maximum mass above 12 tonnes) and on M3 vehicles (buses) above 10 tonnes. In 2002, this Directive was amended by Directive 2002/85/EC, which obliged also N2 vehicles (smaller HGVs with maximum mass between 3.5 and 12 tonnes) and M2 vehicles (buses with more than eight seats + the driver's one with maximum mass not exceeding 5 tonnes) and M3 vehicles below 10 tonnes to be equipped with speed limiters. Directive 2002/85/EC also requires the Commission to assess the road safety and traffic impacts of adjusting the speed limitation devices used by category M2 vehicles and by category N2 vehicles of 7.5 tonnes or less to the speeds laid down by the Directive.

In this context, the European Commission commissioned Transport and Mobility Leuven, CE Delft, TRT and TNO[4] to carry out an evaluation study on this topic. This is the final report of this study.

1.2 Aim and scope of the study

The overall objective of this study is to assist the European Commission with the ex-post evaluation of the current Directive 92/6/EEC as amended by Directive 2002/85/EC on speed limitation devices ("Speed Limitation Directive") and to explore and evaluate options for revising the Directive (ex-ante evaluation). More specifically, the objectives of the study are:

[1] Scientific Study ETAC: European Truck Accident Causation( ) Final Report

[2] BASt ea (2013), Project Report, Safety of Light Commercial Vehicles

[3] Source: EU Transport GHG Routes to 2050 project, www.eutransportghg2050.eu .

[4] The study is carried out within the Framework Contract MOVE/A3/350-2010 Impact Assessments and Evaluations (Ex-Ante, Intermediate and Ex-Post) in the Field of the Transport.

1) To carry out an ex-post evaluation of the application of the Speed Limitation Directive.

2) To assess whether and how the Speed Limitation Directive could be amended to improve its effectiveness and efficiency.

The second objective includes assessment of options for changing the maximum speed applied for Heavy Commercial Vehicles (HCVs), extending the scope of the Directive to Light Commercial Vehicles (LCVs) and/or by application of various types of intelligent speed assistance/adaptation (ISA) devices for HCVs or LCVs.

The results of this evaluation study will be used to decide whether a proposal for amendment is needed and if so, what type of amendment would be needed.

For the evaluation of the current Speed Limitation Directive and of the options for amending the Speed Limitation Directive, the following set of impacts is considered:

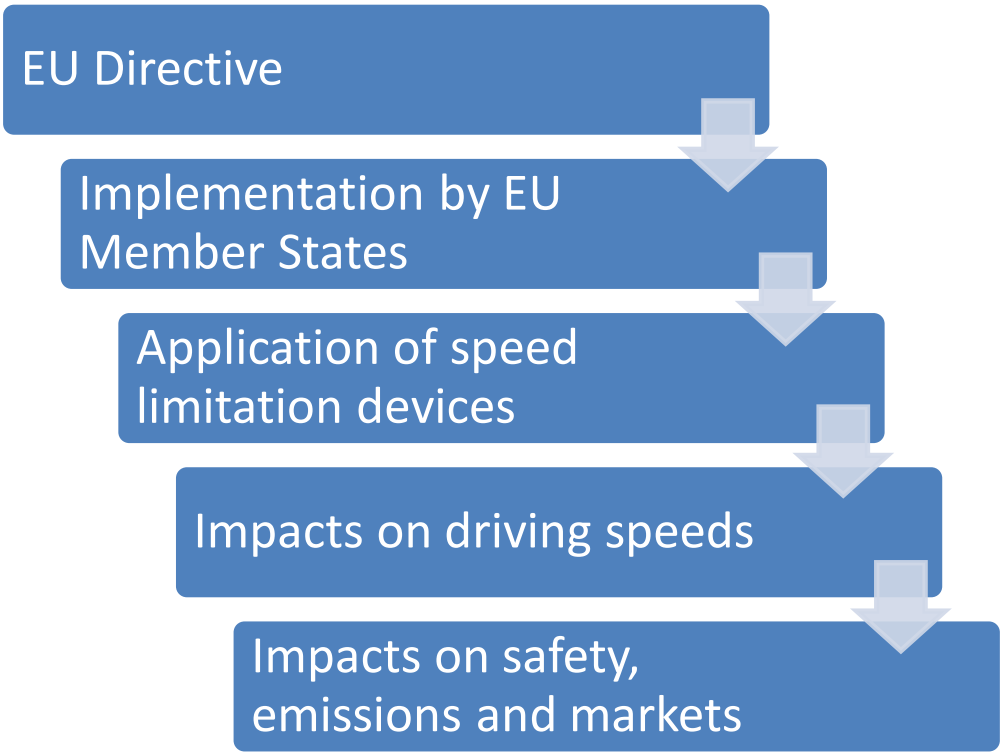
1) Impacts of the Speed Limitation Directive on the application of speed limitation devices and impacts of these devices on vehicle speed and speed profiles.

2) Safety and environmental impacts:
   a) Road safety;
   b) Fuel consumption and CO_2 emissions;
   c) Pollutant emissions (PM and NO_x);
   d) Driving behaviour.

3) Market impacts of the regulation and level playing field:
   a) Vehicle design (e.g. engines);
   b) Shifts between vehicle categories, in particular between HCVs and LCVs;
   c) Fraud;
   d) Administrative burden and costs for compliance/enforcement;
   e) Small and medium enterprises (SME's).

The final impacts on safety and emissions and the various types of market impacts all depend on the changes in driving speeds, which depend on the way the EU Directive is implemented by the various EU Member States. The relationships between the Directive and the final impacts are illustrated in Figure 1-1.

Figure 1-1: Relationship between the EU Directive and its impacts



1.3 Structure of the report

This report is structured as follows. In Chapter 2 the methodology is presented, both for the ex-ante and the ex-post evaluations. It includes an overview of the relevant literature, the general assumptions and data used as well as the approach for evaluating the impacts on speeds, safety and emissions and the market impacts. This chapter also includes an assessment of various types of intelligent speed adaptation (ISA) devices.

To gather available data, a survey among Member States and stakeholders has been carried out. Furthermore, a stakeholder workshop has been organised to gather views and other input from relevant stakeholders. The results of the survey and the stakeholder workshop constitute important input for both the ex-ante and ex-post evaluations of the Speed Limitation Directive and are presented in Chapter 3. In chapter 4, the results of the ex-post evaluation of the application of the Speed Limitation Directive to HCVs are presented. Chapter 5 and 6 show the results of the ex-ante evaluations of various options for amending the Speed Limitation Directive with respect to HCVs and LCVs, respectively. Finally, the main conclusions and recommendation of the study are presented in chapter 7.

The annexes contain data and assumptions used for the analysis and further details on the approach as referred to in the main text of this report.

2 Methodology for the evaluation

2.1 Introduction and overall approach

This study combines an ex-post evaluation of the current Speed Limitation Directive with an ex-ante evaluation of options for amending the Speed Limitation Directive. In this chapter the methodology is described.

The ex-post evaluation of the Speed Limitation Directive focuses on the impacts of the application of speed limitation devices on HCVs in general and on M2 and N2 vehicles in particular. The ex-ante evaluation explores the two main directions into which the Speed Limitation Directive could be amended: modifying speed limits for vehicle categories currently under the scope of the Speed Limitation Directive and/or enlarging the scope to include LCVs. Options for this are identified and evaluated, including options of introducing ISA systems.

Both ex-post and the ex-ante evaluations are based on the results of a survey, interviews, literature review and data analysis. Additional input was gathered via a stakeholder workshop. The impacts covered in the ex-post and ex-ante evaluations are the impacts on speeds, road safety and emissions as well as the various market impacts.

The methodologies for evaluating the various impacts are largely the same for the ex-post evaluation and the two ex-ante evaluations (on HCVs and LCVs). Therefore, the approach for the evaluation of impacts is described per type of impact. The evaluation of impacts starts with an analysis of the impacts on vehicle speeds. Based on this, the impacts on traffic safety and emissions are quantified by applying relationships between speed and accidents and between speed and emissions, respectively. For the ex-post analysis also a time series analysis has been carried out on the relevant accidents statistics. Market impacts are evaluated in a qualitative way. Table 2-1 summarizes the methodologies used for the evaluation of the various types of impacts.

Table 2-1: Summary of the methodologies used for evaluating the various impacts

Type of impact	Methodology	
	Ex-post evaluation	**Ex-ante evaluations**
Speed	Literature review of vehicle speeds and data from Member State survey and stakeholder workshop Modelling (using speed data from literature)	Literature review of vehicle speeds and data from Member State survey and stakeholder workshop Modelling (using speed data from literature)
Traffic safety	Time series analysis of road accident statistics Modelling (using speed data and speed-accidents relationships from literature)	Modelling (using speed data and speed-accidents relationships from literature) For ISA: data from literature on the relationship between ISA and traffic safety
Fuel consumption and emissions	Modelling (using speed data and the VERSIT+ -model for speed-emissions relationships)	Modelling (using speed data and the VERSIT+ -model for speed-emissions relationships) For ISA: modelling data complemented with data from literature on the relationship between ISA and emissions
Market impacts	Qualitative assessment (based on literature review, survey and stakeholder workshop)	Qualitative assessment (based on literature review, survey and stakeholder workshop)

The data available is scarce. Therefore it is not always be possible to obtain the necessary data to precisely estimate the effects of the current Speed Limitation Directive or of the scenarios for amending it. Limitations to the data presented in this report are included whenever relevant for the understanding and interpretation of the results.

The methodology for the literature review and an overview of the main findings from previous assessments as found in literature are summarized in section 2.2. The methodology for the survey, interviews and stakeholder workshop are described in section 2.3.

In section 2.3.2 the general assumptions and data used are described. The geographical scope is also defined. Also the reference years are defined.

Then section 2.5 introduces the ISA systems, and provides an overview of the different types, components and effects of ISA.

The next methodological sections cover speed impacts (section 2.6), safety impacts (section 2.7), impacts on emissions (section 2.8) and market impacts (section 2.8.1), all for both the ex-post and ex-ante evaluations.

Finally, the last section presents the evaluation questions and how these are addressed in this study.

2.2 Previous assessments: literature review

2.2.1 Methodology

The literature review exists of desk research of various relevant reports, scientific articles, data sources and own work performed previously by the researchers. Some of the literature was suggested by the stakeholders, others were selected by the researchers. Additional queries for data were made via e-mail and phone, when appropriate.

The literature review focussed on:

- Previous assessment of imposing a speed limiter for HCV – both ex-ante and ex-post;
- Studies focussing on the main crash types of trucks;
- Studies assessing the effect of equipping N1 vehicles with speed limiters.

2.2.2 Results

Previous assessments of the effects of speed limitation devices on HCVs

Up to now, the European Commission has not made a quantitative evaluation or impact assessment of the Speed limitation Directive. Also no national assessments were found or reported in the survey. In a summary report[5] from the European Commission it was concluded that the implementation would lower fuel consumption (from 3 to 11%), lower maintenance costs (tires, brakes, engine), increase road safety (fewer casualties) and lead to a more relaxed driving experience and reduced insurance premiums. The main negative aspect reported was the problem of speed limited trucks overtaking each other over many km ("elephant" races), causing traffic back-logs.

[5] Report from the Commission to the European Union Parliament and the Council on the implementation of Council Directive 92/6/EEC of 10 February 1992 on the Installation and the Use of Speed Limitation Devices for certain Categories of Motor Vehicles in the Community – as quoted in Transport Canada (2008)

ITF (2006)[6] in his report on speed management refers to research supporting the regulation showing positive effects on emissions and fuel consumption through prevention of over-speeding. They also claim that illegal modification of the speed limiters continues to be a problem. It also mentions that speeding of heavy commercial vehicles has increased in the recent years. This is partly due to the fact that trucks are equipped with more powerful engines to handle heavier loads and to minimise the time of the trips. The just-in-time principle adds additional pressure on speeds. It is however not clear from the text on which research exactly these statements are based. It is also shown that many countries, with the exception of Canada, Mexico, Norway, Russia and the United States, have compulsory speed limiters for certain categories of heavy vehicles. ITF recommends that in countries without mandatory speed limiters, consideration should be given to mandatory speed limiters for trucks and coaches.

The ETSC report (2008)[7] on managing speeds takes over a large part of the statements made in the ITF report. They refer to the results of the SafetyNet project which state that 'surplus speed' is noted as cause for approximately 10% of accidents with HGVs and buses. In this report there is a preference for ISA systems over speed limiters given that the latter

- Have no effect on roads were the speed limit is lower than the speed set by the limiter and on free-rolling downhill
- May temp drivers to always reach the maximum speed set by the limiter
- Overtaking might take long

Transport Canada (2008a)[8] planned the implementation of speed limiters for HCVs and made an international assessment to document the experiences of three participating jurisdictions (the UK, Australia and Sweden) and studied the safety implications of mandating speed limiters for large trucks (weight >11,794 kg) using a microscopic traffic simulation model. The main conclusions from the international assessments were that no country had performed an assessment before implementation or an ex-post evaluation and that the effect could not be seen directly from the safety statistics. Compliance and enforcement issues are centred on the high incidence of tampering, problems with testing equipment and the lack of enforcement personnel. According to the survey, fraud was not seen as a major problem by the interviewees. The results of the traffic simulations showed that the maximum safety gains were obtained when the speed was set at 90 km/h.

Transport Canada (2008b)[9] also made a study to assess the safety implications of mandating speed limiters for large HGVs (weight >11,794 kg) for different speed limits. A microscopic traffic simulation model was used to compare a Crash Potential Index (CPI) for several speed limiting scenarios, ranging from the maximum speed set between 110 to 80 km/h, for different freeway geometrics and different traffic scenarios. This study leads to the following results:

- The introduction of a speed limiter set at 105 km/h increased safety with on average a drop of 16% in the CPI in the uncongested region of traffic flow for all geometric configurations and especially in the straight segments. A maximum speed set at 110 km/h lead to less pronounced safety gains. The maximum safety gains were obtained when the speed was set at 90 km/h.

[6] ITF(2006), Speed Management

[7] ETSC (2008), Managing Speed. Towards Safe and Sustainable Road Transport

[8] Transport Canada (2008a), Learning from Others: An International Study on Heavy Truck Speed Limiters.

[9] Transport Canada (2008b), Safety Implications of Mandated Truck Speed Limiters on Canadian Highways

- As the volumes and percentage of HGVs increased, the safety gains of 105 km/h became less pronounced. Note that this study focussed most on the 105 km/h scenario as this was at the time the Ontarian proposal.
- If the volume is close to capacity there are more vehicle interactions and this leads to a reduction of safety, especially at segments with increased merging and lane changing activity.
- As compliance increased there was a small safety effect.

A parallel investigation was done for two lane rural highways, but the results were inconclusive.

Finally, in a third paper, Transport Canada (2008c[10]) made an overview of the three main groups representing the carrier industry in Canada, offering some insight into their position on mandatory speed limiters. The three associations have very different view point. One is a strong advocate, the other is strongly opposed and the third is also opposed but is waiting for the results of the different studies. A case study showed that in more than 60% of the carrier fleet a speed limiter is in place. They were initially introduced because doing so offered an opportunity to improve the efficiency of their business by reducing operating costs (fuel and maintenance) and potentially reduce collision risks. They were however unable to quantify these improvements since no carriers could provide data on pre-speed limiter costs. The case study showed that none of the fleets studied appeared to have any market disadvantage compared to their competitors as result of their speed control policies and in fact may have an advantage associated with drivers retention and driver job satisfaction. Based on their findings they estimate that the potential fuel savings are significant and could be as high as 250 million Canadian dollars (about 183 million euro) for the carrier industry in Canada. The environmental benefits are equally significant with a potential reduction of greenhouse gas emissions up to 0.6 Mega-tonnes per year. They conclude that speed limiters may benefit industry, government and the general public.

The CTBSSP Synthesis 16 (2008)[11] examines and summarizes literature and industry information relating to speed limiters by the use of a survey and literature research. 44% responded that speed limiters were successful or very successful in reducing tire wear and 76% responded that speed limiters increased fuel economy. The literature review confirmed that there is a paucity of relevant published research on how speed limiters affect driving behaviour, especially in terms of safety.

The US department of Transportation (2012)[12] researched the safety impacts of a speed limiter device in commercial motor vehicles. The US department claims this to be the most comprehensive investigation that has ever been conducted on speed limiters. They found that speeding was a contributing factor in 8% of all reported large truck crashes. Based on crash data for 20 commercial truck fleets for the years 2007, 2008 and 2009 counting for about 15000 crashes, they estimated that the speed-limiter relevant crash rate for carriers without a speed limiter was 1,94 times higher than for the carriers with a speed limiter. A speed-limiter relevant crash rate is a crash where an active speed limiter would be most effective in mitigating or preventing high speed truck crashes on highways. They state that the safety benefit is large and the cost is negligible as speed limiters are standard in new truck (and only need to be activated) and hence there is no cost increase to the operators above the initial vehicle price.

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[10] Transport Canada (2008c), Speed Limiter Case Study and Industry Review, Final Report

[11] CTBSSP Synthesis 16 (2008), Safety Impacts of Speed Limiter Device Installations on Commercial Trucks and Buses, Transportation Research Board of the National Academies

[12] US Department of Transportation (2012), Research on the Safety Impacts of Speed Limiter Device Installations on Commercial Motor Vehicles: Phase II

De Vlieger ea (2005)[13] estimate the effect of reducing the speed limit from 90 km/h to 80 km/h for HGVs on motorways on CO_2 and air pollutants. CO_2 emissions are estimated to decrease with 5-10%, while Particulate Matter (PM) emissions increase with 3-4% and mono-nitrogen oxides (NO_x) emissions increase with 2-3%. They also consider reduction of the speed limit for N2 vehicles to either 90 or 80 km/h. A reduction to 90 km/h leads to a decrease in CO_2 emissions with 13%, in NO_x emissions with 12 % and an increase in PM emissions with 2%. A reduction to 80 km/h decreases CO_2 emissions with 23%, NO_x emissions with 18% and increases PM emissions with 4%. However, in absolute terms the effect is smaller than decreasing the speed limit for N3 vehicles as the share of N2 vehicles in the total emissions of HGVs is relatively small.

Accident studies on HCVs

The most important study on accidents with HGVs remains the European Truck Accident Causation (ETAC) Study[14]. This study aimed at identifying the main causes of the accidents involving HGVs based on an in depth investigation of over 600 accidents with HGVs involved. It did not make an assessment of the influence of the Speed Limitation Directive, but it gives an insight in the order of magnitude (%) of accidents which can be influenced by the Speed Limitation Directive. In the top three of the main accident causes a non-adapted speed ranks first.

The TRL (2009) report analyses whether or not there is likely to be any road safety risk involved in increasing the speed limit of HGVs exceeding 7.5 tonnes on single carriageway de-restricted roads from 40 mph to 50 mph (or possibly 45 mph). It was estimated that only a small proportion of the accidents would be affected by changing the speed limit.

Studies on speed limiters for LCVs

With respect to extending the Speed Limitation Directive towards LCVs two relevant studies were found. CE Delft (2010)[15] investigated the impact on safety and emissions of extending the scope of the Directive with N1 vehicles (LGVs). The potential reduction of CO_2-emissions of a speed limiter for LGVs was estimated at about 4-5% for a speed limiter set at 110 km/h and at about 6-7% for a speed of 100 km/h. Overall, limiting the top speed of LGVs in the EU to 100 and 110 km/h would reduce fatalities by about 190 and 110 per year, respectively.

The European Parliament (2009)[16] report describes the collation and analysis of a wide range of disparate European data on the safety of light goods vehicles (<3,5 tonnes). An important finding of this study is the fact that data availability on LGVs is severely limited as many different definitions are used and as many Member States did not collect information on this type of goods vehicles. They also quote the result of the IMPROVER project in which it was shown that speed limiters for LGVs were not considered economically viable. Referring the UK data in which only 2% of the cases exceeding the speed limit was seen as a contributory factor[17], the study for the European Parliament also concludes that introducing speed limiters such as those mandatory for HGVs are expected to prevent only a small proportion of the aforementioned 2%, as speed limiters

[13] De Vlieger ea (2005), 80 km/u maatregel voor vrachtwagens. Wetenschappelijke screening van het effect op de uitstoot van CO2 en schadelijke emissies, Eindrapport.

[14] Scientific Study ETAC: European Truck Accident Causation( ) Final Report

[15] CE Delft (2010), Speed limiters for vans in Europe, Environmental and safety impacts

[16] European Parliament Directorate-General for Internal Policies, Policy Department B, Structural and Cohesion Policies, Transport and Tourism (2009), The Road Safety Performance of Commercial Light Goods Vehicles.

[17] Note that in 41% of the cases no contributory factor was attributed.

would be set at the maximum speed permitted on the fasted roads. ISA would have greater potential but also greater costs.

De Mol et al. (2009)[18] argue that LCVs form a real safety problem in Belgium: between 1991 and 2007 the total number of accidents with injuries on motorways increased with 23%, while the number of accidents with injuries with an LCV involved increased much more sharply with 83%. They also state that the number of accidents with LCVs increased also in the Netherlands and in Germany. On the other side, in the UK the accidents with LCVs follow the mean evolution of all accidents. Without making a real analysis they conclude that implementing a speed limiter for LCVs is a minimal measure.

BASt et al. (2013)[19] investigated the safety of LCVs using official German road traffic accident statistics, the accident database of German insurers (UDB) and the DEKRA as well as those of the German In-Depth Accident Study (GIDAS). Overall, accidents involving LCVs show a similar pattern to those involving passenger cars, although there are some differences in connection with accidents involving pedestrians, vehicle reversing and the causes of accidents. Rear-end accidents caused by LCVs are the most frequent types of accidents. One of the most frequent causes of accidents are to be found in inappropriate driving speeds and lack of attention and distraction. Especially on motorways, speed plays an important role as it represents 28% of the causes. The report claims that these deficits cannot be adequately addressed with the technical measures of control existing today. Speed limiters are not mentioned in the report.

Smith & Knight (2005)[20] made an analysis of the accidents involving LCVs in the UK with respect to the type of crashes, actors involved, likely causes etc. They also propose some possible countermeasures. Fitting intelligent speed limiters was estimated to save one fatality for the four year period covered by their sample (196.128 accidents with 419.879 vehicles and 275.829 casualties) and is not included in their list of top-countermeasures.

T&E (2005)[21] focuses on the relationship between speed and CO_2. Based on a literature review they conclude that a lower speed on motorways reduces CO_2 emissions and has additional positive effects on road safety, air pollution and congestion. They also suggest some policy options, to be considered at EU level, among which extending the speed limiter system to N1 vehicles.

2.2.3 Main conclusions from the literature review

Overall it can be concluded that assessments are scarce and not comprehensive.

With a view to the present evaluation, conclusions are as follows. Research from the US and Canada, who are considering the implementation of speed limiter devices for HGVs, suggest that there are clear safety and environmental benefits. With respect to the extension towards lighter vehicles, research results are mixed. There is a scope for both environmental and safety effects, but the measure is rated as not being primordial.

This literature is discussed in the relevant methodological sections 2.5 to 2.8.

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[18] De Mol et al. (2009) Abnormaal veel ongevallen met bestelwagens, Verkeersspecialist 158

[19] BASt et al. (2013), Project Report, Safety of Light Commercial Vehicles

[20] Smith & Knight (2005), Analysis of accidents involving light commercial vehicles in the UK

[21] T&E (2005) Road Transport Speed and Climate Change, A note from Transport&Environment for CARS21 WP on Integrated Approach

2.3 Survey, interviews and stakeholder workshop

In this section the methodology for the survey, interviews and workshop are explained. The results of the survey and the workshop are presented in chapter 3. The relevant findings from the interview are integrated in the sections of the chapters on ex-ante and ex-post evaluations.

The collection of available data, as well as of opinions related to the Speed Limitation Directive implementation and its possible amendments, was realised by means of a comprehensive questionnaire survey sent to from Member States competent authorities and significant stakeholders. The survey responses were supplemented by telephone interviews to improve response rates and to enrich questionnaire responses. The survey was targeted to the responsible offices within the Member States government departments and/or the concerned national authorities. In addition, safety experts and European stakeholder organisations (such as IRU, ACEA, T&E, etc.) were included in the survey.

Opinions of road transport operators for both freight and passenger in relation to the market impacts of the Directive application and on its possible amendment were collected by means of direct interviews conducted by the project team.

The final step of the stakeholders' involvement consisted of a Stakeholder Conference in Brussels. The conference offered them the opportunity to provide input to the study and give feedback on the draft results. A broad range of stakeholder organizations and Member States and a representative selection of stakeholders attended the meeting in Brussels.

2.3.1 The survey

The questionnaire for the Member States can be found in Annex 1. It includes both a quantitative part, mainly aiming at collecting data to measure the impacts of the Speed Limitation Directive, and a qualitative one, with the purpose to gather views and recommendations on the problems occurred in the implementation of the current Speed Limitation Directive and on the possible amendments. The slightly simplified questionnaire prepared for experts and stakeholder organisations is included in Annex 2.

The questionnaire includes a range of open and closed questions on the following themes:

- Application of the Speed Limitation Directive;
- Availability of studies on the impacts of the Directive;
- Options for the amendment of the Directive.

Furthermore, the questionnaire asks for the availability of detailed national data on:

- HGV fleet according to vehicle category and total maximum mass (preferably with data for category N2 split in vehicles of less/more than 7.5 tonnes).
- Data on vehicle and traffic speeds (particularly speed profiles) and data on accidents involvement that can complement the CARE database (see section 2.6.2). These include statistics for HGVs and buses in general, M2 and N2 vehicles in particular and, when available, even data on N2 vehicles with maximum mass equal to 7.5 tonnes or less. For all of these, time series were requested, including years before and after 2005, number and gravity of accidents and data on the influence of speed on accident rates.
- Relevant national policies, other than those implementing the Speed Limitation Directive, that may have had significant impacts on accident rates and accident impacts, with particular attention to the vehicle categories mentioned above.

- Enforcement of rules and controls performed on the compliance with regulatory obligations (procedure for controls, frequency, rate of frauds).
- Evidence of shifts between vehicle categories (particularly from HCVs to LCVs) and other market impacts.

Response and completion rates were closely monitored. Missing responses were followed up by email and telephone after a suitable period of time has elapsed. Responses that were unclear were followed up and clarified by email or telephone.

More details on the respondents and topics covered can be found in Chapter 3.

2.3.2 The interviews to transport operators

Additional interviews were carried out with road transport operators operating at EU scale specialised in both freight and passenger transport and covering different types of services (e.g. coach tourism, regular long-distance passenger lines, specialised services for disabled people with minibuses, specialised delivery services with LGV and express delivery services). These telephonic interviews were aimed at getting first-hand information on the impacts experienced by transport operators in the implementation of the Speed Limitation Directive and also about their reaction to the proposed amendment of the Directive. Particular attention was paid to the international operators of fleets with both HGVs and LGVs. Table 2-2 lists the companies that have been interviewed. These interviewees were not aimed to be fully representative, as they were merely used as an additional data sources to complement and triangulate data collected through other means.

Table 2-2: List of transport companies that has been interviewed (by telephone)

Road freight transport:
- Withofs, Belgium
- Consea (subcontractor of DHL, UPS, TNT), Italy
- Wim Bosman Transport, the Netherlands
- Seacon Logistics, the Netherlands
- Ewals, Belgium
Road passenger transport:
- Marino Autolinee, Italy
- Baglivi Tours, Italy
- Buccarella, Italy

2.3.3 The Stakeholder Conference

A Stakeholder Conference was organised in Brussels to present the preliminary results of the survey, the draft results of the ex-post evaluation of the current Directive and the methodology for the ex-ante evaluations of various scenarios for amending the Directive (either for Heavy Commercial Vehicles or by extending the scope to Light Commercial Vehicles). The discussion was structured along a set of questions per topic used as the starting point for the debate. The minutes of the workshop were published on the website of the European Commission.[22]

[22] http://ec.europa.eu/transport/road_safety/pdf/sld_10_06_2013/minutes.pdf

2.4 General assumptions and data used

2.4.1 Geographical scope

The geographical scope of the evaluation is the EU27 given that all Member States have adopted the Speed Limitation Directive over time.

Data on speed limits for each country is available on the European Commission Road Safety Going Abroad Website[23]. The resulting table can be found in Annex 3. Note that the speed limit set can be higher or lower than the speed of the speed limiter.

For urban roads, the speed limit is in general the same for all types of vehicles and set at 50 km/h. Only in Malta and the UK the speed limits are lower. Furthermore, in some countries such as for example in Belgium and the Netherlands, different speed limits apply on certain parts of the urban road network ranging from 30 km/h up to 70 km/h.

For non-urban roads there is much more variation between the different countries with speed limits varying between 60 and 100 km/h, but with most speed limits set at 90 km/h for M1/N1 vehicles and 90 or 80 for N2/N3 vehicles and M2/M3 vehicles.

On motorways and expressways the largest differences can be found between the different types of vehicles. For M1/N1 vehicles most speed limits vary between 120-130 km/h, for N2/N3 vehicles around 80/90 km/h and for M2/M3 vehicles around 90/100 km/h.

Given the differences in speed limits between countries, the analysis of impacts on speeds was carried out at country level.

2.4.2 Reference years

It is not possible to use a single reference year for assessing the impacts of the Speed Limitation Directive.

The first stage of an EU legislation on speed limitation devices was set in 1992 by Directive 92/6/EEC which required speed limitation devices to be installed on N3 vehicles (heavy goods vehicles –HGVs - with maximum mass above 12 tonnes) and on M3 vehicles (buses) above 10 tonnes. In 2002, this Directive was amended by Directive 2002/85/EC, which obliged also N2 vehicles (smaller HGVs with maximum mass between 3.5 and 12 tonnes) and M2 vehicles (buses with more than eight seats plus the driver's one with maximum mass exceeding 5 tonnes) to be equipped with speed limiters.

However, in both cases the actual implementation of the Speed Limitation Directive did not happen overnight. Depending on the year of registration and the use of the vehicles (national and international transport versus exclusively national transport) the year of implementation is different[24].

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23 http://ec.europa.eu/transport/road_safety/going_abroad/index_en.htm

24 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31992L0006:en:NOT and http://eur-lex.europa.eu/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=32002L0085&model=guichett

- For M3 having a mass of more than 10 tonnes and N3 vehicles:
    - To vehicles registered as from 1/1/1994, implementation is mandatory as from 1/1/1994.
    - To vehicles registered between 1/1/1988 and 1994.
        - From 1/1/1995, in case of use for national and international transport.
        - From 1/1/1996, in case of use for exclusively national transport.
- For M2 and M3 having a mass between 5 and 10 tonnes and N2 vehicles
    - To vehicles registered as from 1/1/2005, implementation is mandatory as from 1/1/2005.
    - To vehicles registered between 1/10/2001 and 1/1/2005.
        - From 1/1/2006, in case of use for national and international transport.
        - From 1/1/2007, in case of use for exclusively national transport.
    - Moreover, for a period of no more than three years from 1/1/2005, any Member state could exempt from the provisions for the M2 and N2 (between 3.5-7.5 tonnes).
- The countries accessing the EU at a later stage also received some additional time in order to comply with the Speed Limitation Directive.

Overall, we could state that by 1/1/1996 all M3 (>10 tonnes) and all N3 registered in Belgium, France, Italy, Luxembourg, the Netherlands, Germany, Denmark, Ireland, UK, Greece, Portugal and Spain were equipped with speed limitation devices. Austria, Finland and Sweden joined the EU in 1995, hence the effective implementation date was most likely comparable. For the countries joining in 2004 (Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia) and in 2007 (Romania, Bulgaria), the implementation must have been much later.

For the M2 and N2 vehicles we could assume that by 2008 all vehicles in the EU27 were equipped with the speed limitation devices. Given the legislation, all N2 and M2 vehicles should have been equipped with a speed limitation device by 2007 in Belgium, France, Italy, Luxembourg, the Netherlands, Germany, Denmark, Ireland, UK, Greece, Portugal, Spain, Austria, Finland and Sweden. Given the date of entry to the EU and the date of legislation this should also be true for Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia. The date of implementation might be a bit later for Romania and Bulgaria. Note that all of the above countries could ask for an exemption, but this was only possible until 2008.

Moreover, the length of the time series is limited to 1995-2011, making an analysis for the N3 and M3 impossible for the older member states. Analysis of impacts for older Member States in the ex-post evaluation is thus limited to the impacts of introducing speed limiters in N2 and M2 vehicles. Given the method used further – taking averages over different years – the limited length does not allow selecting a single reference year.

For the ex-post evaluation, impacts of the Speed Limitation Directive were evaluated on a country level and for the EU aggregate. For some countries data is available for the period 1995-2001, for others the time period covered is shorter. For the analysis on a country level, given the time of likely implementation discussed before, we focus on the period 2005-2006 for the "older" Member States, while for the countries joining in 2004 and 2007 any possible changes in accident rates were likely to occur in the period right after their accession (around 2004 or 2007 depending on the country). We also aggregated the data on the EU level. Given the most likely implementation dates for most of the EU countries we focus for this aggregate on possible changes in the data around 2005-2008.

For the ex-ante evaluation, there is no need for a reference year given that the methodology used in the present study constructs results on the basis of the relative changes brought by the fictive implementation of different scenarios compared to a reference scenario. When calculating absolute numbers, the modelling exercise starts from the average number of accidents over the last three years and data on total emissions from TREMOVE (i.e. the reference scenario, see also section 2.7.2 and 2.8.4).

2.4.3 Data basis with respect to vehicle kilometres

In the frame of the present study, an important element determining the absolute levels of emissions and safety[25] is the total number of vehicle-kilometre driven. However, there is no data available on the number of vehicle-kilometres which differentiates between the different M/N vehicles classes. Moreover, up to now there is no consistent data source for vehicle-kilometres[26]. For freight transport data is usually expressed in ton-kilometres, while data for buses are generally expressed in passenger-km.

An important element determining the absolute levels of emissions and safety[27] are the total number of vehicle-kilometre driven. However, there is no data available on the number of vehicle-kilometres that is differentiated to the different M/N classes. Moreover, up to now there is no consistent data source for vehicle-kilometres[28]. For freight transport data is usually expressed in ton-kilometres, while data for buses are generally expressed in passenger-km.

The Statistical Pocketbook for Transport 2013[29] provides data on the total number of ton-kilometres based on the nationality principle (national and international haulage, including cross-border trade and cabotage) of heavy goods vehicles (usually 3.5 tonnes load capacity) by vehicles registered in the reporting country for the years 1995-2011. For the assessment of accidents, the total number of vehicle-kilometres driven in a certain country would be of more relevance. This data, although expressed in ton-kilometres, is available on Eurostat for the years 2008-2011[30].

For the period 1995-2011, the number of vehicle-kilometres driven in a certain country is calculated as follows:

- The starting point is the number of ton-kilometres for the period 1995-2011 as reported by the Statistical Pocketbook for Transport 2013.
- Ton-kilometres as reported for 1995-2007 by registered countries based on the nationality principle are converted into ton-kilometres driven in a certain country based on the territorial principle by using multipliers based on the Eurostat data on ton-kilometres (2013) for 2008-2009. For 1995-2007 we applied the 2008 multiplier; for 2010-2011 we applied the 2009 multiplier. Overall this means that the number of ton-kilometres based on the territorial principle will be different than the number of ton-kilometres based on the nationality principle.

[25] Eenink ea (2008) Accident Prediction Models and Road Safety Impact Assessment: recommendations for using these tools, RIPCORD-ISEREST Deliverable 2

[26] We compared data on vkm from Eurostat, UNECE, ITF and the TREMOVE model.

[27] Eenink ea (2008) Accident Prediction Models and Road Safety Impact Assessment: recommendations for using these tools, RIPCORD-ISEREST Deliverable 2

[28] We compared data on vkm from Eurostat, UNECE, ITF and the TREMOVE model.

[29] European Commission(2013), EU transport in figures, statistical pocketbook 2013, http://ec.europa.eu/transport/facts-fundings/statistics/pocketbook-2013_en.htm

[30] Eurostat – last update 15/1/2013: National annual transport by group of goods and type of transport (in 1000 tonnes and million ton-kilometres), from 2008 onwards.

- Ton-kilometres are converted into vehicle-kilometres by using the loading factors from TREMOVE.

As there are only a limited number of multipliers available, this calculation only provides a very rough approach of the number of vehicle-kilometres driven in a country. Longer time series are not available at Eurostat due to the difficulties and uncertainties in calculating these numbers. The main difficulties are caused by the many changes in the composition of the European Union over time. Each time a country accessed the European Union, ton-kilometres previously driven outside of the European Union became internal.

The calculation also only has a limited impact on the time series analysis described further in the text as the multipliers are quite fixed over time. It does however allow for a better understanding of the real accident risk in a country (total number of accident compared with the number of vehicle-km driven in a certain country), which is important for transit countries such as for example Belgium, the Netherlands and Germany.

For the calculation of bus-kilometres a similar approach was used. The Statistical Pocketbook Transport 2013 provides data on passenger- kilometres for all countries starting from 1995. For some countries data is available also for the period 1990-1994. Again the passenger- kilometres are attributed to the country where the bus is registered (nationality principle). Eurostat provides vehicle-kilometres for nine countries (Austria, Belgium, Bulgaria, Hungary, Poland, Slovenia, Spain, Sweden and the UK), on national territory for the period 2007-2010. CE Delft also gathered this information for Germany, France and the Netherlands from the national statistical offices.

Data on vehicle-kilometres for buses are calculated for the period 1995-2011 in the following way:

- Starting point are the passenger-kilometres for the period 1995-2011 as reported by the Statistical Pocketbook 2013.
- Passenger-kilometres are converted into vehicle-kilometres by using the loading factors from TREMOVE. These vehicle-kilometres are based on the nationality principle.
- The vehicle-kilometres based on nationality principle are converted into vehicle-kilometres based on territorial principle for the 12 countries for which data is available. The multiplier for the year 2011 equals the multiplier of 2010 and the multipliers for the period 1995-2006 were set equal to the multiplier of 2007.
- Given the large differences which are observed between the multipliers for these twelve countries, the data for the other countries is not corrected (multiplier varies from about 70% for Belgium to 180% for the UK).

2.5 Intelligent Speed Assistance (ISA)

Within the ex-ante analysis, ISA is one of the options within the different scenarios. In this section we briefly explain the main characteristics of the system and its possible effects.

Intelligent Speed Adaptation/Assistance (ISA) is an example of an advanced driver assistance system (ADAS). An ADAS is a system that aims at supporting the driver during the driving process through the use of safe human-machine interfaces. ISA systems focus on supporting drivers' speed choices. Different types of ISA exist and have potentially different impacts on speed choice, safety, emissions, driving comfort and road usage.

ISA has been the subject of both theoretical and practical studies over the past two decades. For studies in the Netherlands, the United Kingdom, Belgium, Denmark, Sweden, Finland, Australia and France documentation is readily available describing possible effects on safety and environment, but also allowing for an analysis of potential risks, barriers and solutions[31] . These studies focus mostly on the impacts of ISA for passenger cars.

The successful implementation of any ISA system is linked to the amount of intrusion the system performs on free driving speed choice, acceptance (both in terms of "buy-in" as in terms of "usage"), effectiveness and the timeframe of implementation.

ISA and the ITS Directive

The introduction of ISA systems can be aligned with the numerous attention points identified and efforts made within the context of the so-called ITS directive, Directive 2010/40/EU [32]. Indeed, ISA is a cooperative in-vehicle safety system and as such different aspects thereof fall under the ITS Directive. The deployment of ISA requires the collection, registration and updating of speed limit information, and could use real-time communication between vehicles and infrastructure. The priority actions and actions taken within this Directive can have a strong influence on the introduction and effectiveness of ISA systems for different vehicle types (for example: the availability of existing road data used for digital maps, timely updating, etc.). A further analysis of the link between ISA and the ITS Directive falls outside of the projects' scope. However, we do note that the findings of the current project could also be reported to the European ITS Advisory Group.

2.5.1 Components of an ISA system

An ISA system typically consists of three components. These components can be built into the vehicle, or be provided as an after-market system.

- Component 1: Speed and location monitoring system
- Component 2: Set speed information comparison
- Component 3: A feedback system

The speed monitoring system (component 1) is responsible for providing information on the current location of the vehicle as well as the speed that the vehicle is running at. This information is typically provided by a GPS system (location) in combination with vehicle data input (CANBUS or similar).

This information is compared to a set speed (component 2). This set speed can be provided through the combination of GPS coordinates with map information containing mandatory speed limits, vertical road sign recognition (speed signs) or other sources of information.

[31] Brookhuis, K, & de Waard, D. (1999). Limiting speed, towards an intelligent speed adapter (ISA). Transportation Research Part F 2 (1999), pp. 81-90. Carsten, O.M.J., & Tate, F.N. (2005). Intelligent speed adaptation: accident savings and cost-benefit analysis. Accident Analysis and Prevention, 37, pp 407-416. Vlassenroot, A., Broeckx, S., De Mol, J., Int Panis, L., Brijs, T. & Wets, G. (2007). Driving with intelligent speed adaptation: Final results of the Belgian ISA-trial. Transportation Research Part A, 41, pp. 267-279. Monash university (2006). On-road evaluation of intelligent speed adaptation, following distance warning and seatbelt reminder systems: Final results of the TAC SafeCar Project. Varhilyi, A., Hjälmdahl, M., Hydén, C., & Draskoczy, M. (2004). Effects of an active accelerator pedal on driver behaviour and traffic safety after long-term use in urban areas. Accident Analysis and Prevention, 36, pp. 729-737. Päätalo, M., Peltola, H., & Kallio, M. (2001). Intelligent speed adaptation – effet on driving behaviour. In: Proceedings of the European Working Group on Speed Control, Aalborg.

[32] Directive 2010/40/EU of the European Parliament and of the Council of 7 July 2010 on the framework for the deployment of Intelligent Transport Systems in the field of road transport and for interfaces with other modes of transport.

The driver receives information on the set speed through visual, auditory or haptic channels (component 3). A comparison between set speed and driven speed can take place before the feedback is presented.

2.5.2 Types of ISA

Nine different types of ISA systems can be identified based on two characteristics: the system type and the type of speed limit information.

With respect to the system type, three different types can be distinguished: advisory, voluntary and intervening:

- In the **advisory or informing system** the speed limits are visually presented to the driver (mostly when changes in speed regimes are present). The driver is only informed on the speed limits and there is no warning when the speed exceeds the posted speed limit. The driver is free to adjust his speed. This system is currently being offered as an option in some passenger cars.
- For the **voluntary or driver select system** we distinguish between systems which merely present a warning through visual or auditory means when the speed exceeds the posted speed limit (open) and more intervening systems where the drivers is presented with tactile feedback through the accelerator pedal when exceeding the speed limit (half open). Where in the first system the driver is free to adjust his speed, he experiences in the second system a higher pressure required on the operation of the accelerator pedal to increase driving speed.
- The third system is called **intervening or mandatory system**, as the maximum speed of the vehicle is automatically limited to the posted (set) speed that is in force on that particular location. Remaining driver input is ignored. Additional feedback can be presented to the driver by limiting throttle input (strong haptic feedback or dead throttle).

With respect to the type of speed limit information, fixed, variable and dynamic information can be distinguished. With fixed speed limit information, the basis for the speed comparison is the posted speed limit. With variable speed limit information, the basis for the speed comparison is extended to variable speed information for special situations (road works, dangerous areas, black spots, etc.). With dynamic speed limit information, the basis for the speed comparison is extended to location specific situations (road works, traffic density, etc.) and time specific situations (weather, lighting, etc.).
For each of the nine types of ISA systems, different levels of technological advancement and legislation need to be considered, making some systems more likely to be introduced on a large scale than others.

Table 2-3 presents an overview of technological feasibility in which we rank the feasibility of implementation within a short term from o to ++:

- o: no direct implementation, today in research phase
- +: implementation within a short term possible
- ++: already in use today

Table 2-3: Overview technological feasibility ISA system

Technology		Speed limit information		
		Fixed	Variable	Dynamic
Level of speed choice	Advisory/informing	++ *	+ *	o ***
	Voluntary - Warning (open)	++ *	+ *	o ***
	Voluntary - Half-open intervening	+ **	+ **	o ***
	Intervening/mandatory	+ **	+ **	o ***

- * These systems are already offered in consumer vehicles (passenger cars) and can be purchased on a voluntary basis.
- ** These systems are or have already been the subject of extensive field testing.
- *** Although the technology is theoretically available, there is no mention of explicit field testing.

Apart from technological feasibility, there are also legal issues which play a role. Table 2-4 focuses on the liability question and again ranks the different systems from 0 to ++, where

- o: problems with liability will arise, given the current legislation.
- +: possible problems with liability, given the current legislation
- ++: no problems with respect to liability, given the current legislation

Table 2-4: Overview legal feasibility (focussing on liability) ISA systems

Legislation		Speed limit information		
		Fixed	Variable	Dynamic
Level of speed choice	Advisory/informing	++ *	++ *	+ **
	Voluntary - Warning (open)	++ *	++ *	+ **
	Voluntary - Half-open intervening	+ ***	o *****	o *****
	Intervening/mandatory	o ****	o *****	o *****

- * These systems are already offered in consumer vehicles (passenger cars) and can be purchased on a voluntary basis.
- ** The communication of variable information from third parties (i.e. weather information, traffic congestion information, accident location information) is a point of attention.
- *** Driver feedback systems need to provide clear-cut information that cannot be misinterpreted nor cause driver overloading. At the time of writing, no clear legislation exists on who can be held responsible in case of accidents, nor is the intensity of driver feedback standardized.
- **** Driver feedback systems need to provide clear-cut information that cannot be misinterpreted nor cause driver overloading *through input conflict*. At the time of writing, no clear legislation exists on who can be held responsible in case of accidents, nor is the intensity of driver feedback standardized.
- ***** The communication of variable information from third parties (i.e. weather information, traffic congestion information, accident location information) is a point of attention. Driver feedback systems need to provide clear-cut information that cannot be misinterpreted nor cause driver overloading. At the time of writing, no clear legislation

exists on who can be held responsible in case of accidents, nor is the intensity of driver feedback standardized.

For both HCVs as for LCVs, there could potentially also be problems with the type approval of the speed limitation devices as today there does not exist a type approved ISA system.

2.5.3 Possible effects of ISA

The possible effects of ISA have been extensively researched. Most relevant for this work are the effects on speed and the expected effects on safety and emissions and congestion. Each of these is discussed below.

Effect on speed and speed distribution

With respect to the speed, almost all laboratory and field trials indicate that a speed reduction effect can be found[33]. This effect increases according to the level of intrusion that the system is allowed to have[34]. In some field trials however, an adverse effect on acceleration is reported. It is suspected that drivers use the haptic feedback that is presented as a secondary source of information on vehicle speed and anticipate on this. As such, this is potentially an unwanted effect of the chosen human-machine interaction[35]. Detailed speed profiles or speed distributions are seldom presented. In some cases, a Gaussian curve is presented where the mean average speed is lower as well as the spread of vehicle speeds ran (smaller standard deviations) [36]. Carslaw et al. (2010)[37] do present the speed distribution of vehicle speeds for 70 mph roads for a vehicle without ISA and a vehicle with an intervening/mandatory system. For the base case without ISA the median speed is just below the speed limit and there is a long tail of higher speeds. The distribution with a intervening/mandatory system clearly shows a sharp cut-off in the speed distribution at the speed limit.

Effects on safety

Most field trials mention the potential safety related effect of ISA systems, but given the relative low number of participants it is difficult to present statistically significant differences[38]. Paine M. et al. (2009)[39] made a review of several ISA trials and estimated the potential road safety benefits for Australia. They found that the technology is ready for widespread implementation and that extensive trials throughout the world demonstrated the potential for significant accident savings. They estimate that top-speed limiting of cars can reduce 1% of all serious crashes (the number of crashes happening at a speed larger than 120 km/h).

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33 ETSC (2009). Speed fact sheet: ITS and speed: accelerating the deployment of intelligent transport systems for speed management.

34 DTV Consultants (2012). Snelheidsslot en snelheidsmonitor: evaluatierapport.

35 Vlassenroot, S. (2008). Speed management through vehicle measures, Intelligent Transport Systems and Intelligent Speed Assistance.

36 Saint Pierre, G., & Ehrlich, J. (2008). Impact of Intelligent Speed Adaptation systems on fuel consumption and driver behaviour. In proceedings of 15th World Congress on Intelligent Transport Systems and ITS America's 2008 Annual Meeting.

37 Carslaw D.C. ea (2010), Comprehensive analysis of the carbon impacts of vehicle intelligent control, Atmospheric Environment 44, p. 2674-2680

38 SWOV (2010). SWOV Fact sheet: Intelligent Speed Adaptation (ISA)

39 Paine, M. ea (2009), Speed limiting trials in Australia

Most studies present a clear indication of reductions in speed limit violations (speeding infractions). Kloeden et al. [40] showed that speeding leads to an increased accident risk. The study performed within the PROSPER project (Carsten & Tate[41]) offers a clear overview of *expected estimates*: Table 2-5 shows that the higher the level of intervention by the ISA system, the higher the expected reduction in crashes is.

Table 2-5: Safety impacts of various types of ISA systems

Type of ISA	Type of speed limit	Best estimate of reduction of injury crashes	Best estimate of reduction of fatal and severe injury crashes	Best estimate of reduction of fatal crashes
Advisory	Fixed	10%	14%	18%
	Variable	10%	14%	19%
	Dynamic	13%	18%	24%
Voluntary	Fixed	10%	15%	19%
	Variable	11%	16%	20%
	Dynamic	18%	26%	32%
Intervening	Fixed	20%	29%	37%
	Variable	22%	31%	39%
	Dynamic	36%	48%	59%

Source: Carsten & Tate (2005), see footnote on previous page.

The results of an extensive, more recent study by Carsten at al. (2008)[42] are shown in Table 2-6. It also presents the expected reduction of accidents as a result of ISA systems.

Table 2-6: Safety impacts of various types of ISA systems

Type of ISA	Accident Severity			Total
	Fatal	Serious	Slight	
Advisory	9%	4%	2%	2%
Voluntary	25%	19%	10%	11%
Intervening	44%	40%	25%	27%

Source: Carsten et al. (2008)

[40] Kloeden, C. N., McLean, A. J., Moore, V. M. & Ponte, G. (1997) Travelling speed and the rate of crash involvement. Volume 1: findings. Report No. CR 172. Federal Office of Road Safety FORS, Canberra

[41] Carsten, O.M.J., & Tate, F.N. (2005). Intelligent speed adaptation: accident savings and cost-benefit analysis. Accident Analysis and Prevention, 37, pp 407-416. Lai, Carsten and Tate (2012) How much benefit does ISA deliver: an analysis of its potential contribution to safety and environment, Accident Analysis and Prevention 48, 63-72. Carslaw D.C. ea (2010) Comprehensive analysis of carbon impacts of vehicle intelligent control. Atmospheric Environment 44, P2674-2680

[42] Carsten, Lai, Chorlton,Goodman, Carslaw & Hess (2008), Speed Limit Adherence and its effect on road safety and climate change, Final Report.

The study by Lai et al. (2012)[43] made a distinction between road types. The largest effect is to be expected on roads with a 40-50 mph speed limit. Table 2-7 show the shares of accidents which remain after the installation of an ISA system, compared to the number of accidents before installation of the ISA.

Table 2-7: Predicted accident reduction rates for cars by ISA variant and road type

Road type	ISA variant	Speed limit					
		20 mph	30 mph	40 mph	50 mph	60 mph	70 mph
Unclassified roads	Advisory	5%	2%	3%	2%	0%	-
	Voluntary	1%	20%	47%	9%	4%	-
	Intervening	62%	41%	61%	9%	4%	-
B roads*	Advisory	0.88	0.98	0.96	0.88	0.93	-
	Voluntary	0.70	0.76	0.76	0.85	0.88	-
	Intervening	0.57	0.59	0.59	0.82	0.87	-
A roads*	Advisory	-	0.98	0.98	0.87	0.89	0.97
	Voluntary	-	0.90	0.73	0.84	0.81	0.96
	Intervening	-	0.46	0.42	0.73	0.77	0.87
Motorways	Advisory	-	-	0.98	0.84	-	0.92
	Voluntary	-	-	0.74	0.95	-	0.86
	Intervening	-	-	0.32	0.66	-	0.75

* B roads are numbered local roads in the UK, which have lower traffic densities than the main truck roads, or A roads. A roads are the main trunk and primary roads.

Source: Lai ea (2012)

Effect on emissions and congestion

One of the reoccurring findings in relation to the use of ISA systems is the reduction in speed variation within and between drivers. Although this can possibly be linked with reduced emissions in CO_2, NO_x or other pollutants, this link is not always found. In some speed conditions, the expected decreases could be found while in other increased emissions were found[44]. Carslaw et al. (2010) state that the only significant effect on CO_2 is to be found on motorways with a reduction of about 6%. Table 2-8 shows how the effect changes with respect to the speed limit and the type of ISA implemented. . The 6% reduction can be found back in this table for a mandatory ISA system on motorways at a speed of 112 km/h.

[43] Lai, Carsten & Tate (2012), How much benefit does ISA deliver: an analysis of its potential contribution to safety and environment, Accident Analysis and Prevention 48, 63-72

44 Saint Pierre, G., & Ehrlich, J. (2008). Impact of Intelligent Speed Adaptation systems on fuel consumption and driver behaviour. In proceedings of 15th World Congress on Intelligent Transport Systems and ITS America's 2008 Annual Meeting.

Table 2-8: Results CO_2 emission analysis

Speed limit	Baseline CO2 (mean g/km)	Voluntary ISA - change	Mandatory ISA change
32 km/h	222.1	0.0 ±0.5%	0.1 ±0.6%
48 km/h	185.1	-0.4 ±0.3%	-0.4 ±0.3%
64 km/h	164.0	-1.2 ±0.1%	-1.2 ±0.3%
96 km/h	148.2	0.3 ±0.1%	0.3 ±0.1%
112 km/h	170.8	-3.4 ±0.3%	-5.8 ±0.7%

Source: Carsten et al. 2008

Another effect that is reported is the usage of the ISA system as a source of tertiary information on vehicle speed. In some cases, drivers are reported to use the haptic feedback from the accelerator pedal to estimate driving speed, allowing for a faster acceleration when the speed limit changes. This could possible improve the usage of the available road infrastructure (higher densities) [45]. However, no decreases in travel time were reported. In high traffic density conditions, ISA is not expected to significantly influence travel times since congestion is the main factor influencing travel time. In low traffic density conditions, ISA would increase travel time since the maximum speed is limited by the set speed.

ISA and HCVs

At this time, it needs to be remarked that all these findings are mostly the results of studies where ISA systems were applied to private cars and (public transport) buses. Only one pilot study was found where an ISA system was reportedly used on a HGV[46]. The system used was of the following type "mandatory system – fixed speed limit". A manual override system was in place. Although it is hard to generalise the results of this study as only one vehicle and one driver was involved, it is worth noting that a change in the speed distribution curves for different speed regimes was reported. Mostly, excessive speeding was avoided with the ISA system.
In Carsten et al. (2008) [47] a micro-simulation model was used to estimate the safety effects of ISA on HGVs. The use of a simulation model is due to the fact that the field trial only included one real life example which was not enough to draw any lessons from. Given that a speed limiter is currently mandatory for HGVs, it is assumed that ISA has no effect on motorways and certain rural dual carriageways where speed limits on the road are higher than speed limit set by the speed limitation device. Speed distributions with and without ISA were calculated and next the effect on accident risk was estimated using the formula of Kloeden (see impacts on safety on p. 27). They noted that this is a conservative estimate as the weight effect is not taken into account. The results are presented in Table 2-9

Table 2-9: Predicted accident reduction ratios for HGVs by ISA variant

ISA variant	Urban (30 mph)	Rural single carriageway (40 mph)
Advisory	0.991	0.981
Voluntary	0.951	0.955
Intervening	0.483	0.216

Source: Carsten et al. 2008

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45 Vlassenroot, S. (2008). Speed management through vehicle measures, Intelligent Transport Systems and Intelligent Speed Assistance.

46 Lai, F., Chorlton, K., Simpkin, B. & Fowkes, M. (2007). ISA-UK Intelligent Speed Adaptation – Results of Truck Trial..

47 Carsten ea (2008), Speed Limit Adherence and its Effect on Road Safety and Climate Change, Final Report

Given that these are micro-simulation results, Carsten et al. (2008) decided not to use results above, but to use the same reduction ratios as for cars in the remainder of their analysis (see Table 2-8 on p. 40).

2.5.4 Future evolutions of ISA

ISA systems are subject of further research and could be considered for specific situations, independent of the safety aspects:

- Driver-dependent: ISA is in some cases considered as a driving aid specifically for inexperienced drivers.
- Weather-dependent speed choice.
- Vehicle interaction:
  - Optimizing road usage through the reduction of inter-vehicle speed differences.
  - Optimizing cross-road interactions through the adaptation of vehicle speed for interacting/intersecting vehicle flows.

In this study, however, only short to medium term applications of ISA are relevant. For both the HCV and LCV ex-ante evaluation, two ISA types have been selected. The time horizon considered is about 5 years; only technologies that could be applied within this period were considered. When assessing various ISA systems, it has been taken into account that digital road maps are an important condition for ISA to function and the maps would require regular updating. Liability of the driver is also an issue, given that he should keep control over his vehicle. In this context it is not clear whether active ISA systems could be implemented as alternative to speed limiters or whether only supportive systems are a possible alternative. The definition of the scenarios with ISA systems are presented in section 5.2.2 (HCVs) and 6.3.2 (LCVs).

2.6 Speed impacts

2.6.1 Introduction

In this study, a key question is how the speed was and will be affected by the introduction or adjustment of the speed limiter. The effect on speed determines the impact on road safety and emissions and is also important for the market impacts. In this section, the relevant aspects on speed are introduced and it is explained how these can be modelled.

Both the speed distribution and speed profiles with and without a speed limiter are relevant. Important characteristics of the speed distribution are the absolute speed and speed dispersion. By the absolute speed we mean either the speed of an individual vehicle, or the average speed of the traffic flow. The speed dispersion is a measure for the differences in speeds between individual vehicles that are part of the traffic flow or is the variation in speeds for all vehicles over a road segment. The speed profile is the speed as a function of time of a specific vehicle.

For the assessment, data is required on the speed distribution and speed profile per combination of road type, vehicle type and speed limit. Speed distributions and speed profiles with and without a speed limiter are determined. This is done by analysing information on actual speed distributions for various EU Member States. Next, appropriate speed profiles have been selected/constructed for the same road and vehicle types and for which the average speeds match with the average speeds of these speed distributions.

It should be noted that data on speed distributions is scarce. For HCVs there is particularly very few data on speed distributions in cases without speed limiters. Therefore, extrapolation of available data is needed.

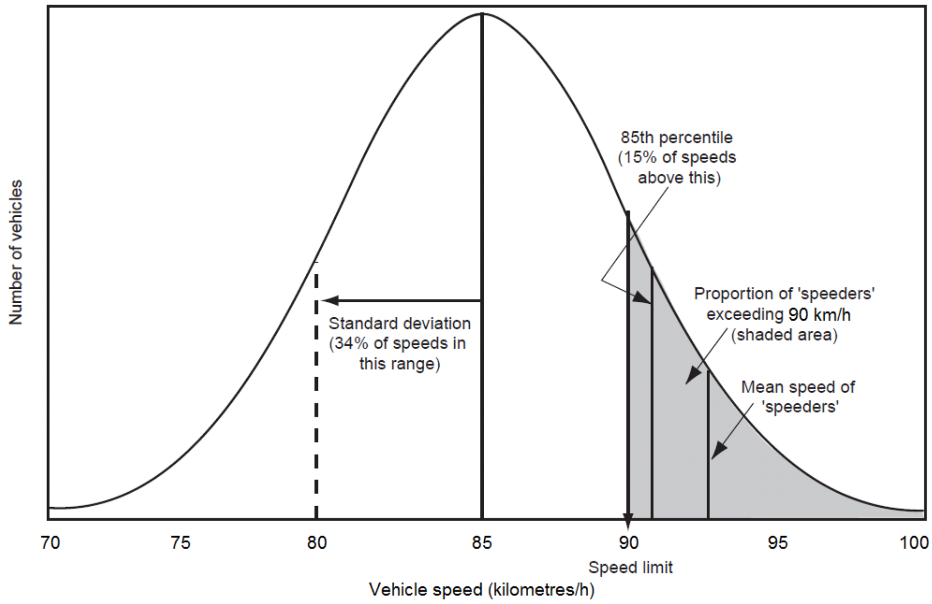
In the following sections first the definitions of the different concepts used are introduced in section 2.6.2 and 2.6.3. Next the data on average speeds, speed distributions and speed profiles with and without a speed limiter are presented in 2.6.4, 2.6.5 and 2.6.6. Finally in 2.6.7, the definition of Member States with high and low posted speed limits is explained as used in the presentation of the impacts on safety and in the analysis of emission impacts.

2.6.2 Definition and use of speed distribution

For the analysis of impacts, both the average speeds and distribution of speeds are important.

The **speed distribution** is the arrangement of speeds driven according to their frequency of occurrence on the road. It can be modelled by assuming that, in the case without speed limiters, the desired driving speed is normally distributed. Many studies[48] use this approach for modelling the speed of vehicles. For each vehicle type, the speed distribution is different depending on the road type and speed limit. An example of the speed distribution for one vehicle category is given in Figure 2-1.

Figure 2-1: A typical speed distribution for one vehicle category showing commonly used parameters, adopted from Taylor et al. (2000)



The speed distribution has two main speed characteristics, the absolute speed and the speed dispersion. The **absolute speed** is either the speed of an individual vehicle, or the **average speed**

[48] e.g. Roszbach, R. & Blokpoel, A. (1991) Veiligheidseffecten van de invoering van 100- en 120 km/uur snelheidslimieten op autosnelwegen: vervolg van de evaluatiestudie. R-91-95 SWOV , Taylor ea (2000), The effects of drivers' speed on the frequency of road accidents, TRL Report No 421, , Hohnscheid (2006) Impact assessment of the measures concerning the improvement of road safety of light goods vehicles (LGV), Final report of Subproject 2. IMPROVER project

(or mean) of the traffic flow. In the example the latter is 85 km/h. The **speed dispersion** (or speed variance) relates to the differences in speeds between individual vehicles that are part of the traffic flow. The measure used for the speed dispersion is the **speed deviation** (or the standard deviation of speed). This is a statistical measure (standard deviation) of the spread in values, applied to speeds. In the example this is 5 km/h. Other measures concerning the speed dispersion are the 85th percentile (15% of the speeds are above this speed), the proportion of speeders and the mean speed of speeders. For this study the average speed and speed deviation are important.

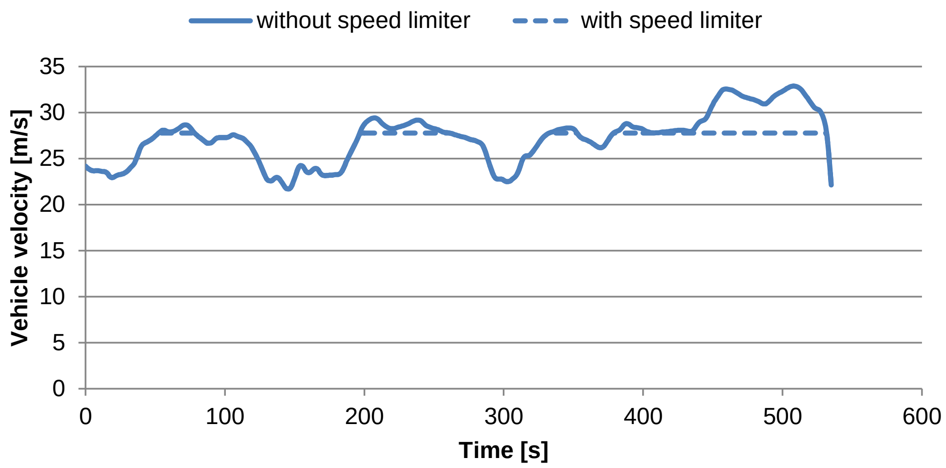
2.6.3 Definition and use of speed profiles

The **speed profile** shows the variation in speed for an individual vehicle over time. In reality, every vehicle will have a different speed profile. This depends on many factors such as the driving behaviour, weather, traffic lights, congestion, etc. The speed profiles are important for assessment of the emission impacts of speed and therefore one or more speed profiles have to be assumed to be representative for the real-world driving speeds.

Figure 2-2 shows an example of a speed profile. On the horizontal axis the time is shown. The graph displays the speed of the vehicle in meters per second (m/s). A speed profile can be characterized by an average speed and a deviation.

It should be noted that for a given combination of vehicle type and road type, the deviation of the speed distribution and the deviation of the speed profile can be different. The first one is a measure of the differences in speeds between various users, while the second is a measure for the variation in speed over time for a single average user. On motorways (without congestion), the deviation in the speed profile will generally be low, while the deviation in speed distributions can be quite large because of the difference between slow vehicles (HGVs) and faster vehicles (cars). On the other hand, on urban and rural roads, the deviation in speed profiles is generally relatively large because of the much more frequent braking and accelerating. At the same time, on these roads the deviation in the speed distribution can be smaller than on motorways, because of the smaller speed differences between the various road users.

Figure 2-2: Example of a speed profile of a passenger car with and without a speed limiter on a motorway without congestion



2.6.4 Data on average speeds and speed distribution

For both the ex-post and the ex-ante analysis, data on the current speed distributions are needed, for all countries and for different vehicle types and road types. However, such a complete data set is not available for all countries.

For the ex-post analysis ideally the measured average speeds and speed distribution before the implementation of the Speed Limitation Directive is compared with the situation after. However, in reality we face three problems:

- Data on speed and speed distribution is not available for all countries.
- If data is available, this data does not distinguish between M2 and M3 or N2 and N3 vehicles. Most of the time only the speeds of cars are measured. If data on HGVs is present it is for the group as a whole (>3.5 tonnes).
- If data is available, this data does not exist in long time series. Data before 2005 is already hard to find and no data was found going back to before 1995.

For the ex-ante analysis, data of today is needed, for the different groups of countries and for all road types. Although this data does not exist for all countries, there is at least data available for different speed limits and for different types of vehicles. Furthermore, for the ex-ante evaluations, the effect of the different scenarios on the speed distribution is required. These speed distributions are not available from literature. The speed distributions are constructed based on the speed distribution in the current situation and making estimates on the changes in driving speeds, see also Annex 12.

Information on speed and speed distribution was found for Austria, Belgium, Denmark, Finland, France, Ireland, Latvia, Slovakia and the UK (see Table 2-10). The European Road Safety Observatory (ERSO) website on the availability of Safety Performance Indicators (SPI) data in the EU[49] suggests that more data would be available. Closer inspection of both the SPI report and the references made there, showed that sometimes data was no longer (publicly) available or that data

[49] http://ec.europa.eu/transport/wcm/road_safety/erso/data/Content/availability_of_spi_data_in_eu.htm

reported could not be used for this analysis (e.g. because only information was given on the number of speeders instead of on the whole speed distribution).

Table 2-10 summarizes the information available on speeds. Best information is available for France, Ireland and the UK as these countries provide the most detailed information. Finland and the UK are of particular interest as they are the only countries differentiating according to M/N type. Note that in general time series start at the earliest around the year 1997.

Table 2-10: Overview of information on actual vehicle speeds and speed distributions in EU Member States

Country	Average speed	Speed distribution	Differentiation according to road types	Differentiation according to vehicle types	Years	Remarks and source
Austria	Yes	Yes	30 km/h and 50 km/h roads	Only car	2008-2010 versus 2009-2011	More data available, but needs to be purchased. Österreichischer Verkehrssicherheitfonds (2011)
Belgium	Yes	Yes (only for 120 km/h roads)	30 km/h, 50 km/h, 70 km/h, 90 km/h, 120 km/h roads	Only for 120 km/h: car versus HGV	120 km/h: 2011 Other roads: 2007-2010	More detailed data was requested, but is not available BIVV (2010) and BIVV (2012)
Denmark	yes	no	City streets, interurban, 110 km/h, 130 km/h	Only car	2002-2012	Hastighedsbarometer
Finland	yes	Standard deviation	100 km/h, 120 km/h	N2 and N3 versus M2 and M3 versus M1 and N1	1999-2012	Speed limit in Finland is lower in the winter on motorways Questionnaires
France	yes	For 2000 and 2011 – cars for 130 km/h roads, 110 km/h roads, 90 km/h roads, 50 km/h roads For trucks for 2011	Urban roads, 90 km/h, 110 km/h, motorways	Car versus truck (more than 3 ax)	2000-2011	No numbers, figures Source: Observatoire vitesse 2005,2009, 2011 and Observatoire sur le comportement des Poids Lourds en IdF (2010)
Ireland	yes	Yes, for the different road types and different vehicle types	Urban and rural roads, including motorways	Car, articulated vehicles, rigid vehicles, single deck buses	Average free speed for 1999-2011, distribution for 2007,2008,2011	Speed Survey studies (2006,2007,2008,2011)
Latvia	yes	no	Motorways, per motorway	no	2005-2012	http://www.lvceli.lv/traffic/Yearly.php
Slovakia	yes	no	50 km/h and 90 km/h	"Motor vehicles"	2010-2012	Questionnaire
UK	yes	yes	30 mph, 40 mph, motorways, dual carriageways, single carriageways	Yes, also LGV, HGV differentiated according to number of axles and rigid/articulated	1997-2011	https://www.gov.uk/government/organisations/department-for-transport/series/speeds-statistics

ETSC Pin Flash 16 [50]gives information on the average speed and the percentage of speeders on different types of road for cars and vans. Within the ETSC Pin Flash 24 (2013) [51] data is given on the mean speed of HGVs over 3.5 tonnes in free flowing traffic for rural and urban roads. The percentage of HGVs speeding is also given. The following table summarizes the information available in terms of countries, time period and speed regimes covered.

Table 2-11: Summary information available in ETSC Pin Flash 24 (2013)

Country	Rural roads Period (speed regime)	Urban roads Period (speed regime)
Austria	2007-2011 (70 km/h)	2007-2011(30,50 and 70 km/h)
Cyprus	2011 (70 and 90 km/h)	-
Finland	2005-2011 (70 km/h)	-
France	2001-2011 (90 km/h)	2001-2011 (50 km/h)
Ireland	2009-2011 (80 and 90 km/h)	2009-2011 (50 km/h)
Portugal	2001-2004 (90 km/h)	-
Sweden	2001-2004 (90 km/h)	2001-2003 (50 km/h)
UK	2001-2011 (64 and 81 km/h)	2001-2011 (48 and 64 km/h)

Source: ETSC Pin Flash 24 (2013)

2.6.5 Speed distributions with and without a speed limiter

The application of a speed limiter has an effect on the speed distribution, because the drivers exceeding the speed limit will be forced to decrease their speed. To apply this principle in the ex-post and ex-ante analysis we start from the situations without the speed limiter.

Given the data limitations explained above we start from a theoretical speed distribution. The speed distribution is assumed to be normally distributed around the average speed with the speed deviation. The average speed that is driven on the road is different for different road types and for different posted speed limits. The average speeds and speed deviations of the speed distributions used for the situations **without a speed limiter** are shown in Table 2-12. Using the information sources from Table 2-10, the average speeds and standard deviation were calculated for different vehicles and different speed limits (Annex 16). This information then forms the base for the figures shown in the table below.

[50] Road Safety Performance Index (PIN) Flash 16 – Tackling the three main killers on the roads. A priority for the forthcoming EU Road Safety Action Programme.

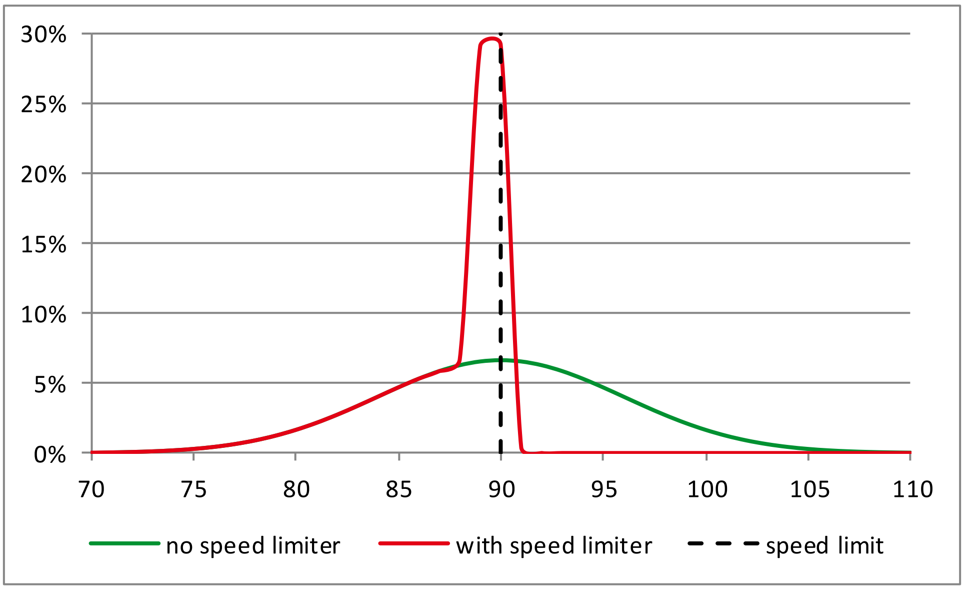
[51] Road Safety Performance Index-(PIN) Flash 24- Towards Safer Transport of Goods and Passengers in Europe

Table 2-12: Average speeds and speed deviations without a speed limiter

	Average speed (in km/h)							
	Motorway				Rural roads			
Posted speed limit (in km/h)	Car	LGV	HGV	Bus	Car	LGV	HGV	Bus
70					60	60	60	60
80	90	90	85	90	70	70	70	70
90	95	95	90	95	80	80	80	80
100	100	100	95	100	90	90	90	90
110	105	105	100	105				
120	110	110						
130	115	115						
140	120	120						
Speed deviation (in km/h)	16	16	6	6	14	14	10	10

It is assumed that without a speed limiter the speed distribution follows a normal distribution around the mean. If a speed limiter is introduced, it is assumed that drivers that are speeding reduce their speeds to the level of the speed limiter, so that speeds above the speed limit become very rare. To illustrate the approach, an example is given. A fictional speed distribution for HGVs with a speed limit of 90 km/h is shown in Figure 2-3. The green line shows the distribution if there is no speed limiter; the red line shows the distribution if the speed limiter is set at the level of the posted speed limit of 90 km/h.

Figure 2-3: Speed distribution with and without a speed limiter



The assumptions on the speed distributions differ per road type, vehicle type, scenario and posted speed limit and are discussed in section 4.2 for the ex-post analysis and in section 5.3 and 6.4 for the ex-ante analyses.

2.6.6 Speed profiles with and without speed limiters

TNO has a broad database of speed profiles that were used in many studies on the impact of speed on emissions. For this study this database has been used. A selection of appropriate speed profiles was made (per combination of speed limit, road type and vehicle type). Where necessary these profiles were tuned to match them with the average speed of the speed distribution used for the same combination of scenario, vehicle type and traffic situation. More information on this can be found in section 2.8.2 and in Annex 13.

2.6.7 Member States with high and low maximum speeds

The effects of the speed limiter on the speed distribution and speed profiles are very different amongst the Member States. This is because the speed reduction depends on the actual speeds driven on the roads. The posted speed limits in the Member States are different for each vehicle class, and therefore the extent to which the speed is limited by the speed limiter. For example, when the posted speed limit on a road is 80 km/h, then a speed limiter of 110 km/h will probably have a negligible effect. The posted speed limits for all Member States are included in Annex 3.

For both the ex-post and ex-ante evaluations the results of the calculation of impacts on safety and emission are presented at EU level, but also separately for Member States with high posted speed limits and Member States with low posted speed limits. This will allow showing the difference in effects depending on posted speed limits.

The speed limit considered for classification of Member States between the categories of low posted speed limits and high posted speed limits is presented in Table 2-13. Annex 14 shows per Member State and vehicle class to which category the Member State was classified. For some Member States, the posted speed limit for certain vehicle classes are so low that the impacts on driving speeds and hence on safety and emissions can be expected to be negligible in all speed limiter scenarios.

Table 2-13: Speed limits in Member States with low posted speed limits and high posted speed limits

		Posted speed limits	
Road type	**Vehicle**	Low	High
Motorway	N1/M1	115	130
	N2/N3	80	90
	M2/M3	90	100
Rural roads	N1/M1	90	100
	N2/N3	80	90
	M2/M3	80	90

The actual calculations for retrieving the safety impacts at EU level were based on the posted speed limits per Member State, per road type and per vehicle category, as is explained in the corresponding methodology sections. However, for illustrative reasons the safety impacts are also presented for these two types of average Member States.

For the emission impacts, this definition of Member States with high and low posted speed limits was not just used for illustrative reasons. To keep the number of speed profiles that was to be developed and the number of VERSIT+ model runs (see section 2.8.3) within a reasonable number, the emission impacts per scenario and vehicle class were estimated for a Member State with a high and a low posted speed limit, as defined in Table 2-13. Each Member State was then mapped to either low or high (per vehicle class and road type – see Annex 14) and the emission impacts of that category were applied.

2.7 Safety impacts

2.7.1 Introduction

There is a strong relationship between speed and road safety. In general the relation is simple: speed is involved in all accidents; no speed, no accidents. Speed not only affects the severity of a crash, but is also related to the risk of being involved in a crash (e.g. Elvik et al., 2004). Speed limiters have an impact on road safety by reducing the number of accidents and the severity of accidents. The methodology applied for estimation of the impacts of speed limiters on road safety will be explained in this section.

First the data on accident rates are presented in section 2.7.2. Then the methodology for the time series analysis of historical accidents rates as applied for the ex-post analysis is explained in section 2.7.3. In section 2.7.4, the methodology for estimating safety impacts with speed-accident relationships is explained. This approach is applied for both the ex-ante and ex-post analyses. Finally, the approach for estimating the safety impacts of the ISA systems is discussed in section 2.7.5.

It should be noticed that changes in traffic speeds may in the long run affect transport demand and traffic volumes. This will also have an impact on accident rates. However, this type of second order effects is beyond the scope of this study and therefore not included in the analysis.

2.7.2 Data on current accident rates

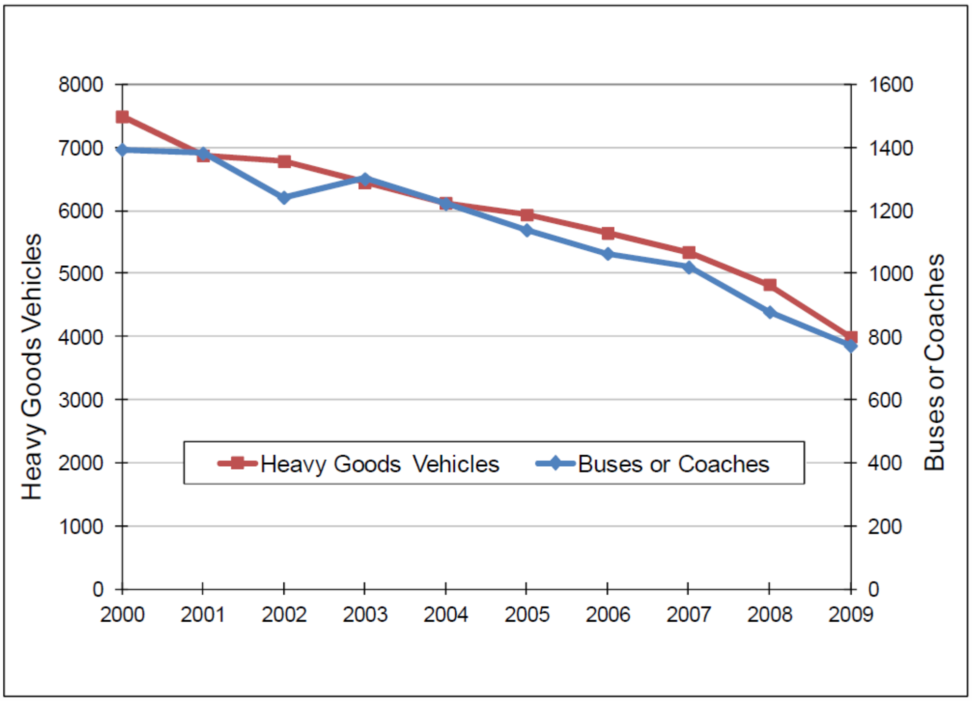
Over time, the number of accidents with HGVs and buses has decreased in the EU. Likewise, the number of fatalities in accidents with HCVs has decreased. Figure 2-4 shows the number of fatalities in accidents involving HGVs and buses or coaches, in the EU-19[52] between 2000 and 2009. No data is available at this level (EU19) to make a further distinction between M3/M2 and N3/N2. Over the nine years presented in the figure, there was a decrease for HGVs of 47%; for buses and coaches a decrease of 45% within the EU19. The relative decrease for the two types of vehicles has been similar, although the absolute numbers are much higher for HGVs.

Over time, also the total number of accident fatalities, whether or not involving HCVs, decreased. For fatalities with an HCV involved, this decrease has been stronger than for the total number of road fatalities. Therefore the share of fatalities in accidents with HGVs or buses/coaches involved, decreased from about 16% in 2000 to 14% in 2009[53].

[52] Belgium, Czech Republic, Denmark, Germany, Ireland, Greece, Spain, France, Italy, Luxembourg, Netherlands, Austria, Poland, Portugal, Romania, Slovenia, Finland, Sweden and United Kingdom

[53] ERSO Traffic Safety Basic Facts 2011 – Heavy Goods Vehicles and Buses

Figure 2-4: Fatalities in accidents involving HGVs or buses



Source: ERSO Traffic Safety Basic Facts 2011 – Heavy Goods Vehicles and Buses

According to the CARE dataset, for the EU24[54] in 2009, 14% of all accidents involving HCVs happened on motorways. In Luxemburg, 100% of the accidents involving HCVs happened on motorways while this was 0% for countries like Estonia, Ireland, Latvia, Malta and Finland. Given the large differences between countries, the analysis of impacts on road safety within this study was also done on a national level.

Table 2-14 and Table 2-15 show the number of fatal road accidents per year and country over the period 1991-2011 for HGVs and buses respectively. The CARE database does not distinguish between the N2 and N3 vehicles, but it does report LGVs defined as below 3.5 tonnes, see Table 2-16. Note however, that these data should be treated with more care as not all countries use the same categorisation. Especially the data for Italy is known to be unreliable and has therefore been excluded for the analysis[55]. No distinction is made either between M2 and M3 vehicles. For M1 vehicles (i.e. commercially used passenger vans comprising no more than eight seats in addition to the driver's seat) there are no data available.

[54] EU-19 + Estonia, Latvia, Hungary, Malta and Slovakia

[55] Source: personal communication with DG MOVE. Moreover, the analysis of Italian data clearly showed unexplainable differences over time. For example between 2000 and 2001 the number of HGV fatal road accidents increased from 324 to 1014.

Table 2-14: HGV fatal road accidents per year and country

	1991	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
BE	179	145	128	135	118	98	105	97	84	99	81	71	71	77
CZ		170	174	151	168	186	172	172	170	173	125	142	147	134
DK	94	83	77	59	53	51	56	65	38	57	50	28	31	
DE			535	509	469	465	412	396	400	389	369	336	320	338
IE	52	60	48	45	29	46	42	15	10	11	16	5	5	
EL	241	277	94	116	119	115	90	77	79	66	70	59	61	47
ES	858	667	672	477	513	521	486	443	387	360	282	238	209	186
FR	1176	993	748	774	716	531	554	564	539	511	482	397	417	439
IT	224	248	324	1014	1017	902	877	841	817	718	710	600	641	
LU	12	5	2	5	5	5	4	0	6	2	1	0	1	
NL	154	161	127	121	98	107	36	39	39	46	28	69	58	56
AT	152	123	93	86	86	103	106	91	85	61	82	60	71	54
PL			703	1202	1246	1242	1257	1194	1108	1026	960	809	763	822
PT	299	229	189	141	152	147	124	104	90	91	77	78	71	
RO			167	157	163	185	170	235	195	221	218	188	149	137
SI			8	14	12	8	16	8	4	13	6	4	4	
FI	111	75	65	102	86	90	81	79	76	79	95	66	74	78
SE	88	85	90	89	104	75	51	53	71	75	50	40		
UK	605	457	414	438	390	405	351	356	322	332	282	213	205	

Source: CARE database, received from DG MOVE April 2013.

Table 2-15: Bus fatal road accidents per year and country

	1991	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
BE	36	18	25	23	27	27	26	18	28	24	20	18	16	20
CZ		56	26	35	34	36	29	23	25	25	24	27	19	22
DK	9	21	11	12	18	15	14	10	12	17	9	8	11	
DE			111	110	85	78	78	84	70	70	62	51	60	55
IE	8	9	9	7	6	2	11	3	1	5	2	2		
EL	62	56	41	36	29	32	24	34	21	21	22	16	17	23
ES	126	91	86	61	65	81	55	61	46	46	42	39	35	37
FR	109	108	99	92	81	71	63	72	66	67	56	56	58	45
IT	108	95	109	97	82	100	110	95	82	70	85	68	72	0
LU	2	4	3	5	4	1	2	2	0	0	1	1	0	
NL	24	17	22	25	20	20	5	10	8	8	4	14	10	10
AT	26	21	22	16	9	19	16	9	12	11	7	10	8	1
PL			124	205	182	196	199	210	155	131	125	106	101	83
PT	67	58	43	34	37	19	29	19	8	13	18	12	18	
RO			56	46	83	67	76	93	85	98	77	83	70	56
SI			8	5	4	11	8	4	2	2	3	5	3	
FI	35	22	16	20	16	12	7	12	16	13	13	8	9	10
SE	28	23	16	26	23	22	12	11	22	10	11	11		
UK	212	157	149	183	135	135	130	120	142	125	104	91	70	

Source: CARE database, received from DG MOVE April 2013.

Table 2-16: LGV (<3.5 tonnes) fatal road accidents per year and country

	1991	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
BE	97	75	119	107	102	72	76	89	90	87	80	102	73	76
CZ		90	95	91	92	65	89	83	75	103	102	76	49	60
DK	121	97	67	61	57	73	42	48	39	57	56	46	28	0
DE			756	672	587	607	577	519	511	449	409	389	365	361
IE	32	33	27	34	27	40	24	14	2	10	5	7	5	0
EL	280	299	140	130	125	118	124	121	114	106	114	93	73	59
ES	842	584	602	585	589	560	540	493	494	452	369	303	270	248
FR	561	365	270	304	297	255	195	192	350	393	356	408	386	375
HR													31	23
IT	693	524	334											
LV							18	15			11		13	7
HU						106	112	125	123	130	110	91	73	
NL	112	135	124	126	112	154	25	27	28	19	24	79	59	63
AT	56	57	56	56	62	63	51	49	36	29	44	39	28	28
PT	418	338	300	323	302	280	210	227	196	143	161	158	162	
RO	0	0	160	188	177	173	199	346	379	401	442	379	365	331
SI	0	0	39	26	36	27	36	16	38	38	39	23	19	
SK								22	15	10	4	2	4	
FI	63	47	41	27	31	39	28	30	14	32	29	18	25	21
SE	53	32	38	32	26	20	19	24	30	18	22	20		
UK	416	299	253	280	266	291	256	234	249	269	187	160	159	

Source: CARE database, received from DG MOVE April 2013.

Similar data is also available

- for all accidents, whether or not they have led to fatalities or serious injuries, and for accidents with serious injuries; and
- per road type where a distinction is made between urban roads, rural roads and motorways.

2.7.3 Methodology for statistical analysis of safety impacts (used for ex-post)

In this section, the statistical methodology (time series analysis) which is used as a first approach to analyse the possible safety effects in the ex-post evaluation is described.

Although such quantification is useful, it has serious limitations. This is due to the following:

- A pure effect analysis implies that a clear before – during – after measurement of road safety is made where no other, secondary, effects influence the measurements. This is of course not the case in practice: other legislations such as driver time registration and technical advances also influence road safety.
- The year of introduction of speed limitation devices differs significantly from country to country (see section 1.1).
- Data availability differs significantly between Member States. This hampers the exactness of a time series analysis.

This approach was nevertheless followed as it is still the best available approach based on actual accident statistics. It was complemented by a second approach (see section 2.8.4).

With the current time series analysis, we try to answer the following question: can we find evidence for the singular effect of the introduction of speed limitation devices on HGVs and buses as far as road safety is concerned.

To this purpose, "road safety" is defined by the following two variables:

- The number of fatal accidents where HGVs or buses ("Coaches & Buses") are involved.
- The relative risk (fatal accidents where HGVs or buses are involved, divided by billion vehicle-kilometre).

The time series analysis uses the following methodological steps.

- Step 1: data clean-up: only complete datasets from the year 2000 onwards are used.
- Step 2: elimination of short-term safety variations (i.e. <2 years) through the use of un-centred moving means over 5-year periods (see below for more explanation on this approach). These are then centred on a two-year basis (averaging two successive un-centred moving means). This is done to avoid influences from one-off measures or short term variations in road safety as a result of local or external measures.
- Step 3: creation of a trend-line with associated R^2 values (coefficient of determination, i.e. indicator assessing the correlation between two variables).

The data which was used for this analysis are:

- An accident database made available by DG MOVE (CARE database)
- The calculated vehicle-km for HCVs per Member State as calculated in section 2.4.3

DG MOVE provided an extract from the CARE database with accident information for 27 countries for the time period 1995 up to 2011. In particular, accident information with HGVs and buses was provided with distinctions between accident location (inside and outside built-up area and motorways) and some accident characteristics. A disadvantage of the CARE database is that it does not distinguish between the different categories as set out by the Speed Limitation Directive (M3, M2, N3, N2 below 7.5 tonnes and N2 above 7.5 tonnes).

The CARE database does give information on the type of road where the accident happens. However, as we could not attribute the vehicle-kilometres driven on national territory to different road types, the analysis uses instead the total number of fatal accidents, irrespective of road type. In order to estimate an accident risk, vehicle-kilometres driven on national territory were used (see section 2.3).

This raw database was adapted for the time series analysis through the elimination of Member States where no consistent data was available for the time period from the year 2000 onwards. In effect, this meant the following:

- 19 countries withheld for analysis: Belgium, Czech Republic, Denmark, Germany, Ireland, Greece, Spain, France, Italy, Luxembourg, the Netherlands, Austria, Poland, Portugal, Romania, Slovenia, Finland, Sweden and the United Kingdom.
- 8 countries were eliminated from analysis: Estonia, Latvia, Hungary, Malta, Slovakia, Switzerland, Iceland and Norway.

This was done because of the necessity to create enough data points for the time series analysis. Through the use of un-centred moving means (5 year average), 5 data points are eliminated from the set. This means that in effect, a dataset that starts in the year 2000 and is complete up to, and including 2011, is delivering 7 data points for the creation of a trend-line. This is considered to be a minimum for reliable results.

2.7.4 *Methodology for estimating safety impacts based on changes in traffic speeds (used for ex-ante and ex-post)*

The second approach applied for assessing the safety impacts is applied for both the ex-post and ex-ante evaluations. It starts from a model that simulates the changes in the speed distribution (average speed and speed dispersion). The model is based on the relations between speed and safety that were found in the literature. To find a good approach, an extensive literature search was performed. The elaborated review of literature can be found in Annex 12. Here, a short overview will be presented. This section only covers the effect of speed limiters. The methodology of the safety impacts of ISA is explained in section 2.7.5.

Literature

There is evidence that a reduction in **absolute speed** has a positive effect on road safety. A higher absolute speed leads to less response time, larger breaking distances, less vehicle control, unpredictable behaviour of other fast driving vehicles, narrowed drivers vision and, last but not least, the kinetic energy released in an accident is higher. With lower speeds, the number of injury accidents will decrease and the effect is even larger for more severe accidents. The formulas that are used to define in the present study this relationship between absolute speed and the accident rates, injury rates and fatality rates, have been developed by Nilsson (1982)[56] and updated by Elvik (2009)[57]. They are also commonly known as the power functions and are widely used to quantify this relationship.

There are also clear indications that a decrease in **speed dispersion** has a positive effect on road safety. Speed dispersion leads to less predictability, more encounters and more overtaking manoeuvres. However, quantification of these effects is less certain because this is much harder to research. At the individual vehicle level there is evidence that a vehicle which drives faster than average have a higher accident risk. This is quantified by, for example Kloeden (2001)[58]. Whether this is also true for vehicles that drive slower than average is not clear. Taylor (2000)[59] developed a formula for speed dispersion at road section level, and included both speed deviation of the traffic flow and the average speed.

Table 2-17 summarises the three studies that were used in this evaluation study with respect to the relationship that they describe and the type of effect that is calculated.

Table 2-17: Summary of the studies that were chosen from the literature

Study	Formula includes	Calculates estimate of effect

[56] Nilsson, G., 1982. The effects of speed limits on traffic crashes in Sweden, In: Proceedings of the international symposium on the effects of speed limits on traffic crashes and fuel consumption, Dublin. Organisation for Economy, Co-operation, and Development (OECD), Paris.

[57] Elvik, R., 2009. The Power Model of the relationship between speed and road safety. Update and new estimates. Report 1034. Institute of Transport Economics, Oslo.

[58] Kloeden, C.N., Ponte, G., McLean, A.J., 2001. Travelling speed and the rate of crash involvement on rural roads. Report No. CR 204. Australian Transport Safety Bureau ATSB, Civic Square, ACT.

[59] Taylor, M.C., Lynam, D.A., Baruya, A., 2000. The effects of drivers' speed on the frequency of road accidents. TRL Report, No. 421. Transport Research Laboratory TRL, Crowthorne, Berkshire.

	Absolute speed	Speed dispersion	on:
Nilsson/Elvik	Yes	No	i..a.. all injury accidents, serious injuries, fatalities
Kloeden et al.	No	Yes	Number of vehicles involved in crashes (accidents leading to at least the hospital)
Taylor et al.	Yes	Yes	All injury crashes

Methodology applied in the ex-post and ex-ante evaluations

For the ex-post and ex-ante evaluation the power functions developed by Nilsson and Elvik and the information on the impact of average speed (see section 2.6) are used to calculate the effects on the number of fatal accidents, accidents with serious injuries and all injury accidents. This is done on a country level (for the 19 countries as mentioned in the previous section), because the maximum speed and the shares of different vehicle types in vehicle-kilometres and accident rates all play a role in the calculations.

The accident reductions that were calculated using the power functions are applied to the accident rates of the vehicle categories involved for each Member State. The studies of Nilsson and Elvik examined the effects on the number of crashes of the increases and decreases of average speeds on a road section and the average speeds were based on all traffic. To correct for the fact that in multilateral accidents the other involved vehicle did not have a speed limiter, the damage potential perspective was used (it is commonly used in external cost studies such as CE Delft et al (2011)[60]). By applying the damage potential perspective, it is taken into account that larger vehicles (i.e. HCVs) expose greater danger to other road users (see text box).

Damage potential perspective (intrinsic risk)

The heavier and faster a vehicle, the greater the danger to which it will expose other road users, i.e. the bigger its damage potential. The damage potential perspective is the allocation of the external accident costs to the different transport modes and vehicle categories for accidents with multiple parties involved, according to the damage potential (sometimes also referred to as intrinsic risk approach) of a certain vehicle category. This means that all victims in a certain vehicle involved in a multiple party accident are attributed to the other vehicle involved.

In this report the road safety effects will be presented on EU level, for Member States with low posted speed limits and for those with high posted speed limits (see also 2.6.7).

The methodology for estimating road safety impacts of speed limiters using the changes in speeds as applied in the current project is described comprehensively in 5 steps in Annex 12.

Limitations of the methodology

The methodology applied has some important limitations that are important to note, before interpreting the results.

- The simulations model that was used to estimate the effect of speed limiters on the speed distribution is a very simplified model of reality. The speed distribution was assumed to be

[60] CE Delft, Infras, Fraunhofer ISI, 2011, External Costs of Transport in Europe, Update Study for 2008, Delft 2011

normally distributed. In literature this assumption is often used. However, the speed distribution at road section level will depend on many conditions, such as the weather, congestion, road characteristics and the specific road users. This will be different for different roads and for different locations on each road.

- The results are very sensitive to the average speed and speed dispersion in the various scenarios. As there was not much data on speeds amongst Member States, the assumed data on the impacts on speed distributions are relatively uncertain (see also section 2.6) and so also the safety impacts are uncertain. In the result chapter for the ex-post analysis, a sensitivity analysis is carried out to show the uncertainty of the calculation (see section 4.3.3).
- In the scenario calculations the effect of speed limiters was standardised. In reality, however the implementation of the Directive by the Member States and enforcement will determine how well the speed limiter performs.
- In this research the power functions were used to estimate the effect of the speed limiters. Only the impacts of the absolute speed are included quantitatively, speed dispersion only qualitatively. In the literature, it is not clear which aspect of speed is more important. Absolute speed is involved in all accidents, certainly in relation to the severity of the accident, while speed dispersion is involved in part of accidents.
- The power functions are based on a fairly sound before–after study design and are considered by Aarts and van Schagen (2006) to describe best the effect of changes in average speed on different crash severities levels. Still, the exact relationship between speed and crash frequency depends on the actual road and traffic characteristics, including road width, junction density, and traffic flow. The evaluation in this report only gives the direction and order of magnitude for the effects.
- The power functions were estimated based on an evaluation of all vehicles in the traffic flow, not just a part of the traffic. In this research however, we apply the power functions only to the part of the traffic flow (mainly HCVs, and LCVs to some extent in the ex-ante evaluation) that changes their speed because of the speed limiter. The overestimation of effects for multilateral accidents is corrected by using the damage potential perspective.
- There is limited data available on speeds and speed differentiation, especially for HCVs without a speed limiter, as they all (should) have speed limiters nowadays
- There is limited data available on accidents on EU level, as many Member States use different definitions and stratifications. The CARE database tries to deal with this as good as possible, but the data should not be taken for granted.

The exact relationship between speed and accidents on a particular road is very complex and will depend on a range of road and traffic characteristics that interact with speed and also on the characteristics and behaviour of the drivers using the road, such as age, driving experience, drink-driving and seatbelt wearing. From all the limitations it has to be concluded that the road safety impacts should be considered as uncertain and a best estimate instead of the exact impacts.

Nevertheless, the approach explained above and applied in this study is the most advanced and accurate approach available for this type of analysis.

2.7.5 Methodology for estimating safety impacts of ISA

The assessment of the safety impacts of ISA is based on the literature discussed in section 2.5.3. This ensures that safety impacts from both the changes in the average speed and speed distributions, as well as in the changes in speed variations over time are fully taken into account. Consequently, no data on the changes in speed distributions are needed for estimating the safety impacts from ISA systems. A main difference between ISA and regular speed limiters is that also accident rates on urban roads are affected.

The table below shows the effectiveness of ISA as used further in the analysis. The percentages shown are from Carsten et al. (2008) (see section 2.5.3). It does not distinguish between road types as the same factors are applied for each country in the EU and it is clear that a motorway in the UK does not have the same characteristics as a motorway in Sweden. However it should be remembered that the literature discussed before indicates that the effects are expected to be the largest for road types with a lower speed limit (20-30-40 mph). As none of the scenarios includes an intervening ISA system, only impacts for Advisory and Voluntary systems are shown.

Table 2-18: Relative reduction in number of accidents for different ISA types assumed in the analysis

Type of ISA system	Accident Severity			Total
	Fatal	Serious	Slight	
Advisory	9%	4%	2%	2%
Voluntary	25%	19%	10%	11%

Source: Carsten et al. (2008)[61]

It is possible to combine ISA with a speed limiter for HCVs. Literature on how to estimate the combined effect of measures is scarce. Elvik (2009)[62] made an exploratory analysis to conclude that there is very little empirical evidence to support model building. Nevertheless, two models were compared.

The common residual model assumes that the (percentage) effect of a road safety measure remains unchanged when this measure is combined with other road safety measures. In simplistic terms, if measure 1 decreases accidents with 30% and measure 2 with 20%, taking merely the sum would lead to a reduction of 50% (30%+20%). The common residual model however would assume a smaller reduction in accidents of 44% corresponding to the following calculation: (1-(1-0.3)*(1-0.2)).

The other model, the dominant common residuals model, assumes that the most effective measure in a set of measures has a dominant effect that weakens the effects of other road safety measures it is combined with. In our example above, this would mean that the combination of the two measures would lead to a decrease in accidents of 30%.

Elvik (2009) found that evidence from available studies was consistent with both these models. A third model, which can be seen as a maximum, assumes that measures are independent and hence merely sums the effects over the measures.

In the remainder of the analysis it is assumed that the dominant common residual model applies. This means that on motorways the impacts of the speed limiter applies as they have there the dominant effect. On the lower speed limit roads (urban and rural roads) it is assumed that the effect of ISA is dominant.

[61] Carsten, Lai, Chorlton,Goodman, Carslaw & Hess (2008), Speed Limit Adherence and its effect on road safety and climate change, Final Report.

[62] Elvik, R. (2009), An exploratory analysis of models for estimating the combined effects of road safety measures, Accident Analysis and Prevention 41, 876-880

2.8 Impacts on emissions and fuel consumption

2.8.1 Introduction

Speed limitation devices have impacts on the levels of emissions. At the vehicle level, fuel efficiency and resulting CO_2-emissions are strongly affected by speed. Higher speeds result in higher friction of air and tires and so a higher energy demand. At the same time the energy efficiency of the drivetrain of the vehicle is also dependent on the speed, generally being suboptimal at low speeds and very high speeds and having an optimum somewhere in between. The combination of both effects makes that there is an optimal vehicle speed for fuel consumption and CO_2-emissions[63]. For cars this optimal is generally reached at a constant speed in the range of 70-90 km/h. For pollutant emissions, a similar relation between speed and emissions exists. Differences in emissions levels between optimal and suboptimal speeds are even larger than for CO_2-emissions.

Apart from the average vehicle speed, also the speed dynamics have a great impact on emissions. Generally, the higher the speed dynamics are, the higher the emissions. The more technology is installed on vehicles, the larger the role of throttle movements on pollutant emissions is. Regarding fuel consumption and CO_2, especially accelerating results in temporarily higher fuel consumption and associated emission increase.

The estimation of the impacts of speed limiters on energy use and emissions will therefore start from the assessment of the impacts of speed limiters on speed and speed profiles. Using the vehicle emission model VERSIT+, speed profiles without and with (simulated) speed limiter are then used to assess the impact on energy use and emissions. With the relations between speed and speed profile on the one hand and energy use and emissions on the other, the impacts on macro scale can then be estimated with policy assessment model TREMOVE. As these relations depend on vehicle type and road type, these parameters will be taken into account.

In this section the methodology for analysing emission impacts of speed limiters is presented. The simulation models that will be used, i.e. VERSIT+ and TREMOVE, are concisely described in Annex 15.

Besides the impacts from changes in emissions and fuel consumption at the vehicle level, second order emission impacts can be expected from changes in transport volume. Lower vehicle speeds result in the long term in lower transport volumes. In the long run, these impacts can be rather significant; for CO_2 emissions in some cases even as large as the primary impacts[64]. However, the assessment of this type of second-round impacts is beyond the scope of this study.

2.8.2 Selection of speed profiles

Changes in emissions cannot be estimated on the basis of statistical data on total emissions estimated from measured or manually recorded data on total fuel consumption and total travelled distance. First of all, the absolute changes in emissions due to speed limitation are likely too low to be distinguished from other effects such as changes in transport demand, vehicle efficiency

[63] As there is 1 to 1 relationship between the impacts on CO_2 emissions and fuel consumption, the results for only one of the two (CO_2 emissions) is presented. The relative changes in fuel consumption are the same.

[64] Task 3 Paper Exploration of the knock-on consequences of relevant potential policies', Richard Smokers (TNO), Ian Skinner (TEPR) and Huib van Essen (CE Delft), EU Transport GHG Routes to 2050 project, www.eutransportghg2050.eu .

improvements, etc. Furthermore, statistical data on total fuel consumption and total travelled distance is not detailed enough for such an analysis. Therefore, the analysis of the impacts of speed limiters on emissions is based on the analysis of their impacts on speed profiles.

The application of a speed limiter lowers the average vehicle speed as well as the vehicle speed dynamics, particularly on motorways. Both a lower average speed and a less dynamic speed profile lead to lower emissions on motorways. Speed limiters thus most likely leads to a decrease in emissions. Additionally, emissions are also influenced by the typical stop-drive and/or brake-accelerate pattern during congestion. Decreasing the number of accidents, as a result of less dynamic speed profiles, would reduce congestion and hence this pattern of driving (see also analysis of impacts on safety). This could in turn lead to an additional positive effect on emissions, since emissions increase at very low speeds, e.g. during congestion. Just like the demand effects, this latter type of secondary effects is not quantified in the present study.

For the analysis of impacts on emissions, speed profiles are selected that represent the typical driving behaviour for a specific vehicle type (e.g. LGV, HGV or bus) on a specific road type (e.g. motorway or rural road) without a speed limiter. Since it is assumed that the driving behaviour of HGVs and buses are comparable both on rural roads and motorways, only one speed profile is used for both HGVs and buses for each road type. For LCVs on the other side, different profiles are used than for HCVs. The speed profiles on motorways and rural roads are shown in Figure 2-5 and Figure 2-6, respectively.

Figure 2-5: Motorway speed profiles for HGVs and buses (left) and LGVs (right), without speed limiters and average speeds of respectively 85 km/h and 115km/h

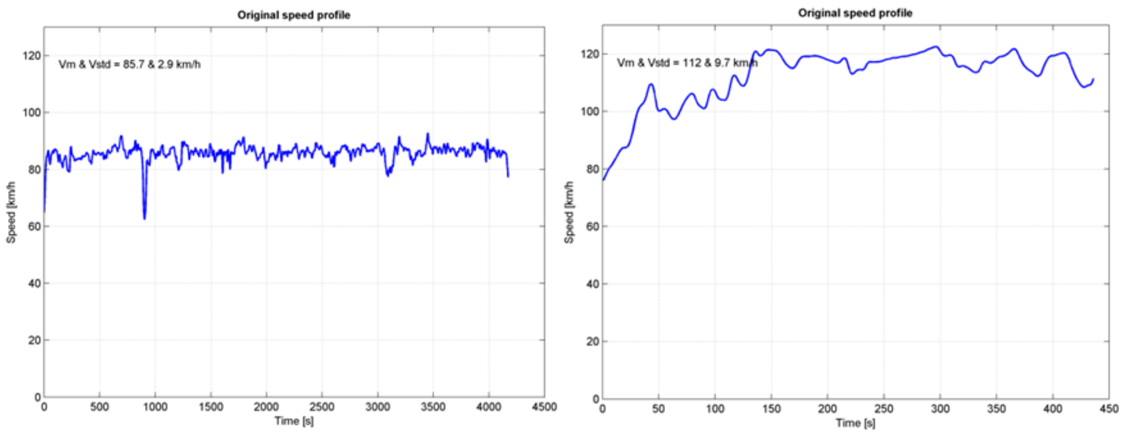
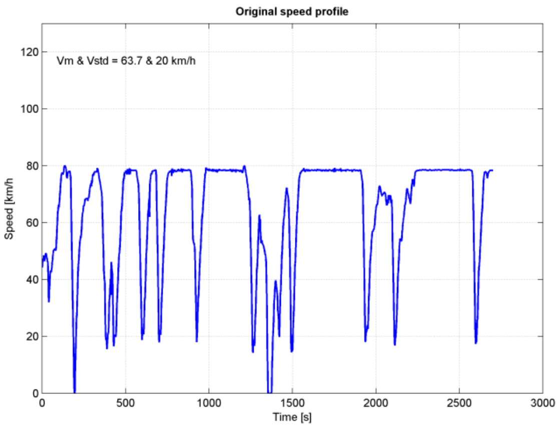


Figure 2-6: Rural road speed profiles for HGVs and buses (left) and LCVs (right), without speed limiters and average speeds of respectively 80 km/h and 90 km/h



To analyse the effect of the speed limiter, these speed profiles are than compared to the desired average speed. To do this, the same speed profile is adapted by multiplying the velocities of the speed profile with a factor determined by dividing the desired average velocity with the initial average velocity. In the analysis hereafter, the speed is limited to the analysed speed limiter speed. The resulting speed profiles are shown in Annex 13.

The posted speed limits (and therefore the average velocities) vary per country. In order to be able to determine the effects of speed limiters in different countries with different average velocities (before the introduction of speed limiters), a high and low variant is used for each scenario. Each country is ranked into high or low depending on the posted speed limit (see also section 2.6.7). The variant chosen per country is shown in Annex 14 for each combination of road type and vehicle type.

2.8.3 Methodology for estimation of relative emission impacts

The CO_2, NO_x and PM emissions of the different vehicle types with these speed profiles are determined using VERSIT+ [65] (see Annex 12). This TNO emission model determines emissions of different vehicle types as a function of the velocity and acceleration of the vehicle, using the frequency of the speed profile, e.g. a second-by-second recorded speed profile results in a calculation of emissions on every second. The vehicles chosen for the simulation represent the average vehicle in that category, with an average load. The emissions count up to total emissions, which are calculated and divided by the distance travelled to get the average emission factors in g/km.

The relative changes in emission factors are calculated: the average emission factor of a current real-world driving scenario are set at 100%, while the emission factor for each of the corresponding new or changed speed limiter scenarios are expressed as a percentage relative to the baseline scenario. The relative effect of the introduction of speed limiters or of the change in the speed limiter speed on the PM emissions is assumed to be equal to the relative effect on CO_2 emissions.

To calculate the total impact on emissions, the standard baseline scenario of TREMOVE model is used and will be compared to scenarios with speed limiters. This scenario represents the baseline vehicle fleet and transport demand in Europe and includes the baseline emission factors from COPERT. The scaling factors calculated by VERSIT+ are then applied to the baseline emission

[65] [TNO 2007] A new modelling approach for road traffic emissions: VERSIT+. Smit, R., Smokers R., Rabe E. Transporation Research Part D, 12 (2007), pp. 414–422.

factors in TREMOVE. This is done in order to yield the emissions in the speed limiter scenarios. It gives an estimation of the total emissions reduction or increase in CO_2, $PM_{2.5}$ and NO_x on a European scale between the baseline scenario and the compared scenarios.

For the ex-post analysis the use of the TREMOVE model is limited to assessing the impacts of reduction in emissions on motorways, as there are no significant impacts on emissions on other roads. For the ex-ante analyses, it is limited to motorways and rural roads as there are no significant impacts on emissions on urban roads.

2.8.4 Methodology for estimating emissions impacts of ISA

The impacts of ISA systems on emissions are based on the speed impacts plus an additional impact of ISA. The latter has been based on literature (see section 2.5.3). Overall, Carslaw et al. (2010) and Lai et al. (2012) found that only on motorways the impact of ISA on CO_2 emissions was relevant with reductions of about 6% (see 2.5.3). On other roads only a small and variable change is found, which is not significant enough to use in the present study.

2.9 Market impacts

2.9.1 Introduction

The market impacts that can be attributed to the Speed Limitation Directive and to the possible amendments can refer to different areas:

- Composition of vehicle fleet
- Cost of transport
- Vehicle design
- Compliance costs, administrative costs, enforcement and fraud
- Level playing field and transport demand.

The impact in terms of vehicle fleet particularly makes reference to the possible shifts between vehicle categories: whether and to what extent there has been a shift towards more frequent use of smaller LCVs which are subject to fewer limitations than HCVs.

Impacts on the cost of transport are considered assuming that lower speed limits impose longer travel times, which turn into higher costs, although mitigated by cost savings due to lower fuel consumption and also lower maintenance costs.

The impact of vehicle design is related to the possibility that the industry has revised vehicle design and/or reduced engine power as result of the Speed Limitation Directive.

The impacts on compliance costs include the equipment and the cost of retrofitting, while those on enforcement and fraud consider how the Speed Limitation Directive is enforced and in how many cases frauds and illegal behaviours lead to distorted competition among operators. In principle the vehicle compliance is checked together with the periodic controls performed for the safety of vehicles, but this is carried out in different manners by the Member States (see also results of the survey in chapter 3).

The last impact taken into consideration is related to the possible distortion of competition among road transport operators and among transport modes as well as to possible effect on transport demand development.

2.9.2 Methodology

It is important to underline three important conditions under which the road transport market has evolved over the last years:

- The implementation of EC legislation affecting the HCV market: EURO emissions standard, tachograph, work/rest time, road charging, etc.
- The economic crisis and the consequent adaptation measures taken by transport operators to reduce their costs and to accommodate dropped demand volumes.
- The road freight transport market tendency towards higher fragmentation of flows (less stocks, just in time, dedicated shipments, etc.), inducing a more differentiated vehicle choice.

It is also relevant to mention that the literature related to the assessment of market impacts is quite poor in comparison with the previously mentioned studies focused on safety and emission impacts. Together with the market impacts quoted in the literature mentioned in section 2.2, the analysis considered the following additional references.

The TNO-CE Delft study for T&E (2010)[66] on potential CO_2 reduction from optimal engine sizing for LCVs, explains that the performance of vans has increased over the last decades. Analysing the five best sold LCV models of 2007, power-to-weight ratios have increased over 9% between 1997 and 2009. Because of the enhanced performance (stronger engines) the achieved levels of fuel consumption and CO_2 emission reductions are smaller than the engines efficiency improvements. A possible way to realise this potential is by modifying engine characteristics. In particular combining the current specific power outputs (averaged approximately 33 kW/dm^3) and average 1997 power-to-weight ratios of the five analysed LCVs, today's engine displacements could be decreased by 13%. As a result of this smaller power and displacement, fuel consumption and CO_2 emissions could be reduced by approximately 6%.

Moreover, increasing the specific power output to levels that are being achieved already, CO_2 emissions could be reduced even more. For instance, with a specific power output of 41.3 kW/dm^3, approximately 16% less CO_2 emissions could be obtained. Concomitant with vehicle optimal engine sizing, it is expected that the total cost of ownership could decrease by up to 12%. This is mainly due to decreased fuel consumption and the possibility of reduced purchase costs

The main objective of the NEA-TML study (2010)[67] on LGVs was to provide the Commission services with economic insight into the importance of LGVs in long distance commercial road freight transport. An evaluation was made of the extent of competition between the LGVs and the HGVs. The cost calculation exercises showed that there is no substantial cost price based competition between LGVs and the heavier and larger freight vehicles. The freight cost price per tonne or per cubic metre of the latter is at least 25% lower than that of an LGV. The analysis of the bilateral freight flows (in tonnes) between the Member States has shown that on average the maximum share of LGVs in international goods transport is less than 5% of the total goods flow.

[66] Sharpe R.B.A., Verbeek M.M.J.F., Smokers R.T.M., 2010, Potential CO2 reduction from optimal engine sizing for light commercial vehicles, TNO and CE Delft for Transport & Environment.
[67] NEA, Transport & Mobility Leuven, 2010, Light Goods Vehicles in the Road Transport Market of the European Union.

The report 'Speed limiters for vans in Europe, Environmental and safety impacts" (2010)[68] performs a social cost-benefit analysis associated with mandatory application of speed limiters to new vans. Two variants have been calculated, one without optimal power rating and one with optimal power rating. The cost-benefit analysis shows that the benefits balance the costs on average over both variants calculated. Optimal power rating has, however, a significant impact on the outcome of the cost-benefit analysis. Additional travel time costs, lower vehicle purchase costs due to optimal power rating and reduced fuel costs are amongst the most important costs items.

From the BESTUFS reports surveys (2006)[69] conducted on urban freight transport typology and frequency, it emerges that with reference to urban distribution, a mix of vehicles is currently used where passenger cars and small vans are in many cases adopted for own account shipments, such as for example those for procurement of goods by small retail shops, bars and restaurants.

The Background Paper of the EU Public-Private Smart Move High Level Group, IRU (2013) suggests to increase the maximum authorised weight for two-axle coaches in international EU traffic to at least 19.5 tonnes and recommend 100 km/h maximum speed for coaches on European motorways and first class roads as well as improved training for drivers.

The IRU Bus and coach road safety handbook (2013) suggests again ensuring drivers are trained to observe and adhere to speed limits. The IRU is also more in favour of Distronic or Adaptative Cruise Control System as it automatically regulates vehicle speed depending on the traffic flow.

None of the governmental contacts neither stakeholders suggested specific studies on the impact of speed limiters on the market.

[68] Den Boer E., Brouwer F., Smokers R., Verbeek M., 2010, Speed limiters for vans in Europe, Environmental and safety impacts.

[69] TU Delft, 2006, Data verzameling Stedelijke Distributie

2.10 Coverage of evaluation questions

Table 2-19 lists the evaluation questions that are covered in this study (in accordance with the technical specifications of the call for Tender) as well as where each question is covered.

Table 2-19: Evaluation questions

	Evaluation Question	**Where is this covered?**
Relevance	To what extent has the Speed Limitation Directive contributed to the improvement of road safety and environmental protection in the context of other factors/initiatives having effects on road safety, fuel consumption and CO2 emissions?	Chapter 4
Effectiveness	What are the main results and impacts related to road safety, fuel consumption and CO2 emissions and level playing field of the measures set out in the Directive taking into account all categories of heavy commercial vehicles, with special focus on the use of heavy commercial vehicles of category M2 and N2 with maximum mass exceeding 3.5 tonnes but not exceeding 7.5 tonnes?	Chapter 4
	Are there any other significant results and impacts of the measures set out in the Directive than those mentioned above?	Chapter 4
	Which factors have hindered the improvement of road safety, environmental protection and level playing field?	Chapter 4
	To what extent could further decreasing the speed limits as laid down in the Directive and the use of various types of ISA systems improve the impacts achieved by the implementation of the Directive?	Chapter 5
	Would the application of speed limitation devices with specific speed limits to light commercial vehicles be necessary in view of road safety, fuel consumption and CO2 emissions and the application of ISA systems?	Chapter 6
Sustainability	What are the main problems with implementation of the Directive in Member States? Is there any evidence on existence of fraud? If relevant, what is the extent and dynamics of fraudulent practices?	Chapter 3
	Given the technological developments, would exploitation of speed limitation devices be still appropriate in 5 years?	Chapter 7
Efficiency	Is there a scope for administrative burden and compliance/enforcement cost reduction while implementing the Directive?	Sections on market impacts
	Is there a scope for limiting burdens for SMEs and micro-enterprises without significantly hindering the achievement of safety and emission reduction objectives of the Directive? Could SMEs and micro-enterprises be excluded from the scope of the Directive?	Sections on market impacts
	Would it be possible to achieve the same level of road safety and environmental protection more efficiently by other means (e.g. infrastructure improvements, advanced solutions in vehicle construction, better enforcement of traffic rules)?	Chapter 7
	Could ISA systems be efficient enough to replace or complement existing speed limitation devices? Would these technologies be mature enough for widespread implementation?	Chapter 2 and 5
Utility	In the light of the targets set by the White Paper on Transport, can the impacts achieved by the implementation of the Directive be considered as sufficient in medium and long term?	Chapter 7
EU added value	Why should the introduction of speed limitation devices to commercial vehicles be regulated at EU level, and not left up to each Member State to decide?	Chapter 7

3 Member States Survey and stakeholder workshop

3.1 Introduction

The purpose of the survey was to collect the required data from Member States' competent authorities and other relevant stakeholders in relation to:

1. the impacts of the Speed Limitation Directive (first objective of the study), and
2. their opinions on its possible amendment (second objective).

The results of the survey feed the analytical work of the ex-post and ex-ante evaluations. As a final step of the consultation process, a stakeholders' conference was held on 10 June 2013 in Brussels. The goal of the conference was to provide the stakeholders and Member States representatives with the opportunity to give feedback on the project intermediate results and proposed methodology and to share their views and knowledge on the subject.

In this chapter, first the questionnaire responses are presented (section 3.2). Then the implementation of the Directive by Member States is discussed (section 3.3). In section 3.4 the replies with respect to the impacts are discussed and in section 0 the replies with respect to the data availability. In section 3.6 the replies and suggestion with respect to possible amendments are summarised. Section 3.7 presented the main outcomes of the stakeholder workshop. Finally in section 3.8 the main results from the stakeholders' consultation process are briefly summarized.

3.2 Questionnaire responses

As the result of very actively stimulating and reminding government officials to fill out the questionnaire, 63% of the governmental offices (17 out of 27) provided the filled questionnaire, however in some cases with partial answers. Among the stakeholders invited to participate to the survey, the replies to the questionnaire amounted to 31% (22 out of 72), also here with some incompleteness. The majority of the stakeholders responding to the questionnaires is composed by associations (64%, 14 out of 22 replies): most of these (6 replies) related to road safety, the others varying from automobile manufacturers (1 reply), organization for environment (1 reply), association of cyclists (1 reply), professional drivers (1 reply), road transport (1 reply), road freight transport (1 reply), road traffic victims (1 reply), and driving school (1 reply). Other respondents include research centres (4 replies), road safety specialists (2 replies) and governmental agencies (2 replies).

Below Table 3-1 and Table 3-2 list respectively the governmental contacts and the stakeholders responding to the questionnaire. The list of all ministerial offices, experts[70] and stakeholders contacted can be found in Annex 6.

[70] CARE experts and Road Safety experts were informed about the survey - they were in copy in the e-mails sent to governmental contacts - and were not required to answer to the questionnaire.

Table 3-1: List of the governmental contacts responding to the questionnaire

Country	Authority
AT	Federal Ministry of Transport, Innovationand Technology
BE	Federal Public Service Mobility and Transport
BG	Ministry of Interior
DK	Danish Transport Authority
EE	Ministry of Economic Affairs and Communications
FI	Ministry of Transport and Communications
EL	Ministry of Development, Competitiveness, Infrastructure, Transport and Networks
HU	KTI Institute for Transport Sciences Non-Profit Ltd., Road Safety Centre
IE	Road Safety Authority
IT	Ministry of Infrastructure and Transport
LT	State Road Transport inspectorate under the Ministry of Transport and Communications of the Republic of Lithuania
LU	Ministère du Développement durable et des Infrastructures, département des transports
LV	Road Traffic Safety Directorate
PO	National Road Safety Council, National Police Headquarters, General Inspectorate of Road Transport
RO	Ministry of Transport – General Directorate Land Transport, Road Directorate
SK	Ministry of Interior
UK	Department for Transport

Table 3-2: List of stakeholders providing contribution to the survey

Country	Stakeholders
BE	Belgian Road Safety Institute
CZ	DEKRA Automobila
HR	MP EDUCON
DE	German Road Safety Council
DE	VDA Verband der Automobilindustrie
EL	Centre for Research and Technology Hellas / Hellenic Institute of Transport
ES	CNAE -Spanish Confederation of Driving Schools
ES	CETM -Confederacion Espanola de Transporte de Mercancias
FR	Association Prévention routière
IT	Centro di Ricerca per il Trasporto e la Logistica, "Sapienza" Università di Roma
IT	Dekra Automotive Italy
IT	Fondazione ANIA per la Sicurezza Stradale
NO	Norwegian Public Roads Administration
SI	Slovenian traffic Safety Agency
SE	Trafikverket- Swedish Transport Administration
UK	ITS Leeds
EU	ETSC- European Transport Safety Council
EU	FEVR European Federation of Road Traffic Victims
EU	Transport &Environment
EU	European Cyclists' Federation
World	UICR- Union International des Chauffeurs Routiers
EU	UETR- European Road haulers Association*
World	IRU-International Road Transport Union
BE	Transport & Logistieks Vlaanderen *
EU	ASECAP-Association Européenne des Concessionnaires d'Autoroutes et d'ouvrages à Péage*

*stakeholders providing relevant comments without compiling the questionnaire

3.3 Implementation of the Speed Limitation Directive

The information collected on the implementation of speed limitation devices were mainly provided by transport ministries and regard different issues such as problems encountered in implementing the Speed Limitation Directive, the maximum speed allowed for vehicles on different type of roads, checks on vehicles' compliance with the Directive and maximum speed used for speed limiters.

3.3.1 Enforcement of the Speed Limitation Directive

According to the answers, no particular problems have been confronted for the implementation of the Speed Limitation Directive. Few exceptions are Italy, which faced both administrative and technical costs, Hungary, which experienced problems related to the manipulation of the speed limitation devices, and Greece, which encountered high costs and administrative burdens.

3.3.2 Maximum speed allowed for vehicles on different types of roads.

The information regarding the maximum speed allowed to the different vehicle categories (M3, N3, M2, N2, M1, N1) on the different type of roads (i.e. motorways, interurban roads and urban roads) is available for all European Countries on the website of the Commission[71], except for few missing data. In order to cover the information gap, the questionnaire tried to gather the relevant data for those countries, i.e. Bulgaria, Luxembourg, Latvia, Ireland and United Kingdom. All the ministries replying to the questionnaire supplied the missing information. Speed limits applied in EU countries are reported in Annex 3 together with the information on speed limits provided in the questionnaire by the above mentioned countries.

3.3.3 Frequency of checks on vehicles' compliance with the Speed Limitation Directive

Checks on vehicles' compliance with the Speed Limitation Directive are carried out yearly with few exceptions: Austria, Belgium, Bulgaria and Romania perform checks every two years while in UK checks on vehicle compliance are carried out whenever vehicles are checked at the roadside. Directive rules enforcement are verified through roadside inspections in all EU countries providing the relevant information as reported in Annex 7 on the implementation of the Speed Limitation Directive and the enforcement of checks.

3.3.4 Maximum speed used for speed limiters

According to the Speed Limitation Directive vehicles included in categories M3 and M2 should be equipped with a speed limitation device set in such a way that their speed cannot exceed 100 km/h, while vehicles belonging to category N2 and N3 should be equipped with speed limitation devices set in such a way that their speed cannot exceed 90 km/h. Accordingly, all the countries replying to the relevant question, comply with the provisions[72]. In UK, speed limiters are set at 62,5 mph and 56 mph respectively for passenger and heavy goods vehicles which correspond to the speed limits in km/h required in the Directive.

Checks on the maximum speed used for speed limiters are mainly carried out during roadside inspections such as in Austria, Poland and Romania or roadworthiness tests such as in Ireland and Poland (specifications on information received on checks on the maximum speed used for speed limiters are reported in Annex 7).

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[71] http://ec.europa.eu/transport/road_safety/going_abroad/index_en.htm

[72] The Road Safety Authority of Ireland specifies that some speed limit exemptions may apply to emergency service vehicles.

3.4 Impacts of the Speed Limitation Directive

The following sections provide an overview of the responses regarding information and feedbacks on the impacts of the speed limitation devices on different issues:

1. Impact on the trend of the stock of vehicles,
2. Impact on average speeds and speed profiles,
3. Impacts on emissions,
4. Impacts on road safety,
5. Impacts on the market.

Together with opinions about the impacts, governmental offices and stakeholders were asked to suggest studies related to these issues; their list can be found in Annex 8. Studies provided most frequently cover impacts on emissions and road safety. A specific question on the existence of national policies with significant impacts on emissions and road safety was addressed to ministries and governmental offices. Answers are listed in Annex 9.

3.4.1 Impacts of speed limitation devices on the stock of vehicles

The relation between the application of speed limiters and the stock of vehicles development seems to be rather weak and difficult to trace. The CNAE- the Spanish Confederation of Driving Schools - points out a relation between the installation of speed limitation devices and the trend of vehicles weighing more than 3.5 tonnes since 2005. According to Dekra Automotive Italy, although the Directive on speed limitation devices has not heavily affected vehicle sales, it led to an increase in purchase choice of N1 vehicles to the detriment of N2 vehicles.

Other stakeholders point out that the trend in vehicle stock is affected by different variables such as vehicle taxes (Norwegian Public Road Administration) or the cost of ownership which, according to VDA Verband der Automobilindustrie, is the main criterion affecting the choice of vehicle category. Also payload, transport purpose and cost (vehicle cost and fuel) are important factors.

The contact from the CERTH- Centre for Research and Technology Hellas believes that no relation between the two exists, and the same position is also taken from the Slovenian Traffic safety Agency.

3.4.2 Impacts of speed limitation devices on average speeds and speed profiles

Different feedbacks have been provided by the stakeholders on the relation between speed limitation devices and actual speed. According to the European Transport Safety Council speed limiters affect the speeds of vehicles on roads where the highest speed is permitted such as highways and motorways but when the posted speed limit is below that of the speed limiter, these are unlikely to have an impact.

Many respondents highlight that the vehicle speed is actually also influenced by other variables than speed limiters. The Norwegian Public Road Administration points out that since 2004 a minor reduction in vehicle speed has been registered in Norway. However, in their opinion this fact may have been influenced by massive informative campaigns addressing the importance of appropriate speed performed, as well as by average speed cameras, which have demonstrated to be effective and strong means of achieving a significant reduction in driving speeds on stretches of road where the speed is initially higher than the speed limit. Also road design and traffic density play an important role.

Quite different were the opinions of UICR (Union International des Chauffeurs Routiers), who claims that speed limitation devices do affect the flow of traffic and could even lead to congestion, and VDA, who believes that on average only 5% of the time the traffic flow is faster than 120 km/h in Europe[73] and thus that there should be no need to limit the speed in a technical way.

Dekra Automotive Italy states that it is believed that the introduction of speed limiters do not have a significant effect on vehicles speeds considering that speed limits for coaches on highways were already below the speed limits imposed by the speed limiter.

3.4.3 Impacts of speed limitation devices on emissions

The concept that fuel consumption and carbon dioxide emissions are a function of speed, and that managing speed is a very effective carbon abatement policy is agreed by various stakeholders, including the European Transport Safety Council. In this respect the Danish Transport Authority remarks that some of their enterprises have further reduced the speed limitation from 90 km/h to 85 km/h to save fuel.

Some stakeholders underline that market competition and the legislation on vehicle emissions has promoted the improvement in terms of CO_2 and pollutant emissions reduction which are deemed to be more effective than the introduction of speed limitation devices. The Federal Public Service Mobility and Transport of Belgium mentions studies showing that the impact of speed reduction of HGVs on CO_2 emissions is positive while the impact on the environment is negative for NO_x and PM emissions in the short term (in the long term the negative impact is reduced through the introduction of stringent NO_x and PM standards in the new European Norms)[74].

The Italian Ministry of Transport and Infrastructure states that although, in principle, the limitation of the maximum speed should have provided lower CO_2 and pollutants emissions, an increase in vehicles engine's power has been observed, which could be put in relation to the need to keep constant commercial speed under heavy conditions of use, i.e. uphill and/or with full load.

A different point of view is presented by VDA, who states that there are already a number of specific measures addressing emissions reduction in Europe and that in the case of Germany several studies have shown that the effectiveness of a general speed limit for CO_2-reductions is limited (Umweltbundesamt – Federal Environmental Agency, ADAC) and its benefit mainly applies to LCVs.

Governmental authorities have also mentioned specific national policies that have had a direct impact on emission reductions, such as the introduction of gas vehicles (in Estonia[75]), circulation bans for HCVs (in Greece and in Hungary), local measures for traffic restrictions and promotion of cleaner vehicles (in Italy). More details are available in the complete list in Annex 9.

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[73] Vehicle speed distributions in Europe, WLTP-database (Steven, March 2011).

[74] Studies: VITO, FEBIAC and Transport & Mobility Leuven.

[75] In Estonia the government has introduced a strategic plan for the introduction of gas vehicles: the state and local governments have bought gas buses for public transport.

3.4.4 Impacts of speed limitation devices on road safety

The positive impact of speed limiters on road safety is clearly recognized by different stakeholders providing feedbacks on the specific issue. The Norwegian Public Road Administration reports that some commercial transportation companies have experienced a reduction in costs of fuel and cost of accidents thanks to the introduction of speed limitation devices.

Transport and Environment points out that the introduction of speed limitation devices to HGVs has a positive impact on road safety both by reducing the likelihood that accidents will occur (braking distances, reaction speed) and by reducing the impact of crashes (reduced kinetic energy), also taking into consideration that while they represent only 3% of vehicles and 7% of vehicle/km, HGVs are responsible for 18% of traffic fatalities. They emphasise that setting speed limiters at identical levels for all HGVs in Europe puts a de facto stop to HGV overtaking on highways, which is a major accident risk according to the German national Police union, who have supported the call for EU harmonization of 80km/h limiters for HGVs (Verkehrsrundschau 5/2011). Speed limitation devices have also been shown to reduce approach speeds at intersections, curves, and roundabouts[76].

VDA and other stakeholders affirm that different measures have lead to a decrease in number of fatalities such as driver education, rescue service, road infrastructure and vehicle technology, while a few countries indicate also the positive impact on road safety of police enforcement measures.

- In Denmark these regard mandatory control of mirror adjustment, overtaking prohibited on motorways on certain times or distances, road construction to avoid "black spots".
- In Hungary the measures regarding the ban of HGV traffic in weekends and the general prohibition of overtaking for HGVs have effects not only on emissions as reported in the preceding section but also on road safety.
- In Ireland road safety measures regard the installation of safety belts on buses and in particular on buses involved in the organized transport of children, and the permission for six axle articulated vehicles to operate at a gross combination weight of 46 tonnes if conform with specific standards such as the use of Electronic Braking Systems (EBS), Electronic Stability Control (ESC), Roll Stability Control (RSC).
- In Romania the following national policies have been reported: extension of social legislation (AETR Agreement) and legislation on transport of dangerous goods (ADR agreement) to national transport operations, professional training of drivers of HGVs and Public Service Vehicles.
- In UK several safety measures have been implemented since 2002, such as banning the use of mobile phones whilst driving, the publication of Government's road safety strategy, the power given to police to seize uninsured vehicles being driven on the road, the publication of the Road Safety Act making provision on different road safety matters including drink driving, speeding, driver training, driver and vehicle licensing, campaigns against drink and drug driving, the Strategic framework for road Safety publication setting out the

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[76]Sources:

- CTBSSP, Safety Impacts of Speed Limiter Device Installations on Commercial Lorries and Buses, 2008.
- BEES (2010): Technology and approaches to reducing the fuel consumption of medium and heavy duty vehicles, Board on Energy and Environmental Systems, National Research Council, USA ;
- TRB (2008): Safety impacts of speed limiter device installations on commercial lorries and buses.
- Varhelyi and Makinen, "The Effects of In-Car Speed Limiters: Field Studies," Transportation Research Part" 2001.

Government's approach to continuing to reduce killed and seriously injured casualties on Britain's roads.

- In Italy several information campaigns were performed to increase awareness and train professional drivers.

3.4.5 Market Impacts of speed limitation devices

Some stakeholders have provided relevant feedbacks on the effects of speed limitation devices on the market. These mainly regard the shift between vehicle categories i.e. a shift from heavier to lighter vehicles and changes in vehicle design.

The Italian Ministry of Infrastructure and Transport states that, while it could be reasonable to think of a shift from heavier to lighter vehicles relative to borderline vehicles (light N2 vehicles), it is also important to mention that other elements such as professional driving license and tachograph play an important role in this respect. Other stakeholders mention different parameters that have an influence on the size of the vehicle used for transport such as road charge, cargo weight, changing customer demand (e.g. urban deliveries in connection with internet shopping), etc.

Dekra Automotive Italy underlines that the extension of speed limiters to N2, M2 and M3 with gross weight less than 10 tons lead to an increase of N1 category which could substitute N2 vehicles but the shift regard only this type of vehicles.

The point of view of Transport & Environment on this subject is different. According to them, the competition between vans and HGVs is distorted, as EU legislation makes vans artificially faster and heavier to drive than light HGVs. In fact vans are favoured with respect to HGVs by EU legislation in relation to

a) mandatory speed limiters for HGVs and not for vans
b) mandatory tachograph for HGVs and not for vans
c) regulation of work and rest times for HGVs and not for vans
d) inclusion of Eurovignette charges for HGVs and exclusion for vans
e) special driving licence required for HGVs and not for vans

Transport & Environment view is that these measures have consequences on vehicles fleet. In the years 1995 - 2010, vans fleet grew much faster than light HGVs' fleet (60% in comparison to 25%) and the main share of the growth was in new member states and Spain. In other countries the fleet shrank (Germany, for example, counts 11% less light HGVs in 2010 than it did in 2000[77]) and recent data confirm the long term trend[78]. Mandatory speed limiters for vans would then address the tendency to use vans as fast and cheap substitutes for light HGVs.

As for vehicle design some stakeholders observe that the vans' power have been increasing in the recent years but whether and in which measure this trend could be correlated with the speed limiters introduction is difficult to define although one way to maintain a good commercial speed with the speed limitation is to increase the vehicle power in order to be able to keep constant speed under any travel conditions i.e. uphill and full load.

[77] TREMOVE database, vehicle stock

[78] ANFAC, Motorvehicles in use in 2008, 2010.

3.5 Availability of quantitative data

The questionnaire on speed limitation devices includes a section on the availability of quantitative data on:

- The stock of vehicles.
- Speed detected.
- Road safety.
- Frauds detected.

Data have mainly been required per vehicle categories (M1, M2, M3, N1, N2, N3) and for periods before and after the implementation of the Speed Limitation Directive in order to verify if there is a relation between the obligation of installing the speed limiters on vehicles and the trends in vehicle stock, accidents and frauds detected. Data on the stock of vehicles are available for most of the countries but given the disparities in data differentiation, harmonisation between countries cannot be easily provided. Also data on road accidents have been indicated but only few data differentiated per M and N categories have been provided. The list of the type of data collected per issue is reported in Annex 10.

3.6 Possible amendments to the Speed Limitation Directive

Both governmental contacts and stakeholders have been asked to indicate options for amending the Speed Limitation Directive according to the following possible amendments:

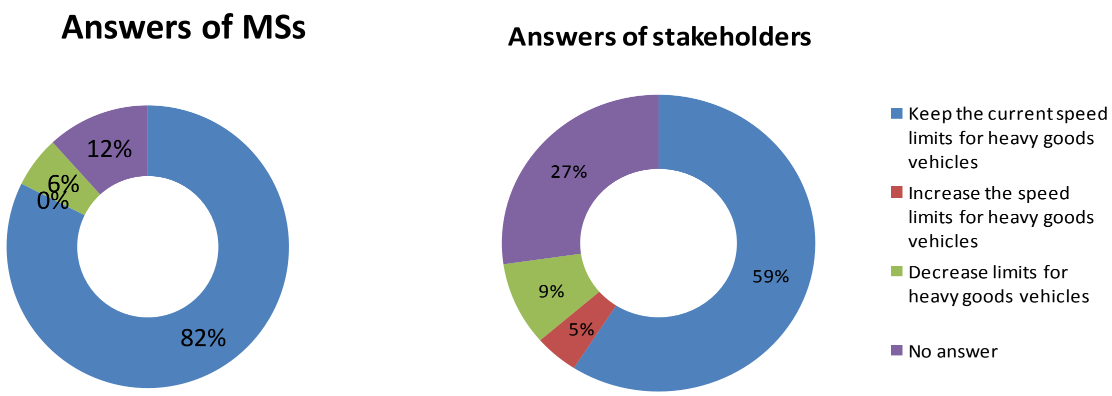
- Speed limits for HGVs:
  - Keep the current speed limits for HGVs ;
  - Increase the speed limits for HGVs;
  - Decrease the speed limits for HGVs.
- Extension of the speed limitation devices to LCVs:
  - Extend the requirement for using speed limitation devices to light commercial goods vehicles (N1 category);
  - Introduce speed limitation devices for light commercial passenger vehicles like minibuses/vans (M1 category).
- Introduction of the ISA systems:
  - Introduce ISA (Intelligent Speed Assistance/Adaptation) systems for some or all commercial vehicles.

3.6.1 Speed Limits for HGVs

Almost all the governmental contacts (82%) and the majority of the stakeholders (59%) agree to keep the current speed limits for HGVs (see Figure 3-1). Only 9% of the stakeholders and 6% of governmental contacts are in favour of the possibility to decrease speed limits for HGVs[79]. Only the 5% of the stakeholders and none of the governmental contacts agree to increase the speed limits for HGVs.

[79] To this regard Transport & Environment believes that speed limiters for lorries have had multiple positive effects on safety and environment (air pollution, noise) thus reducing the maximum speed of lorries to 80km/h would help reducing CO2 and other emissions, improve road safety and help enforcing existing speed limits in about half of EU countries.

Figure 3-1: Share of the preferences expressed by governmental contacts and stakeholders on options for amendments on the speed limits for HGVs



3.6.2 *Extension of the speed limitation devices to LCVs*

More contradictory is the opinion on the application of speed limitation devices to light commercial goods vehicles (N1) and on the introduction of speed limitation devices for light commercial passenger vehicles like minibuses/vans:

- 29% of governmental contacts and 50% of stakeholders believe that speed limitation devices should be extended to LGVs (N1).
- 18% of governmental contacts and 50% of stakeholders agree on the introduction of speed limitation devices to light commercial passenger vehicles like minibuses/vans (M1 category).

As for the possibility to extend speed limitation devices to LGVs (N1 category), two opposite positions emerge: on the one side Transport & Environment claims that such extension would have positive impacts both on emissions and road safety (shielding drivers from ever increasing pressure to deliver as quickly as possible and put a brake on competing by speeding[80]) and on the other side,

[80] In particular Transport & Environment points out that the introduction of speed limiters to vans would lead to a substantial reduction of causalities and injuries. On the basis of studies, they highlight that there is a high percentage of fatalities involving vans both at European and national level. Accordingly, on a European scale, the number of fatalities decreased by 34% between 2000 and 2008. At the same time fatalities involving vans only decreased of 26%.
In Germany between 1995 and 2007 the number of accident with injury involving vans increasedof 22% (Bast). For vans with a weight between 2.8t and 3.5t there was a 360% increase between 1996 and 2006. Alarmed by the high risks linked to vans driving at high speeds the German Union of Insurers (GDV) demanded vans to be mandatorily equipped with speed limiters in 2003 (http://www.gdv.de/Presse/Pressearchiv_Linkliste/Pressemeldungen_2003___Uebersicht/inhaltsseite11786.html).
In Belgium, between 1991 and 2007 the number of accidents with injuries on motorways involving vans increasedof 83% (De Mol). In the United Kingdom accidents related to vans seem to have followed the general trend. However, whereas accident reduction trends for vans followed or emulated general trends (1993-2003), "the fatality rate for accidents involving vans has risen or stayed constant, contrary to other trends vans are involved in a higher proportion of fatal accidents than average." The situation in the Netherlands is similar.
Sources: CE Delft, Speed limiters for vans in Europe, Environmental and safety impacts, 2010; De Mol, J., Abnormaal veel ongevallen met bestelwagens, Verkeersspecialist (158), 2009, 28; De Mol: http://biblio.ugent.be/input/download?func=downloadFile&fileOId=1131525; Smith, Tanya, Analysis of accidents involving light commercial vehicles in the UK, 2005, p1-5.

VDA, which asserts that such extension would result to a negligible reduction of CO_2 emissions only and appeals to the "principle of subsidiarity" suggesting that speed limit itself is a question of national law.

3.6.3 Introduction of ISA systems

Questions on the option of introducing ISA to commercial vehicles have been differently formulated to governmental contacts and stakeholders. The formers have been asked to express preferences on the type of ISA system to be introduced while the second have been asked to express attitudes. Accordingly the following results have been registered.

35% of the governmental contacts and 82% of the stakeholders believes that ISA system should be introduced to all commercial vehicles. To this regard, the majority believe that a supportive or informative ISA system is the best option, with a slight favour towards supportive ISA systems.

Preferences and attitudes on the ISA type expressed respectively by governmental contacts and stakeholders are reported in the following table.

Table 3-3: Governmental contacts preferences and Stakeholders' attitudes toward the introduction of ISA system to all commercial vehicles

ISA type	Member States' preferences
Informative	33%
Supportive	50%
Informative/Supportive	17%
Mandatory	0%

ISA type	Stakeholders' attitudes		
	Positive	Neutral	Negative
Informative	72%	17%	6%
Supportive	89%	17%	11%
Mandatory	56%	11%	17%

Besides the options for amendments, some stakeholders expressed further opinions on the possibility to introduce ISA system to commercial vehicles, which further support the idea of introducing informative, supportive or mandatory ISA system. According to the Hellenic Institute of Transport there should be a sufficient time period of drivers' adaptation before intervening to driving tasks. ISA systems of an informative type would be easier accepted, more reliable to be implemented in the short term and less expensive with respect to more advanced systems. In line, ETSC suggests a step-wise approach to introduce ISA, with a culmination in an intervening system. The Association Prevention Routière believes that legal and technical obstacles should however be solved before deploying the mandatory system.

As for stakeholders supporting the possibility of introducing a more stringent type of ISA (supportive and mandatory) the following justifications have been provided.

- ITS Leeds believes that all the empirical work on ISA systems so far has indicated that the stronger the system, the greater the effectiveness. There are almost no rational arguments against the prevention of speed violation through ISA systems, and ISA systems have very high benefit to cost ratios. In terms of saving lives across Europe, it is almost impossible to think of any other intervention with equivalent safety potential to ISA systems.
- The Swedish Transport Administration thinks that supportive/warning ISA systems have shown significant safety effects. A stringent speed control and enforcement is also good for fair commercial competition. Lower technical margins in the speed limiter systems would make the competition fairer. Law breaking should not be part of a business plan as it is today.

- The European Cyclists' Federation remarks that it is easy to ignore a warning signal if a delivery has to be made on time. Therefore, mandatory interventions built into the vehicle would mean slower speeds for HGVs trying to make delivery times, without competitive distortion.
- The Slovenian Traffic Safety Agency is strongly in favour of mandatory ISA systems: mandatory implementation of ISA systems for all commercial vehicles would be a significant factor in increasing traffic safety. Excessive speed is the main factor in causation and severity of traffic accidents. ISA systems would help to maintain all drivers' focus on an appropriate speed, which would result in a more efficient traffic flow and less possibility of encountering dangerous traffic situations.
- Transport & Environment states that the introduction of ISA systems is an ideal solution but in the current situation this could be difficult to introduce. That is why the speed limit reduction for HGVs to 80km/h and the introduction of speed limitation devices for LCVs would be the most important measures to implement, as these are technically simple and very cost-effective. Also the roll-out of advisory ISA systems should be encouraged: these will become part of the EURO-NCAP requirements and are thus likely to be fitted onto most new passenger cars in the coming years but since EURO-NCAP doesn't cover commercial vehicles, additional action may be required to promote ISA systems in vans and HGVs. Mandating advisory ISA for new vans and HGVs would be a way to stimulate and promote the use and development of these systems, paving the way for mandatory ISA systems that prevent drivers from exceeding speed limits at any given moment.
- Dekra Automotive Italy suggests that vehicles should be equipped with a system which excludes the function of the speed limitation for the period of time necessary to overtaking in order to facilitate these operations (for example by defining a system connected to the accelerator pedal for driving while overtaking). Pursuant to Dekra Automotive Italy, ISA systems should be introduced to all commercial vehicles in order to make up for inadequate checks during technical inspections and insufficient controls at the roadside.
- Finally the road Safety Authority of Ireland explains that ISA systems for category N2, N3, M2 & M3 vehicles would involve significant investment by the state in ensuring that appropriate speed signage is placed on all roads and that the speed limits assigned are actually suitable. In this regard they are currently conducting a nationwide audit of speed limit and would therefore recommend that any decision on the mandatory introduction of ISA throughout the EU is postponed until this audit has been completed to ensure that all speed restrictions are both safe and sensible[81].

3.7 Stakeholders' workshop

The stakeholders' conference took place on June 10th 2013 at the Albert Borschette Conference Centre in Brussels. At the conference the project team presented the draft results on the survey as well as the draft results of the ex-post evaluation of the Speed Limitation Directive and the methodology for the ex-ante evaluations of various scenarios for amending it.

The presentations and the minutes of the conference are available on the following website: http://ec.europa.eu/transport/road_safety/events-archive/2013_06_10_speed_limitation_en.htm; while the list of attendants is included in Annex 5.

[81] http://www.transport.ie/pressRelease.aspx?Id=495

The conference was characterised by a lot of interaction and lively participation of the attendants. In relation to the ex-post analysis, the participants endorsed the methodology proposed by the team and no significant changes were required. The questionnaire was well received and the interim survey results that were presented corresponded to what was expected by the stakeholders. There was general consensus about the fact that the analysis results of safety statistics were inconclusive: there is a decrease in accidents but there is insufficient data to determine if this is due to the speed limiters. Also the draft results from the model simulation generally corresponded to the experience and expectations of the stakeholders. Eventually, the methodology for the ex-ante analysis was considered as appropriate and the workshop gave no reason to change the proposed scenarios for HCVs and LCVs.

3.8 Main findings

The survey can be considered quite successful in terms of data and opinions gathered: 63% of the governmental contacts and 31% of the stakeholders responded to the questionnaire. While the information collected confirms the initial expectation of poor availability of quantitative data related to the specific M and N categories and related to the period before and after the implementation of the Directive, relevant feedbacks on the effects of speed limitation devices on vehicle stock, market impacts and above all on road safety and emissions have been provided by the respondents.

As for the effects of speed limiters on emissions and road safety, stakeholders seem overall to agree on the positive relation existing between the speed limiters introduction and the reduction of pollutants and road accidents. With respect to the effects on market and vehicle stock, the majority of the respondents state that the relation between the speed limiter introduction and the vehicles stock trend is difficult to isolate from other factors.

In relation to the possible amendments of the Directive, the majority of stakeholders and governmental contacts agree to keep the current speed limits for HGVs. More contradictory is the opinion on the application of speed limitation devices to LGVs (N1) and light commercial passenger vehicles like minibuses/vans (M1): government contacts are mainly against both options while half of the stakeholders believe that speed limitation devices should be extended to lighter vehicles because of benefits in terms both of road safety and emissions reduction.

Finally, 35% of governmental contacts and 82% of the stakeholders believe that ISA system should be introduced to all commercial vehicles, above all in the form of informative or supportive systems.

Also the stakeholder workshop provided useful input to the analysis. The draft results that were presented generally corresponded to the experience and expectations of the stakeholders. The methodology was considered as appropriate and the workshop gave no reason to change the proposed scenarios for HCVs and LCVs. The literature and data sources suggested at the stakeholder conference have been included and investigated.

4 Ex-post evaluation HCVs

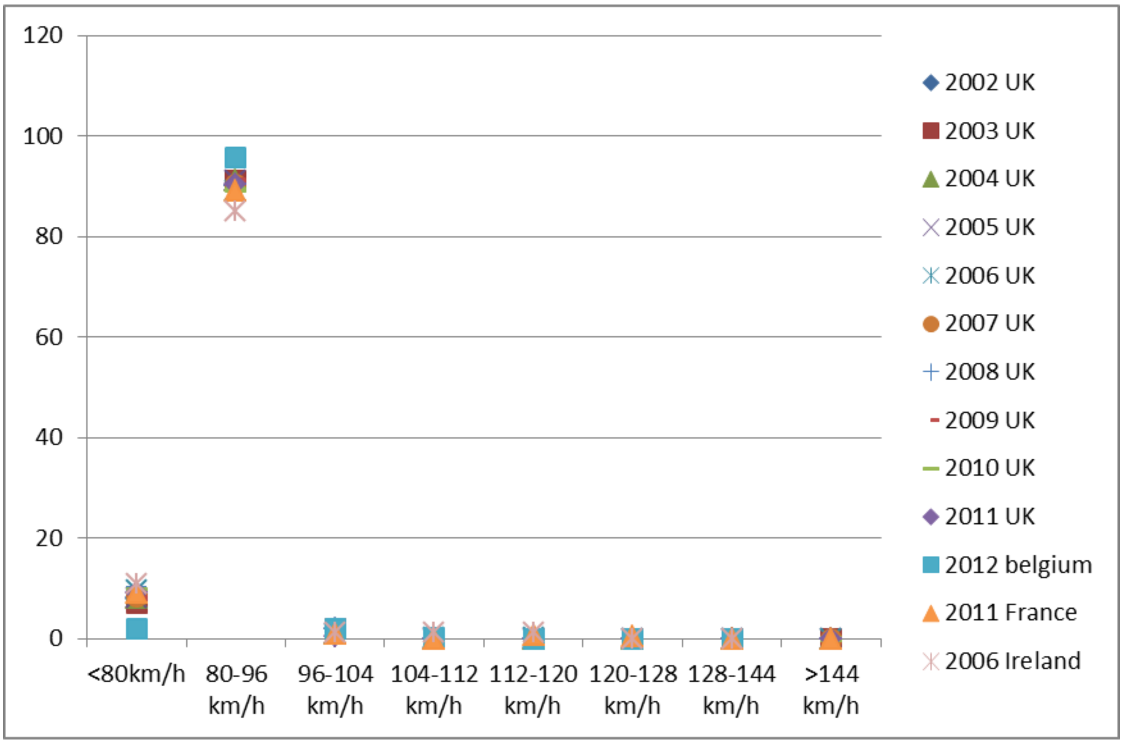
4.1 Introduction

In this chapter the results of the ex-post evaluation of the application of the Speed Limitation Directive to HGVs and buses are presented. First, section 4.2 describes the main results with respect to impacts on speeds driven. Next section 4.3 describes the findings on the safety impacts, section 4.4 the findings on the emission impacts and section 4.5 the findings on the market impacts. Finally section 0 summarizes the main findings of the ex-post analysis.

4.2 Impacts on speed

The main driver of the effects on safety and emission is the change in speed and speed distribution. In order to determine the effect on the speed, an analysis was made of historical speed distributions. Only the UK has information on speed distributions, disaggregated according to vehicle and road types over a long enough period. Unfortunately the disaggregation with respect to speed classes is very rough. The figure below shows the speed distribution for the UK for the years 2002-2011 for HGVs with 5 axles and the distribution for all HGVs in France, Belgium and Ireland.

Figure 4-1: Speed distribution for HGVs with 5 axles in the UK and all HGVs in Belgium, France and Ireland



There is no time series on speed distributions long enough to assess the impact of the first implementation of the Speed Limitation Directive. This graph seems to suggest that the amendment by Directive 2002/85/EC did not have an impact on the speed distribution, nor on the average speed. Hence, at the time of the amendment, the Directive would probably not have had a large impact either. This may have to do with the fact that according to these data, before the mandatory introduction of speed limiters on N2 vehicles, the speed of almost all HGVs in the UK was yet below the speed set by the limiter. Furthermore this database for the driving speeds prior to the introduction of the limiters is very weak.

Moreover, now the question arises: what would be the speed distribution today? Today, the vehicles are much more powerful and more energy efficient while also the road infrastructure has improved.

The remainder of the analysis will be based on more theoretical speed distributions. For the situation of today, with speed limiters, two cases are relevant:

- A speed distribution for a country in which the posted speed limit[82] is higher than or equal to the speed determined by the speed limiter (90 km/h for HGVs and 100 km/h for buses). This is the case in for example Belgium where the speed limit on motorways for HGVs is 90 km/h. In this case the speed limiter determines the maximum driving speed for a significant share of the HGVs.
- A speed distribution for a country in which the posted speed limit is lower than the speed determined by the speed limiter. This is the case in Ireland where the posted speed limit on motorways for HGVs is 80 km/h. In this case the speed enforcement in a country will play an important role. The speed limiter will only limit the top offences and have a relatively limited impact.

For the ex-post evaluation, we need to compare the current speeds with the theoretical case in which there would be no speed limiters. In this case we assume that the speeds would be normally distributed around the average speed.

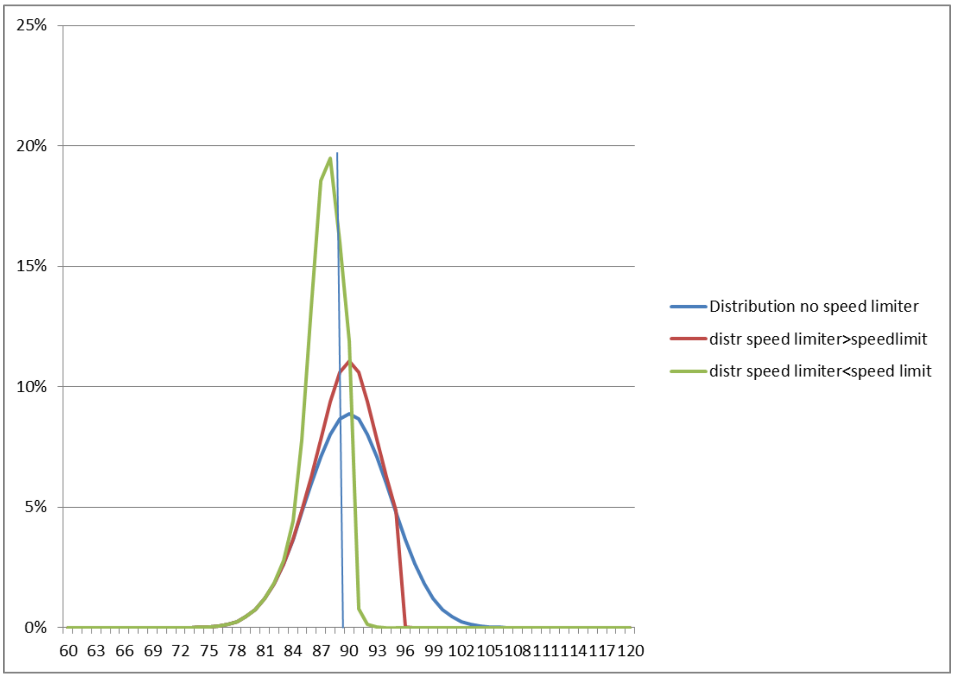
When speed limiters are applied, the speed distributions change. Because of the speed limiter, vehicles with a speed limiter cannot drive faster than the speed limit so those who were driving faster will slow down. When a speed limitation device is in place, the distribution of speeds has a cut-off point at the set speed limit (see also section 2.6.5).

Hence, assuming a posted speed limit of 90 km/h, the blue line in Figure 4-2 shows the distribution in case there is no speed limiter. The red line shows the distribution if there is a speed limiter, but set at a speed of 100 km/h and the green line shows the distribution if the speed limiter is set at the level of the posted speed limit of 90 km/h.

If the speed limit in a country is lower than the speed set by the speed limiter, this means that the general enforcement of that country plays a higher role in determining the average speed than the limiter itself. For the distribution this means that the standard deviation is higher if the speed limiter is set higher than the speed limit than in the case it set a lower speed.

[82] This is the speed limit for a road as posted on the traffic signs. These differ per Member State and road type.

Figure 4-2: Speed distributions for HGVs in cases with and without speed limiter



In function of the current speed limits in each country, it was determined on a case-by-case what speed distribution with a speed limiter was relevant for that country, i.e. speed limiter set higher than posted speed limit or other way round. The distribution with speed limiter chosen as well as the distribution without speed limiter were then centred around the average speed, which depends on the speed limit in place.

The table below shows the average speed and the standard deviation without a speed limiter (i.e. the before situation) on motorways for the HCVs currently equipped with a speed limiter. The average speed and the standard deviation are based on real life measurements for the UK, Belgium, France, Finland, Ireland and Austria[83]. The table also shows the average speed and standard deviation on motorways with a speed limiter set at 90 km/h for HGVs and 100 km/h for the buses. A distinction is made between countries with high and low posted speed limits.

Table 4-1: Average speed and standard deviation for HCVs without and with a speed limiter, motorways

			Before (no speed limiter)		*After (with speed limiter)*			
Member State type	Vehicle	Posted speed limit	Average speed	Speed deviation	Speed limiter	Average speed	Speed deviation	Change in average speed
Low	HGV	80	85	6	90	84	5	-1%
Low	Bus	90	95	6	100	94	5	-1%
High	HGV	90	90	6	90	87	3	-3%
High	Bus	100	100	6	100	97	3	-3%

Source: own assumptions based on measured data (Annex 16).

[83] The real life data can be found in Annex 16

4.3 Impacts on safety

4.3.1 *Introduction*

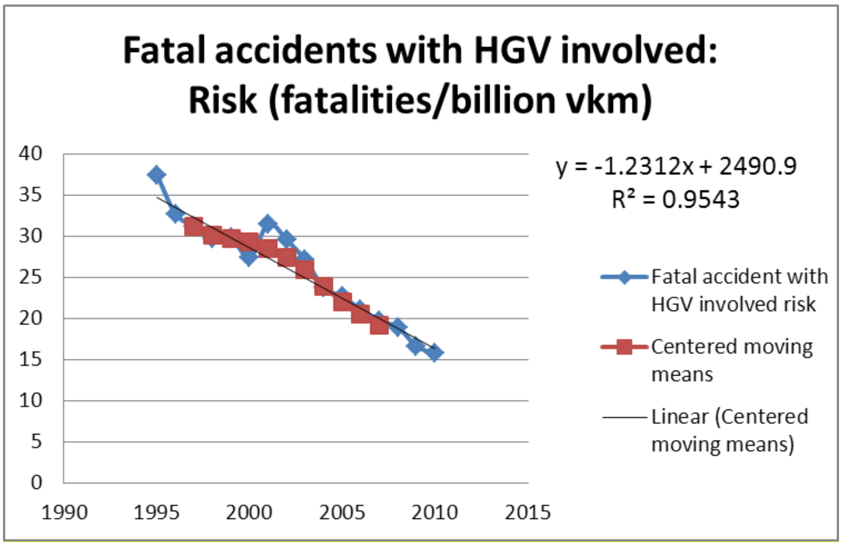
In this section the results on the safety impacts are presented for the ex-post evaluation. First, the results of the time series analysis are presented in section 4.3.2. Then, the results of the second approach are presented in 4.3.3, relying on the methodology set out and discussed in sections 2.6 and 2.7. Finally, the synthesis of both approaches is presented in section 4.3.4.

4.3.2 *Estimation of safety impacts based on time series analysis*

In the first step an analysis is made based on the evolution over time (1995-2011 when possible) of the accident risk for fatal accidents where HGVs or "buses and coaches" are involved. By considering the accident risk[84] – defined as the absolute number of accidents divided by the total vehicle-kilometres driven in a country by HGVs or buses respectively - the analysis corrects for trends which are due to the continuous increase in traffic. For both HGVs and buses we analysed the evolution of the accident risk and the centred moving means of the accident risk[85]. For more details, see section 2.7.3.

The analysis shown below focuses on the results for the EU15[86] as a whole for HGVs and buses. This means that we summed the number of accidents of the individual countries to come to one number for the EU15. The technical approach and the results for the individual countries are included in Annex 11. Over the period 1995-2010, Figure 4-3 shows a reduction in the accident risk in Europe with HGVs involved. When controlling for temporal fluctuations by using the centred moving averages, a similar reduction is found.

Figure 4-3: Fatal accident risk with HGVs involved



Source: own calculations based on CARE database and Eurostat.

[84] The full report also shows the analysis for the absolute number of accidents with fatalities where a HGV or a bus is involved.

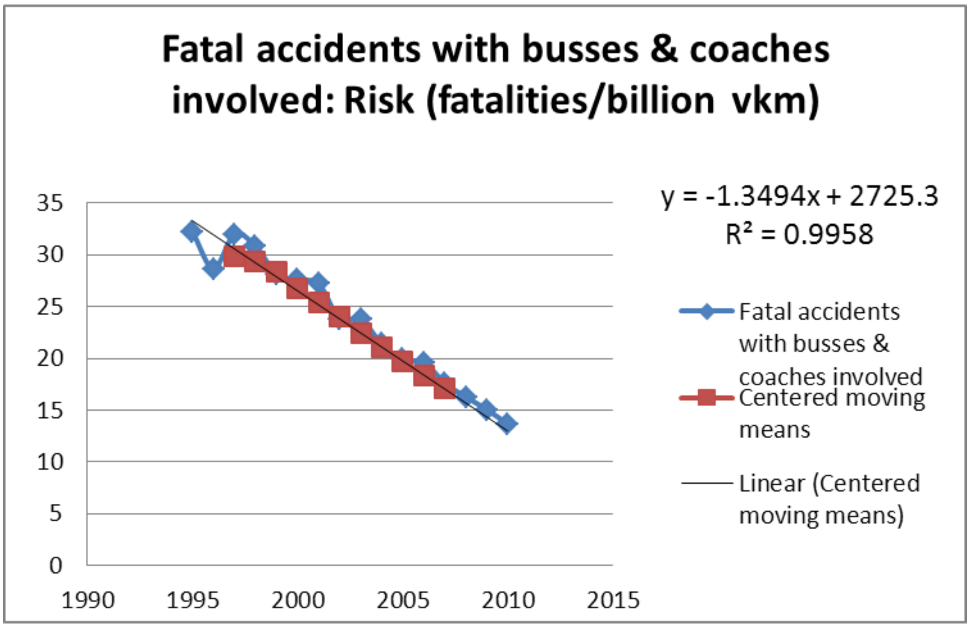
[85] By using centred moving means the numbers are controlled for small yearly influences and the focus lies on the larger trends.

[86] Belgium, Denmark, Germany, Ireland, Spain, France, Italy, Luxembourg, the Netherlands, Austria, Poland, Portugal, Finland, Sweden, UK.

A first order linear trend-line achieves an R^2 of 0.95, suggesting a strong linear effect over time[87]. This suggests that a maintained, yet stable reduction in the fatal accident risk per vehicle-kilometre has been achieved over the period of 1995 up to 2008.

Similar findings can be made for accident risk for buses and coaches. A high R^2 of 0.99 indicates that the majority of the reduction in fatal accident risk can be accounted for by a sole linear parameter (time).

Figure 4-4: Fatal accident risk with buses and coaches involved



Overall, there is no indication that within the period 2005-2007, a single element like the introduction of speed limiters on N2 and M2 vehicles, has contributed or brought changes to the continuous increase in traffic safety. Hence, purely looking at the accident data, no safety effect can be attributed to the implementation of the Speed Limitation Directive.

However, it should be noticed that due to data limitations, this analysis was carried out for all road types, while speed limiters mainly have impacts on motorways. The share of fatal accidents on motorways in the total of fatal accidents with HCVs involved is relatively small (about 13%).

4.3.3 Estimation of safety impacts based on changes in speed distributions

In this section we present the results of the second approach applied for assessing the safety impacts. The data on the number of accidents were retrieved from the CARE[88] database. Table 4-2 shows the accidents on motorways (which is a selection of Table A-5 that can be found in Annex 12). The total number of accidents, fatal accidents and serious injury accidents are displayed. Not in every accident, a HGV or bus was involved. These numbers and percentages are also shown. The low number of accidents with buses on motorways makes this estimation uncertain.

[87] R^2 provides a measure of how well observed outcomes are replicated by the model – the maximum value is 1.

[88] For the accident data the average number of accidents for the 4 most recent available years was taken, if there was sufficient data available. Member States with insufficient data were left out of the analysis (BG, EE, IT, CY, LV, LT, MT, FI)

Table 4-2: Accidents rates on motorways

	fatal accidents	percentage of total	serious injury accidents	percentage of total	all injury accidents	percentage of total
Total	1667	100%	9390	100%	52370	100%
HGV involved	507	30%	2159	23%	9714	19%
Bus involved	38	2%	97	1%	489	1%

The effects of the implementation of speed limitation devices for HGVs and buses were estimated from the speed impacts. For this a simulation was used, that simulates the speed distribution without a speed limiter in every Member State and the effect on speeds due to the speed limiter. The effect on the number of accidents is determined by the reduction in average speed. The change in average speed due to the implementation of the speed limiter depends on the initial speeds driven. This is shown in the tables below. These percentages have been calculated by applying the power functions (see section 2.7.4 and Annex 12).

Table 4-3: Impacts on accidents rates on motorways in Member States with high or low[89] posted speed limits (based on Elvik, 2009)

	Member State with posted speed limits: Low	Member State with posted speed limits: High
HGVs		
Average speed	-1%	-3%
Fatal accidents	-4%	-11%
Serious injury accidents	-2%	-7%
All injury accidents	-1%	-5%
Buses		
Average speed	-1%	-3%
Fatal accidents	-3%	-10%
Serious injury accidents	-2%	-7%
All injury accidents	-1%	-4%

Amongst the EU Member States, the maximum speeds are very different for HGVs and buses (and also for cars). The results show that according to this analysis, speed limiter has little effect in a Member State where the posted speed limits are more than 10 km/h below the limit of the speed limiter (as in the 'Low' case shown above).

The decrease in average speed in Member States with high posted speed limits on motorways was about 3% due to the implementation of the speed limiter. This resulted in a decrease of accidents.

This analysis was carried out for every Member State and the percentages were applied to the accident data per Member State with HGVs or buses involved. The aggregated results at the EU level are shown in Table 4-4. The table indicates the average reduction in accidents in number and in percentage due to a decrease in speed, based on average accident data for the years 2008-2011.

[89] The low posted speed limits are 80 km/h for HGVs and 90 km/h for buses on motorways, which means that the posted speed limit is was lower than the speed limiter. The high posted speed limits are 90 km/h for HGVs and 100 km/h for buses on motorways.

Table 4-4: *Impacts on the number of accidents on motorways (based on Elvik, 2009)*

		Accidents (average number of accidents in the EU for the period 2008-2011)	Reduction due to a decrease in speed	% reduction
With HGV involved	Fatal accidents	507	-43	-9%
	Serious injury accidents	2,159	-89	-4%
	All injury accidents	9,714	-281	-3%
With Bus involved	Fatal accidents	38	-5	-13%
	Serious injury accidents	97	-6	-7%
	All injury accidents	489	-21	-4%

Source: own calculations based on CARE database

This analysis is sensitive for the assumptions made with respect to the speeds that HCV would be driving today if no speed limiter would be in place. This is also clear from the difference in effects between a Member State with high posted speed limits and a Member State with low posted speed limits. Therefore a sensitivity analysis has been carried out, testing the hypothesis that speeds without speed limiter would be 5 km/h higher than the ones listed in Table 2-12 (see 2.6.5). This assessment has been carried out for HGVs and buses combined. The results of this assessment are shown in Table 4-5.

Table 4-5: *Impacts on the number of accidents on motorways in Member States with higher assumed vehicle speeds or speed deviations for the case without speed limiter (based on Elvik, 2009)*

		Accidents	Reduction due to a decrease in speed	% reduction
HCV involved	Fatal accidents	545	-48	-9%
	Serious injury accidents	2,256	-95	-4%
	All injury accidents	10,203	-302	-3%
Speeds 5 km/h higher	Fatal accidents	545	-116	-21%
	Serious injury accidents	2,256	-243	-11%
	All injury accidents	10,203	-723	-7%
Speed deviation 1,5 km/h higher	Fatal accidents	545	-62	-11%
	Serious injury accidents	2,256	-128	-6%
	All injury accidents	10,203	-390	-4%

Source: own calculations based on CARE database

It becomes clear that in the case HGVs would drive 5km/h faster without speed limiter, the effects of the speed limiters are more than two times larger than the base case shown in Table 4-4.

The same analysis is tested for a higher speed deviation. If the speed dispersion is assumed 1.5 km higher than in the base case, the accident reduction percentages are 1-2% higher, depending on the accident severity. This is a relative small difference, compared to the impacts from changing the assumptions for the average speed.

Given the uncertainty in the vehicle speeds and speed deviations in the case when there would be no speed limiters, it is therefore not possible to provide a precise estimate of the safety impacts of speed limiters. However, the results presented above provide a bandwidth that can be regarded as a reasonable estimate of the safety impacts deriving from the introduction of speed limiters. Beside, the speed limiter has caused the speed deviation in the total traffic flow to increase by 1-3%, which leads to more encounters and more overtaking manoeuvres. There are clear indications that this has a negative effect on road safety, which means that the effect of the Directive may have been smaller than what was estimated. However these effects are difficult to quantify.

4.3.4 Synthesis

The results of the time series analysis did not reveal any significant impacts on traffic safety. This does not mean that the Directive did not have any safety effects, as the implementation covered several years and the impacts may be blurred by the general trends in improving traffic safety and by the fact that mainly motorway accidents are reduced, while fatal accidents on motorways constitute only 13% of all fatal accidents with HCVs involved.

The modelling based on changes in vehicle speeds and the relations between speed and traffic safety shows that the Directive has resulted in a reduction in the number of fatal accidents on motorways with HCVs involved of about 9%. This corresponds to a reduction of about 50 fatal accidents a year.

This estimate is relatively uncertain and should be interpreted with care, as some of the main assumptions and input data are relatively uncertain, particularly with respect to changes in speed. In case the impacts on vehicle speed have been higher than assumed, the safety impacts will also have been higher. On the other hand, not only the average speed changed, but also the speed dispersion. Because HCVs decreased their speed compared to the rest of the traffic flow, the speed dispersion in the total traffic flow has increased. There are clear indications in the literature that this has a negative effect on road safety.

Unfortunately, there is a lack of sufficient data to be able to distinguish clear road safety impacts of introducing speed limitation devices in vehicle categories N2 and M2, as required by the legislator in Directive 2002/85/EC. For this, both traffic data and accident data differentiated to M2, M3, N2 and N3 would be needed. However, the differentiation between the smaller vehicle types (M2 and N2) and the larger ones (M3 and N3) can be made for neither traffic data nor safety statistics.

4.4 Impacts on emissions

The emission levels on motorways for HGV and buses were retrieved from TREMOVE (see 2.8) and are shown in Table 4-6. About 2/3 of the emissions issue from HGVs.

Table 4-6: Emission levels on motorways (year: 2010)

	CO2		NOx		PM	
	emissions (tonnes)	percentage of total	emissions (tonnes)	percentage of total	emissions (tonnes)	percentage of total
HGV	28.214.604	69%	192.332	63%	4.020	68%
Bus	12.509.377	31%	113.671	37%	1.857	32%
HCV total	40.723.981	100%	306.003	100%	5.877	100%

In EU Member States, speed limiters are mandatory for buses and HGVs. The effects of these speed limiters on the vehicles emissions were modelled using VERSIT+ and are shown in Table 4-7. The impact of speed limiters on emissions is shown for Member States with low and high posted speed limits, and is presented separately for HGVs and buses.

Table 4-7: Effect of introduction of speed limiters on CO2, NOx and PM emissions for HGVs and buses on motorways for Member States with low and high posted speed limits

	Member State with posted speed limits	
	Low	High
HGVs		
CO2	0%	-1%
NOx	0%	-1%
PM	0%	-1%
Buses		
CO2	0%	-2%
NOx	0%	-2%
PM	0%	-2%

The introduction of speed limiters lowered the emissions of all three studied components (i.e. CO_2, NO_x and PM) with 0% to 2%. This is the result of less deceleration and acceleration and a lower average speed. The larger the difference between the average speed before the introduction of the speed limiter and the speed limiter speed, the higher the emissions reduction.

The reduction can be decomposed in two components. The first one is a lower average velocity with a lower rolling resistance and air-drag. The second component is lower dynamics, with less braking, which will decrease the CO_2 emission as well, but will mainly affect the pollutant emissions which have a stronger dependence on dynamics.

Fuel consumptions, and therefore (CO_2) emissions, increase more than linearly with an increasing velocity, because e.g. drag increases more than linearly with increasing velocity. Since the initial velocity of buses in higher than that of HGVs, the emission reduction resulting from the introduction of speed limiters in higher for buses than for HGVs.

The standard deviations, resulting from the drive cycles of HCVs and used to determine the impacts of speed limiters on vehicle emissions, differ from what is used in the road safety calculations, because of the difference in choice of speed distribution and speed profiles used. The emission analysis is based on speed profiles of actual individual vehicles, while the safety is based on a distribution of average velocities of a vehicle fleet.

The emission reduction effects calculated above were applied to all Member States based on their posted speed limits and aggregated to the EU level. The overall emission reductions of CO_2, NO_x and PM of the emissions by HCVs on motorways in the EU27 are approximately close to 0% for HGVs and about 2% for buses. They are shown in Table 4-8 for HGVs and buses.

Table 4-8: Ex-post emission reduction by trucks and buses on motorways in EU27 (year: 2010)

		Emissions (tonnes)	Reduction due to a decrease in speed (tonnes)	% reduction
HGV	CO2	28.214.604	-126.592	0%
	NOx	192.332	-1.020	-1%
	PM	4.020	-19	0%
Bus	CO2	12.509.377	-199.670	-2%
	NOx	113.671	-1.962	-2%
	PM	1.857	-30	-2%

Similarly to what was done for safety impacts, a sensitivity analysis was carried out, assuming an average speed without speed limiter which is 5km/h higher. For HGVs and buses combined, the emission reduction is approximately 1%. This is shown in Table 4-9.

Table 4-9: Effect of introduction of speed limiters on CO2, NOx and PM emissions for HGVs and buses in case of a higher assumed average speed before the introduction of the speed limiter

		Emissions (tonnes)	Reduction due to a decrease in speed (tonnes)	% reduction
HCV	CO2	40.723.981	-326.262	-1%
	NOx	306.003	-2.982	-1%
	PM	5.877	-48	-1%
Speeds 5 km/h higher	CO2	40.723.981	-2.019.122	-5%
	NOx	306.003	-12.192	-4%
	PM	5.877	-296	-5%

In case the average velocity were to be 5 km/h higher than assumed in Table 4-8, the emissions reduction resulting from speed limiter is expected to be higher, of approximately 4% to 5% of the emissions of HCVs on motorways in the EU27.

4.5 Market impacts

4.5.1 Introduction

The market impacts that can be attributed to the Speed Limitation Directive refer to different areas:

- shifts between vehicle categories, in particular from HCV to LCV;
- transport operating costs;
- vehicle design;
- compliance costs, administrative costs, enforcement and fraud;
- level playing field and transport demand..

4.5.2 Shifts between vehicle categories

As already explained, data collected from the survey are rather incomplete: only few countries i.e. Belgium, Bulgaria, Denmark, Finland, France, Ireland, Italy, Latvia, Luxembourg and United Kingdom provided data of vehicles differentiated per M and N categories for periods before and after the Speed Limiters Directive implementation, which occurred in 2005 in almost all countries analysed. The vast majority of respondents did not see evidence of a correlation between the implementation of the Directive and the vehicles stock development, and the analysis carried out confirms that there is no certain association between the two. Generally vehicles stock time series did not alter their growth rate after the Directive implementation, while in the case of Latvia heavier commercial and passenger vehicles growth trend was stronger compared to light vehicles one (trends of available M and N vehicle stock are presented in Annex 9). It's important to mention that the evolution of vehicles fleet composition in Eastern European countries like Latvia, Lithuania, Slovakia and Romania has been also influenced by the opening of new branches from many Western European road transport companies not only for logistical reasons or lower labour costs, but also for new vehicles purchase incentives (as emerged also during the interviews with the operators).

The problem is that for all countries it is not possible to isolate the impact of the Speed Limitation Directive from a number of other elements that have had an influence on the growth rates of different categories of commercial vehicles. As also confirmed by the outcome of the survey and by the stakeholders' conference, the various factors that have played a role include: road charging schemes, cargo weight, logistic patterns, cargo fragmentation, e-commerce deliveries, etc. not to mention also the economic downturn.

Information collected through specific interviews with passenger/freight transport and logistics operators in order to understand whether they were influenced by the Speed Limiters Directive implementation in terms of vehicle choice confirm the difficulty to disentangle this specific impact from the many other factors.

Eventually, it is relevant to mention that according to the majority of the government agencies responding to the questionnaire, the share of LGVs in international freight transport is not significant and therefore no shifts between vehicles categories have substantially influenced international commercial road freight transport.

4.5.3 Transport operating costs

The benefit of the implementation of speed limitation devices from the transport operators' point of view is perceived essentially in terms of operating costs savings: fuel consumption can be more easily predicted and also tires, breaks and other components are less eroded. Especially the more recent installation of speed limitation devices on N2/M2 vehicles confirmed this positive and quite immediate impact on vehicle's operating costs and life cycle by the operators themselves.

No major impact was distinguished in relation to travel time increases as a consequence of the Speed Limitation Directive implementation.

4.5.4 Vehicle design

The impact on vehicle design is intended here essentially as downsizing of engines' power for vehicle categories affected by the implementation of the Speed Limitation Directive.

According to the information collected such an impact has been negligible in comparison to the relevance of technology development and innovation, starting from the introduction of turbo chargers to more recent systems like Electronic Stability Control, adaptive cruise, pneumatic disc brakes on all axles, electronically controlled breaking systems and retarders. In this sense, the presence of speed limiters may have positively influenced a "right engine design" also for improving the performances of some systems like automatic speed adaptation on hill and descend road sections.

The downsizing or "rightsizing" of engines' power is in any case dependent on vehicles' usage (especially the type of service and the cargo loaded) and strictly linked to optimal fuel consumption performances.

Whereas for companies operating long distance regular coach services or coach tourism, availability of new on-board technologies for adaptive cruising and speed monitoring are fundamental for increasing safety and comfort of their passengers (such characteristics are also highly evaluated during a new vehicle's acquisition), road freight operators may be more oriented to purely fuel saving advantages of new engines.

Heavy cargoes transported on the road still require high powered engines given that steep roads still need to be driven at the maximum speed.

4.5.5 Compliance costs, administrative costs, enforcement and fraud

As for administrative and compliance costs (including equipment and retrofitting) encountered by the Member States, few responses from governmental authorities have been provided (see section 3.4.1). These answers prove that no major problems have been encountered, as also confirmed by interviews with transport and logistics operators.

According to the survey respondents, there was no evidence of significant levels of frauds and illegal behaviours. Vehicle compliance is checked together with the periodic controls performed for vehicles safety and according to the different Member States' regulations.

Another conclusion that can be drawn by the survey among the governmental contacts[90] is that no differences were observed (or no data are available) in relation to the behaviour of small/medium enterprises (SMEs) in comparison to large enterprises with respect to the Directive provisions: i.e. in terms of frequency of illegal behaviours and/or frauds. In this respect, stakeholders' answers are also in line with those of the Member States representatives.

As final consideration it can be stated that the Speed Limitation Directive did not lead to distorted competition among operators and that the available information seems to indicate that there is no need for measures aimed at reducing administrative burden and compliance/enforcement costs.

4.5.6 Level playing field and transport demand

In addition to what is already mentioned in the previous paragraph, the implementation of the Speed Limitation Directive, which helped the enforcement of posted speed limits on highways, had a positive impact in terms of level playing field among transport companies of different EU countries operating in the international transport sector. On the other hand, for those logistic sectors where both HGVs and LGVs are in competition, the Speed Limitation Directive might also be seen as part of the EU legislative initiatives that penalise HGVs, as mentioned in chapter 3.4.5. No impacts on transport demand were detected.

4.6 Main findings

The ex-post evaluation of the Speed Limitation Directive focussed on the possible impacts with respect to speed, road safety, emissions and the market.

The impacts of the Directive on actual vehicle speeds are difficult to estimate due to data limitations. When comparing historical data on traffic speeds, no clear effect of the Directive on the speed distribution could be found.

When considering the evolution of the accident risk of HCVs over time, there is no clear evidence of the impact of the Directive on traffic safety. This is mainly due to three reasons. Firstly, there is not a single year of implementation of the Directive, which makes that the possible effect is spread over time. Secondly, together with the Directive many other regulations came into place which either directly or indirectly impacted traffic safety. Finally, as data limitations with regard to vehicle-kilometre per road type only allowed for analysing accidents rates for all road types together, the

[90] The only exception is the Italian Ministry of Transport that, although stating that no direct evidence of different behaviour between enterprises emerges, reports that some resistance to the retrofitting speed limiter scheme was noted mainly from small enterprises using vehicles for their own account.

impacts of the speed limiters (mainly taking place on motorways) were not traceable in the overall accident statistics.

However, what is relevant for the ex-post evaluation is not the speed distribution of 10 years ago, but the speed distribution if no speed limiter would be in place today. Hence, based on real data, more theoretical speed distributions were assumed, implying a small impact on speed of the speed limiters. Using these speed distributions the impact on safety and emissions could be calculated.

Hence this second approach was chosen to analyse the possible effect on traffic safety. Given the relationships between the distribution of speed and accidents and the impact of speed limiters on the distribution of speed, the impact of speed limiters could be demonstrated. Using the more theoretical speed distributions, the impact on speed was assessed and the impact on safety could be calculated.

Overall, the Directive had a positive impact on traffic safety, leading to a reduction of 9% of fatal accidents, 4% of serious injuries and overall a reduction of 3% for all injury accidents on motorways with HCVs involved. The reduction percentages for buses are higher with a reduction of 13% of fatal accidents, 7% of seriously injured and overall a reduction of 4% for all injury accidents on motorways. However, as the number of accidents with buses is small, the results should be treated with care as they are more uncertain. The total reduction in the number of fatalities due to the Directive is estimated at about 50.

Furthermore, two uncertainties remain. Firstly, what would the speed distribution look like if there were no speed limiters? If the speed would be higher than first assumed, the effect of the speed limiter would be larger. If the speed deviation would be larger than assumed, the effect of the speed limiter would also increase as well. The extent of the impact on safety is thus largely depending on the hypotheses taken regarding speed distribution. Secondly, the speed-accident relationships used are estimated for a mix of traffic, consisting mainly of cars. Given the weight and the dimensions of the HCV, the relationship – especially with respect to the consequences of an accident – could be stronger. However, no research has been done to allow for specific HCV speed – accident relationships. Unfortunately, data is lacking to distinguish the road safety impacts of introducing speed limitation devices in vehicle categories N2 and M2.

With respect to the effect on emissions, by comparing speed profiles, it can be concluded that the introduction of speed limiters lowers emissions of CO_2, NO_x and PM with 1% for HGVs and with 2% for buses for motorways with high posted speed limits. For motorways with low posted speed limits the effect on emissions is zero. The higher the average speed is before the introduction of the speed limiter and the speed limiters speed, the higher the reduction in emissions. Overall, for the EU as a whole it is estimated that the introduction of speed limiters decreased emissions with 1%.

With respect to the market impacts the focus lies on the possible impacts of a shift between HCVs and LCVs, the transportation costs, vehicle design and enforcement and fraud. For none of these impacts clear evidence of problems were found. With respect to shifts towards LCVs, some countries did see this shift, but this could also be caused by other regulations (e.g. drinking and rest times, tachograph,…) and to other influences (supply chain and distribution patterns, internet shopping) – rather than by the Speed Limitation Directive. Fraud was not seen as a problem by the interviewees, but did come up as a problem in the literature from outside the EU.

5 Ex-ante evaluation for HCVs

5.1 Introduction

In this chapter the results are presented of the evaluation of various options for amending the current Speed Limitation Directive with respect to HCVs. This includes both scenarios in which the maximum speeds that apply to HCVs are decreased/increased and scenarios in which the Intelligent Speed Adaptation/Assistance (ISA) systems become mandatory. Section 3.3 already gave a brief description of various types of ISA systems.

This chapter starts with the scenario description in section 5.2. Next the results of the ex-ante evaluation are presented: in section 5.3 the impacts on speed, in section 5.4 on traffic safety, in section 5.5 on emissions and in section 5.6 the market impacts. Section 5.7 provides a synthesis of the evaluation. The various impacts have been quantified by applying the methodology described in chapter 2.

5.2 Scenario definition

Four scenarios were evaluated. In the first two scenarios only the maximum speeds as set by the speed limiter are changed compared to the current situation, while in the last two scenarios two different ISA systems are introduced.

5.2.1 Speed limiter scenarios

With respect to maximum speeds set by the speed limiter the following two scenarios are evaluated:

- Scenario 1 (HCV1): A speed decrease for the N2/N3 vehicles from 90 km/h to 80 km/h maximum speed and a speed decrease from 100 km/h to 90 km/h for M2/M3 vehicles.
- Scenario 2 (HCV2): A speed increase to 100 km/h for the N2/N3 vehicles and keeping the speed fixed for M2/M3 vehicles.

The reasoning behind these scenarios is as follows. One scenario with an increase of the speed and one with a decrease of the speed has been chosen to assess a broad range of scenarios. The levels of 80 km/h for N2/N3 is a reasonable assumption as many countries have a maximum speed on motorways set for this type of vehicles at 80 km/h. A lower maximum speed is less likely to be possible as in many Member States, for example Belgium, the minimum speed on motorways is 70 km/h. An increase of the maximum speed for HGVs to 100 km/h decreases the differences in vehicle speed between the various vehicle types. Furthermore a speed of 100 km/h would be technically feasible for the HCV's.

The different EU27 countries however have different maximum speeds on their motorways and rural roads. Important for the analysis of these scenarios is the assumption on what will happen given the national maximum speeds. These national posted speed limits remain unchanged throughout the analysis.

Scenarios which differentiate speed limits between M2 and M3 and/or between N2 and N3 vehicles were not withheld as there is insufficient data for carrying out such an analysis. Therefore, such scenarios, although potentially relevant from the policy perspective, have not been selected for the evaluation.

5.2.2 ISA scenarios

For the scenario a time horizon for implementation of about 5 years is relevant. Hence only technologies that could be applied within this period were considered. This means that the systems scoring an o in Section 2.5 (the dynamic speed limitation information) are not relevant for the scenarios. Furthermore, it should also be taken into account that digital road maps are an important condition for variable ISA systems to function and the maps would require regular updating. This means that a fixed system is more likely to be feasible than a variable system. Liability of the driver is also an issue, given that he should keep control over his vehicle. In this context it is not clear whether active ISA systems could be implemented as alternative to speed limiters or whether only supportive systems are a possible alternative. This means that the intervening/mandatory systems fall out as an option.

Given these requirements two alternative ISA systems for HGVs are evaluated in this study. One of these systems is also combined with a change in the maximum speed.

- Scenario 3 (HCV3): "Advisory/informing" or "warning" driver feedback with variable posted speed limit information and no changes in current maximum speeds.
- Scenario 4 (HCV4): "Voluntary" driver feedback with fixed posted speed limit information and a decrease in the maximum speed to 80 km/h for N2/N3 and to 90 km/h for M2/M3.

For the ISA scenario 3, the technology is currently already being offered by several car manufacturers in the sense that visual or acoustic signals are being fed back to the driver. Haptic feedback (vibration) is currently not yet being offered as an option. However, it does not necessarily require significant adaptations to the principle. As such, the technology is already introduced to a sufficiently high level to be transposed on a heavy goods vehicles fleet. The informative nature of the system implies that no invasive actions are taken by the ISA system. The driver remains fully responsible for the eventual speed choice. This also means that from a liability perspective, it would be possible to combine this system with variable posted speed limit information. By keeping the speeds as they are today, this scenario allows to assess the pure effects of implementing this type of ISA for HCVs.

Also the technology needed for ISA scenario 4 is available. This system has been the subject of some research and field tests. It is currently not being offered as an option by vehicle manufacturers, but could be ready for the market within 5 years. Databases with maximum speed information are up to a certain extent already available at both private and public level. Driver acceptance can sometimes be a problem for this type of system since a more explicit invasion takes place in relation to driver input (speed pedal pressure). As the system is more intrusive, from a liability perspective this system should be combined with fixed maximum speed information as this type of information is most reliable. Many EU Member States already have a maximum speed in place for HCVs which is lower than the current speed limiter. By combining a voluntary ISA system with a lower maximum speed we expect that this scenario will have the highest safety impact and can serve as a comparison for the other three scenarios.

It should be noted that where regular speed limiters particularly have an impact on motorways, ISA systems have also impacts on rural roads and urban roads. These are the road types with relatively high accidents rates, compared to motorways. Therefore, ISA systems can be regarded as complementary to the speed limiters. This is an important reason why scenarios 3 and 4 have ISA systems on top of regular speed limiters.

5.2.3 Overview of all four scenarios

We can summarize the four scenarios for HCVs as follows.

Table 5-1: Summary of the scenarios for the ex-ante analysis for HCVs

	Speed limiter HGVs	**Speed limiter buses**	**ISA system**
Reference	90 km/h	100 km/h	no
HCV1	80 km/h	90 km/h	no
HCV2	100 km/h	100 km/h	no
HCV3	90 km/h	100 km/h	Advisory/open – variable maximum speed information
HCV4	80 km/h	90 km/h	Voluntary – fixed maximum speed information

5.3 Impacts on speed

For the impacts on speed, the focus lies on the impact of scenario 1 – with a reduction in speed and scenario 2 – with an increase in the speeds. As the speed set in the speed limiters remain the same, and speed limiters are still in place in scenario 3, no changes in speed or the distribution for motorways are expected in this scenario. In scenario 4, for motorways and rural roads the effects on speed and its distribution will be the same as in scenario 1. In this section the influence of ISA on urban and rural speeds is not analysed, as the impacts on safety and emissions for this type of roads will follow directly from the literature on ISA.

The tables below show the average speed and standard deviation for HCVs for the reference case, scenario 1 and scenario 2. This is used as an input for estimating the safety and emission impacts. High and low refer Member States with relatively high or low posted speed limits, for more details see section 2.6.7.

Table 5-2: Average speed and standard deviation for HCVs in the different scenarios, motorways

				Before			*After*			
Member State type	Scenario	Vehicle	Posted speed limit	Speed limiter	Average speed	Speed deviation	Speed limiter	Average speed	Speed deviation	Change in average speed
Low	HCV 1	HGV	80	90	84	5	80	79	2	-6%
Low	HCV 2	HGV	80	90	84	5	100	85	6	1%
High	HCV 1	HGV	90	90	87	3	80	79	1	-9%
High	HCV 2	HGV	90	90	87	3	100	90	6	3%
Low	HCV 1	Bus	90	100	94	5	90	89	2	-6%
Low	HCV 2	Bus	90	100	94	5	100	94	5	0%
High	HCV 1	Bus	100	100	97	3	90	89	1	-8%
High	HCV 2	Bus	100	100	97	3	100	97	3	0%

Source: own assumptions based on measured data (Annex 16).

For the rural roads similar assumptions are made. Given the speed limits on rural roads, the main impact on speeds is for scenario 1 and 4 in which the speed set in the speed limiter is decreased. The results are shown in Table 5-3.

Table 5-3: *Average speed and standard deviation for HCVs for the different scenarios, rural roads*

Member State type	Scenario	Vehicle	Posted speed limit	*Before* Speed limiter	Average speed	Speed deviation	*After* Speed limiter	Average speed	Speed deviation	Change in average speed
Low	HCV 1	HGV	80	90	70	10	80	69	9	-1%
Low	HCV 2	HGV	80	90	70	10	100	70	10	0%
High	HCV 1	HGV	90	90	79	9	80	76	6	-4%
High	HCV 2	HGV	90	90	79	9	100	80	10	1%
Low	HCV 1	Bus	80	100	70	10	90	70	10	0%
Low	HCV 2	Bus	80	100	70	10	100	70	10	0%
High	HCV 1	Bus	90	100	80	10	90	79	9	-1%
High	HCV 2	Bus	90	100	80	10	100	80	10	0%

Source: own assumptions based on measured data (Annex 16).

So, the speed changes in scenario 1 are much higher than in scenario 2, with the highest impacts in Member States with high posted speed limits.

5.4 Impacts on safety

This section presents the results of the ex-ante evaluation of impacts on road safety for HCVs.

5.4.1 *Safety impacts at Member State level*

The application of speed limiters leads to a decrease in average speed for the involved vehicles. This was simulated by the model and has an effect on accidents.

In this section the relative effects on speed and accident rates for fatal accidents, serious injury accidents and all injury accidents are shown. The effects are based on the decrease of the average speed due to the speed limiters and the formulas of Nilsson (1982) and the updated exponents by Elvik (2009). The effect differs for the accident severity: the effect of a decrease in speed on more severe accidents is larger. This is because the exponent of the power functions is higher for more severe accidents (see 2.7.4).

There is a large difference in the posted maximum speeds for HGVs or buses in the EU Member States. This is important because the effect of the speed limiter will be different when the maximum speed on the roads is high or low. This is because the decrease in speed due to the speed limiter is much higher on a road with a maximum speed of 130 km/h than on a road with a maximum speed of 100 km/h. Similarly, the relative effects of speed limiters on motorways will be larger than on rural roads.

Table 5-4 and Table 5-5 show the change in average speed and the change in accident rates for the four scenarios that were defined, for HGVs in Member States with high and low[91] maximum speeds. The effects on road safety are based on the change in average speeds, which is presented first. The accident reduction percentages in these tables are the result of the model calculations using the power functions, but not yet applied to the accident rates in the Member States. Scenario

[91] The low posted speed limit is 80 km/h for HGVs and 90 km/h for buses on motorways, which means that the posted speed limit is was lower than the speed limiter. The high posted speed limit is 90 km/h for HGVs and 100 km/h for buses on motorways. For rural roads this is respectively 80 km/h (low) and 90 km/h (high) for HCVs.

4 consists of both the voluntary ISA system and the speed limiter for HCVs as in scenario 1. In the calculations for this scenario, effects of both measures were calculated and the dominant effect was applied (see 2.7.5).

Table 5-4: Impacts of different scenarios for HGVs on accident rates for Member States with low maximum speeds (based on Elvik, 2009)[92]

		Scenario			
Road		HCV1 Speed limiter for HGVs to 80 km/h and for buses to 90 km/h	HCV2 No change in speed limiter for buses and speed limiter for HGVs to 100 km/h	HCV3 No change in speed limiter and advisory ISA for all HCVs	HCV4 Speed limiters as in HCV1 and voluntary ISA for all HCVs
motorway	Average speed	-6%	+1%	0%	-6%
	Fatal accidents	-22%	+3%	0%	-22%
	Serious injury accidents	-13%	+2%	0%	-13%
	All injury accidents	-8%	+1%	0%	-8%
rural	Average speed	-1%	0%		
	Fatal accidents	-4%	0%	-9%	-25%
	Serious injury accidents	-2%	0%	-4%	-19%
	All injury accidents	-2%	0%	-2%	-11%
urban	Average speed	0%	0%		
	Fatal accidents	0%	0%	-9%	-25%
	Serious injury accidents	0%	0%	-4%	-19%
	All injury accidents	0%	0%	-2%	-11%

Note that for scenario HCV3 and HCV4 on motorways the effects of the ISA system were corrected for the already present speed limiter. Both in HCV3 and HCV4, the ISA has no significant additional safety impact on motorways as the speeds are already limited and the ISA will not intervene. The safety impact in HCV4 is from the lower maximum speed of the speed limiters (as in HCV1).

For rural and urban roads the safety impacts in HCV3 and HCV4 are from the ISA. The differences in the safety impacts are because of the different types of ISA.

For HCV3 the impact on average speed on motorways is 0%, because no additional effect of advisory ISA is expected on motorways. For HCV4 the impact of ISA on average speed is also 0% but the lower maximum speed of the speed limiter causes a -6% average speed effect. For other roads no average speed impacts are available, because no calculations on the speed were performed. The road safety effects are based on Carsten et al. (2008).

[92] Note that for HCV3 and HCV4, the impacts on motorways are from the speed limiters, while the impacts on the other roads are from the ISA.

Table 5-5: Impacts of different scenarios for HGVs on accident rates for Member States with high maximum speeds (based on Elvik, 2009) [93]

		Scenario			
Road		HCV1 Speed limiter for HGVs to 80 km/h and for buses to 90 km/h	HCV2 No change in speed limiter for buses and speed limiter for HGVs to 100 km/h	HCV3 No change in speed limiter and advisory ISA for all HCVs	HCV4 Speed limiters as in HCV1 and voluntary ISA for all HCVs
motorway	Average speed	-9%	+3%	0%	-9%
	Fatal accidents	-30%	+11%	0%	-30%
	Serious injury accidents	-19%	+6%	0%	-19%
	All injury accidents	-12%	+4%	0%	-12%
rural	Average speed	-4%	+1%		
	Fatal accidents	-15%	+4%	-9%	-25%
	Serious injury accidents	-9%	+2%	-4%	-19%
	All injury accidents	-6%	+1%	-2%	-11%
urban	Average speed	0%	0%		
	Fatal accidents	0%	0%	-9%	-25%
	Serious injury accidents	0%	0%	-4%	-19%
	All injury accidents	0%	0%	-2%	-11%

In scenario1, the speed limiter of 80 km/h for HGVs has a large effect on motorways, both in Member States with high and low maximum speeds. For rural roads the speed limiter has a large effect for roads with a higher maximum speed. The change in average speeds in scenario 1 is between -6% and -9% on motorways and between -1% and -4% on rural roads according to this simulation. The increase in average speed for scenario 2 is between 1% and 3% on motorways.

An increase of the maximum speed for HGVs as in scenario 2 leads to an increase of accidents, mainly on motorways with high maximum speeds. The effect is almost a reverse of the results of the ex-post simulation.

The speed limiters have no effect on urban roads, as no vehicles drive faster than the maximum speed of the speed limiter. Compared to the speed limiters, both ISA systems have considerable road safety effects on rural and urban roads.

Literature provides either a distinction of ISA effects according to road type or accident severity. For this study we choose to use a distinction to accident severity and the effects on different road types are therefore the same. The results for voluntary ISA on motorways are comparable with scenario 1, with a significant reduction in fatal accidents. Advisory ISA leads to a smaller effect on motorways compared to the speed limiter, but it has a larger effect on rural roads and urban roads. Compared with voluntary ISA the effects are always smaller

It should be noted that the effects of the ISA systems are based on literature and gives a rough estimate, more an indication. The effect of voluntary ISA on motorways is comparable to the speed limiters on motorways The effect of advisory ISA is comparable with speed limiters on rural roads.

[93] Note that for HCV3 and HCV4, the impacts on motorways are from the speed limiters, while the impacts on the other roads are from the ISA.

The same approach was taken for buses. Table 5-6 and Table 5-7 show the impact on road safety of the scenarios for buses for Member States with low and high maximum speeds.

Table 5-6: Impacts of different scenarios for buses on accident rates for Member States with low maximum speeds (based on Elvik, 2009) [94]

Road		Scenario HCV1 Speed limiter for HGVs to 80 km/h and for buses to 90 km/h	HCV2 No change in speed limiter for buses and speed limiter for HGVs to 100 km/h	HCV3 No change in speed limiter and advisory ISA for all HCVs	HCV4 Speed limiters as in HCV1 and voluntary ISA for all HCVs
motorway	Average speed	-6%	0%	0%	-6%
	Fatal accidents	-20%	0%	0%	-20%
	Serious injury accidents	-12%	0%	0%	-12%
	All injury accidents	-8%	0%	0%	-8%
rural	Average speed	-0%	0%		
	Fatal accidents	-0%	0%	-9%	-25%
	Serious injury accidents	-0%	0%	-4%	-19%
	All injury accidents	-0%	0%	-2%	-11%
urban	Average speed	0%	0%		
	Fatal accidents	0%	0%	-9%	-25%
	Serious injury accidents	0%	0%	-4%	-19%
	All injury accidents	0%	0%	-2%	-11%

Table 5-7: Impacts of different scenarios for buses on accident rates for Member States with high maximum speeds (based on Elvik, 2009) [95]

Road		Scenario HCV1 Speed limiter for HGVs to 80 km/h and for buses to 90 km/h	HCV2 No change in speed limiter for buses and speed limiter for HGVs to 100 km/h	HCV3 No change in speed limiter and advisory ISA for all HCVs	HCV4 Speed limiters as in HCV1 and voluntary ISA for all HCVs
motorway	Average speed	-8%	0%	0%	-8%
	Fatal accidents	-27%	0%	0%	-27%
	Serious injury accidents	-17%	0%	0%	-17%
	All injury accidents	-11%	0%	0%	-11%
rural	Average speed	-1%	0%		
	Fatal accidents	-4%	0%	-9%	-25%
	Serious injury accidents	-2%	0%	-4%	-19%
	All injury accidents	-1%	0%	-2%	-11%
urban	Average speed	0%	0%		
	Fatal accidents	0%	0%	-9%	-25%
	Serious injury accidents	0%	0%	-4%	-19%
	All injury accidents	0%	0%	-2%	-11%

[94] Note that for HCV3 and HCV4, the impacts on motorways are from the speed limiters, while the impacts on the other roads are from the ISA.
[95] See previous footnote.

Results are similar for buses than for HGVs. For buses the impact of the speed limiter of 90 km/h on speed and accidents is slightly smaller than for HGVs, but still significant. On rural roads the effect is small.

5.4.2 Safety impacts at EU level

For every Member State the effect of the implementation of speed limiters is different, due to the maximum speed in the Member States. The analysis was carried out for every Member State and the reduction percentages were applied to the accident data with HGVs or buses involved per Member State. The aggregated results at the EU level are shown in Table 5-8, which shows the accident reduction rate for the four scenarios for HCVs, on motorways, rural roads, urban roads and aggregated to all roads for an average year based on accident rates in the period 2008-2011.

Table 5-8: Road safety effect on the number of accidents at EU level

			Scenario			
		Accidents	HCV1 Speed limiter for HGVs to 80 km/h and for buses to 90 km/h	HCV2 No change in speed limiter for buses and speed limiter for HGVs to 100 km/h	HCV3 No change in speed limiter and advisory ISA for all HCVs	HCV4 Speed limiters as in HCV1 and voluntary ISA for all HCVs
motorway	Fatal accidents	545	-137 (-25%)	+38 (+7%)	0 (0%)	-137 (-25%)
	Serious injury accidents	2,256	-338 (-15%)	+80 (+4%)	0 (0%)	-338 (-15%)
	All injury accidents	10,203	-1,011 (-10%)	+253 (2%)	0 (0%)	-1,011 (-10%)
rural	Fatal accidents	2,293	-93 (-4%)	+13 (+1%)	-200 (-9%)	-570 (-25%)
	Serious injury accidents	4,777	-124 (-3%)	+16 (0%)	-198 (-4%)	-888 (-19%)
	All injury accidents	20,087	-356 (-2%)	+44 (0%)	-486 (-2%)	-2,297 (-11%)
urban	Fatal accidents	1,439	0 (0%)	0 (0%)	-126 (-9%)	-358 (-25%)
	Serious injury accidents	6,441	0 (0%)	0 (0%)	-267 (-4%)	+1,198 (-19%)
	All injury accidents	40,001	0 (0%)	0 (0%)	-968 (-2%)	-4,574 (-11%)
all roads	Fatal accidents	4,277	-230 (-5%)	+51 (+1%)	-326 (-8%)	-1,065 (-25%)
	Serious injury accidents	13,473	-462 (-3%)	+95 (+1%)	-464 (-3%)	-2,424 (-18%)
	All injury accidents	70,290	-1,368 (-2%)	+297 (+0%)	-1,454 (-2%)	-7,881 (-11%)

For the HCV scenarios the differentiation between road types is clear. The speed limiter (scenario 1 and 2) only has an effect on motorways and rural roads. The relative effect on motorways is the largest. However, the number of accidents is larger on rural roads compared to motorways. Therefore the absolute effect of the speed limiters relatively high on rural roads, but still smaller than on motorways.

Compared to the ex-post evaluation, the effect of setting the maximum speed for the speed limiter for HGVs to 100 km/h in scenario 2 has almost the same effect, although now reversed.

The ISA scenarios show an effect on rural roads and urban roads. On motorways, the effect of adding ISA systems to speed limiters is assumed to be very small. This is because the speed is already limited by the speed limiter on motorways.

The effect of advisory ISA and voluntary ISA on rural roads and urban roads is substantial, especially for voluntary ISA. This is because the number of accidents on rural and urban roads is very high, and therefore absolute accident reduction is relatively large on those road types.

In the ISA scenarios the vehicles are still equipped with a speed limiter. For scenario 3 the set speed does not change and the speed limiter has no additional effect. The maximum speed set by the speed limiter changes in scenario 4 and voluntary ISA is also applied. Here the dominant effect was applied (see for an explanation section 2.7.5), which means that the measure that has the largest effect was used in the calculations. For rural and urban roads ISA is dominant, but for motorways the effect of the speed limiter was applied.

Figure 5-1, Figure 5-2 and Figure 5-3 show the overall road safety effect for all scenarios on all road types on fatal accidents. Figure 5-1 shows the relative reduction of fatal accidents on all roads. Here the distinction in effects per road type is shown. ISA systems especially have a large effect on rural and urban roads. The effect on motorways is significant in scenario 1 and 4.

Figure 5-1: Road safety effect on fatal accidents – HCV scenarios

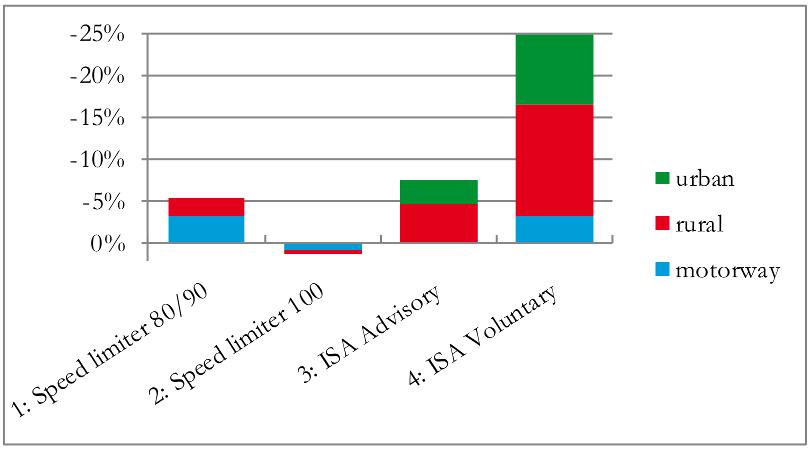


Figure 5-2 shows the road safety effect on severe injury accidents for the four HCV scenarios, also relative to the number of accidents on all roads. The difference between scenario 1 and 3 is smaller than for fatalities.

Figure 5-2: Road safety effect on severe injury accidents – HCV scenarios

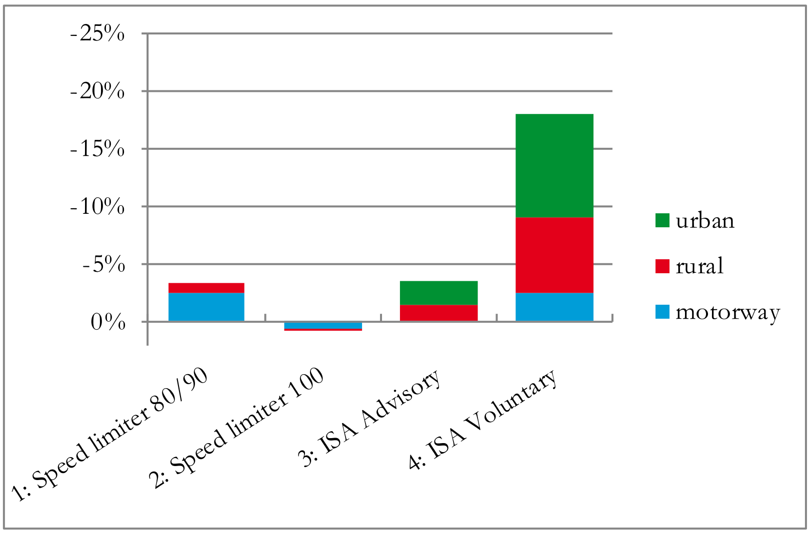
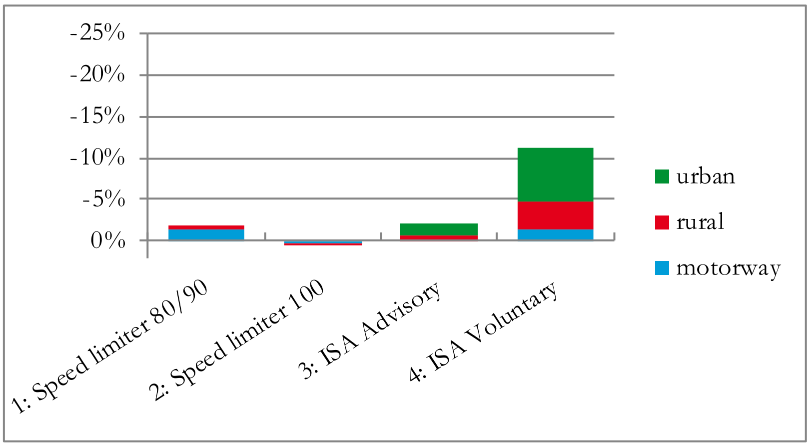


Figure 5-3 shows the road safety effect on all injury accidents for the HCV scenarios, relative to the accidents on all roads. The effect of a reduced maximum speed for the speed limiters of HCVs, as in scenario 1, has an overall effect which is of the same order of magnitude as ISA Advisory, but still much smaller than the Voluntary ISA. Effects are however obtained on different types of roads.

Figure 5-3: Road safety effect on all injury accidents – HCV scenarios



5.4.3 Safety impacts of changes in speed dispersion

A further decrease of the speed limiters has a positive effect on road safety, according to the calculations with the Nilsson formulas. However, a further decrease in maximum speed for HGVs and buses would also mean that the speed differences between heavy vehicles and other vehicles (cars and LCVs) become larger. This also has an effect on road safety.

The relationship between road safety and speed dispersion was also researched in this project. Several studies have argued that high speed dispersion on the road leads to an increased number of accidents. This effect has been quantified by Taylor (2000) and Kloeden (2001). Because there are many limitations to applying these formulas, the quantitative results are not presented. Only the effects for the first two scenarios were calculated as the effects for the ISA scenarios are based on literature. The results are presented in Table 5-9. A positive sign corresponds to an improvement of the road safety (on top of, or contrary to the impacts from reductions in average speeds that were estimated in the previous two sections).

Table 5-9: Effect of the change in speed dispersion in HCV scenarios 1 and 2

		Scenario	
Road		HCV1 Speed limiter for HGVs to 80 km/h and for buses to 90 km/h	HCV2 No change in speed limiter for buses and speed limiter for HGVs to 100 km/h
motorway	Taylor	--	+
	Kloeden	--	++
rural	Taylor	+	+/-
	Kloeden	+/-	+/-

Both the calculations for Taylor and those for Kloeden show that a further decrease of the speeds of HCVs has a negative impact on road safety for motorways. According to the study of SWOV (1991) this negative effect might be just as large as the positive effect on road safety of lower average speeds. In scenario 2 the speed limiter for HGVs and buses is homogenised, both are at 100 km/h. This has a positive effect on road safety, because speed differences between vehicles become smaller.

For rural roads, only the HCVs that drive much faster than the average speed on the road reduce their speeds due to the speed limiters. Therefore speed differences will decrease when the speed limiter is applied. Because the decrease in speed is only small and applies to a small share of the vehicles, this effect is small. An increase of the maximum speed for HCVs hardly leads to an increase of speed differences.

5.4.4 Conclusion on safety impacts

The calculations with the simulation model show that a further decrease in the maximum speed for the speed limiter will reduce the average speeds of HCVs by 6% to 9%. This leads to a significant effect on road safety, which was quantified using the power functions of Nilsson (1982) and Elvik (2009). For the ISA scenarios a rough estimation based on literature was given, to be compared to the results of the calculations. This showed that ISA systems especially have a larger effect on rural and urban roads. Scenario 4 combines the speed limiter for HCVs with a voluntary ISA and has the largest effect. The speed limiters have a dominant effect on motorways and reduce the number of fatal accidents by about 25%. The voluntary ISA would lead to about the same reduction on rural and urban roads. The effect of the change in speed dispersion is opposite to that of the reduced average speed in scenario 1 on motorways, and will certainly reduce the effect of the speed limiter. For scenario 2 this is the other way around.

Overall, scenario 4 with a voluntary ISA on top of the existing speed limiters for all HCVs shows the highest improvement in traffic safety, with a 25% reduction in fatal accidents with HCVs involved. This corresponds to a reduction of about 150 fatal accidents annually.

5.5 Impacts on emissions

5.5.1 Emission impacts at Member State level

Also for emissions the effects were estimated for the different scenarios for all Member States. At Member State level, here we present the results for an 'average' Member State with low and high posted speed limits, based on the speed limits per Member State. In the next section, these numbers are applied per Member State to estimate the impacts on emissions at EU level.

Table 5-10 and Table 5-11 show the effect of the different scenarios for HGVs on CO_2, NO_x and PM emissions for Member States with low and high posted speed limits. The tables show the change in average speed[96] and the change in level of emissions for the four scenarios that were defined, for motorways and rural roads. Impacts on urban roads are expected to be negligible.

[96] The changes in speed shown here refer to changes in the average speed of the speed profile of an average vehicle. These can be different from the changes in average speeds shown in the section on the safety impacts, because the latter refer to changes in the average speed of the speed distribution (of all vehicles).

Table 5-10: Effect of different scenarios for HGVs on CO_2, NO_x and PM emissions for Member States with low posted speed limits

		Scenario			
Road		HCV1 Speed limiter for HGVs to 80 km/h and for buses to 90 km/h	HCV2 No change in speed limiter for buses and speed limiter for HGVs to 100 km/h	HCV3 No change in speed limiter and advisory ISA for all HCVs	HCV4 Speed limiters as in HCV1 and voluntary ISA for all HCVs
motorway	Average speed	-6%	+0%	0%	-6%
	CO2	-9%	+0%	0%	-9%
	NOx	-7%	-0%	0%	-7%
	PM	-9%	+0%	0%	-9%
rural	Average speed	-4%	0%	0%	-4%
	CO2	-6%	0%	0%	-6%
	NOx	-4%	0%	0%	-4%
	PM	-6%	0%	0%	-6%

Table 5-11: Effect of different scenarios for HGVs on CO_2, NO_x and PM emissions for Member States with high posted speed limits

		Scenario			
Road		HCV1 Speed limiter for HGVs to 80 km/h and for buses to 90 km/h	HCV2 No change in speed limiter for buses and speed limiter for HGVs to 100 km/h	HCV3 No change in speed limiter and advisory ISA for all HCVs	HCV4 Speed limiters as in HCV1 and voluntary ISA for all HCVs
motorway	Average speed	-10%	+1%	0%	-10%
	CO2	-12%	+1%	0%	-12%
	NOx	-10%	+0%	0%	-10%
	PM	-12%	+1%	0%	-12%
rural	Average speed	-8%	+6%	0%	-8%
	CO2	-10%	+6%	0%	-10%
	NOx	-8%	+2%	0%	-8%
	PM	-10%	+6%	0%	-10%

In case the speed limiter speed of the currently implemented speed limiters are to be decreased by 10 km/h to 80 km/h for HGVs and 90 km/h for buses (scenario 1), emissions are expected to decrease even further, since emissions of the HGVs and buses are lowest in the range of 50 – 80 km/h.

In scenario 2 the emissions are hardly affected. This is the result of the maximum velocity without a speed limiter is not or only slightly higher than the maximum velocity with a speed limiter, as was concluded in the ex-post evaluation. In other words, the velocity is hardly affected by the speed limiter. Only on motorways, emissions slightly increase as a result of a higher speed limitation.

As stated in section 2.5.3, ISA can have a positive effect on vehicle emissions. The biggest effect is achieved in case of a mandatory system while driving on motorways, but this is not included in the scenarios. Advisory ISA has no effect on emissions. The effect of ISA on rural roads is close to zero. For scenario 4 the additional effect of ISA is assumed to be very small for these vehicles, due to the dominant speed limiter effect.

The same approach is followed for buses. Table 5-12 and Table 5-13 show the effect of different scenarios for buses on CO_2, NO_x and PM emissions for Member States with low and high posted speed limits.

Table 5-12: Effect of different scenarios for buses on CO_2, NO_x and PM emissions for Member States with low posted speed limits

		Scenario			
Road		HCV1 Speed limiter for HGVs to 80 km/h and for buses to 90 km/h	HCV2 No change in speed limiter for buses and speed limiter for HGVs to 100 km/h	HCV3 No change in speed limiter and advisory ISA for all HCVs	HCV4 Speed limiters as in HCV1 and voluntary ISA for all HCVs
motorway	Average speed	-5%	0%	0%	-5%
	CO2	-3%	0%	0%	-3%
	NOx	-2%	0%	0%	-2%
	PM	-3%	0%	0%	-3%
rural	Average speed	0%	0%	0%	0%
	CO2	0%	0%	0%	0%
	NOx	0%	0%	0%	0%
	PM	0%	0%	0%	0%

Table 5-13: Effect of different scenarios for buses on CO_2, NO_x and PM emissions for Member States with high posted speed limits

		Scenario			
Road		HCV1 Speed limiter for HGVs to 80 km/h and for buses to 90 km/h	HCV2 No change in speed limiter for buses and speed limiter for HGVs to 100 km/h	HCV3 No change in speed limiter and advisory ISA for all HCVs	HCV4 Speed limiters as in HCV1 and voluntary ISA for all HCVs
Motorway	Average speed	-9%	0%	0%	-9%
	CO2	-7%	0%	0%	-7%
	NOx	-5%	0%	0%	-5%
	PM	-7%	0%	0%	-7%
Rural	Average speed	-5%	0%	0%	-5%
	CO2	-4%	0%	0%	-4%
	NOx	-3%	0%	0%	-3%
	PM	-4%	0%	0%	-4%

For buses the effects in scenarios 1 and 4 are comparable with the effects for HGVs, only relatively smaller. In scenario 2 the effects for buses are null.

Speed profiles on rural roads, typically differ from those on highways in two ways, i.e.

- More dynamics; more acceleration and deceleration e.g. due to crossings and fewer lanes. High dynamics generally result in higher emissions (in case of all other things being equal).
- Lower average velocities, due to typically lower posted speed limits. All other things being equal, the lower average velocity results in lower emissions (as long as it does decrease below approximately 70 km/h).

As can be seen in Table 5-10, Table 5-11, Table 5-12 and Table 5-13, the emission reduction resulting from lowering maximum speed limiter velocities are generally lower on rural roads than on motorways. This is because speed limiters are assumed only to have effect on rural road vehicle velocities (average velocity and driving dynamics) if the posted speed limit is relatively high while the maximum velocity due to the speed limiter is set relatively low.

5.5.2 Emission impacts at EU level

The emissions at Member State level were aggregated at EU level (see Table 5-14).

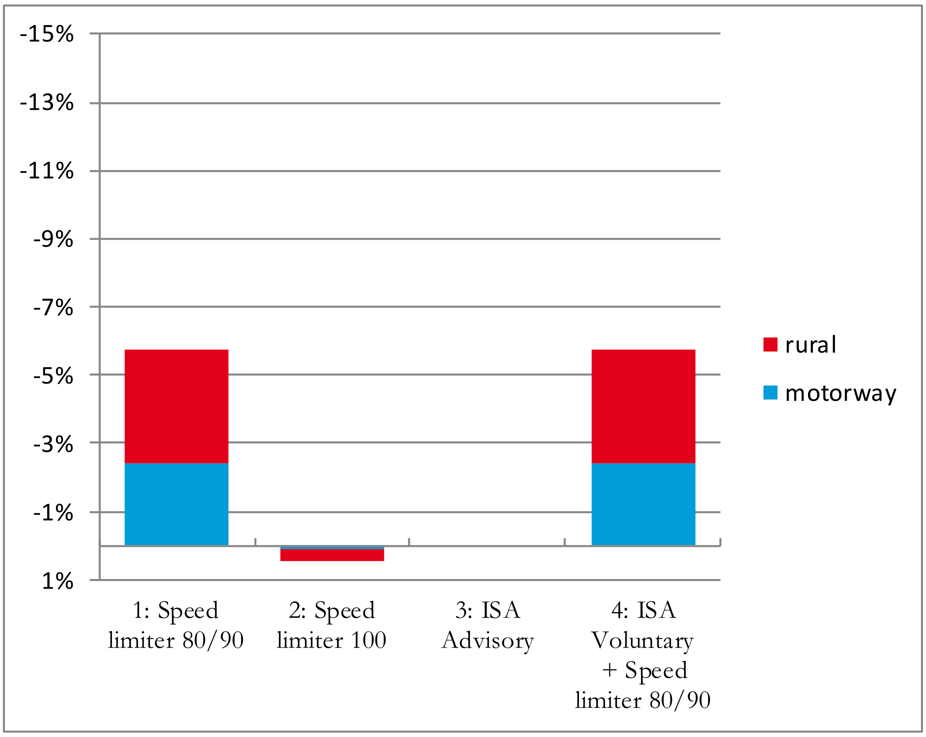
Table 5-14: Ex-ante emission reduction by HGVs and buses on motorways and rural roads in EU27 (year: 2010)

			Scenario			
		Emissions (tonnes)	HCV1 Speed limiter for HGVs to 80 km/h and for buses to 90 km/h	HCV2 No change in speed limiter for buses and speed limiter for HGVs to 100 km/h	HCV3 No change in speed limiter and advisory ISA for all HCVs	HCV4 Speed limiters as in HCV1 and voluntary ISA for all HCVs
motorway	CO2	40,723,981	-3,666,281 (-9%)	+126,592 (+0%)	0 (0%)	-3,666,281 (-9%)
	NOx	306,003	-22,288 (-7%)	+294 (+0%)	0 (0%)	-22,288 (-7%)
	PM	5,877	-529 (-9%)	+19 (+0%)	0 (0%)	-529 (-9%)
rural	CO2	111,218,953	-5,062,249 (-5%)	+558,221 (+1%)	0 (0%)	-5,062,249 (-5%)
	NOx	923,736	-30,852 (-3%)	+1,791 (+0%)	0 (0%)	-30,852 (-3%)
	PM	18,227	-854 (-5%)	+109 (+1%)	0 (0%)	-854 (-5%)
all non-urban roads	CO2	151,942,934	-8,728,529 (-6%)	+684,813 (+0%)	0 (0%)	-8,728,529 (-6%)
	NOx	1,229,739	-53,140 (-4%)	+2,086 (+0%)	0 (0%)	-53,140 (-4%)
	PM	24,104	-1,383 (-6%)	+128 (+1%)	0 (0%)	-1,383 (-6%)

Given the emission reductions as shown at Member State level, the overall emission reductions of CO_2, NO_x and PM are approximately 4% to 6% of the emissions by HCVs on motorways and rural roads in the EU27 in scenario 1 and close to 0% in scenario 2.

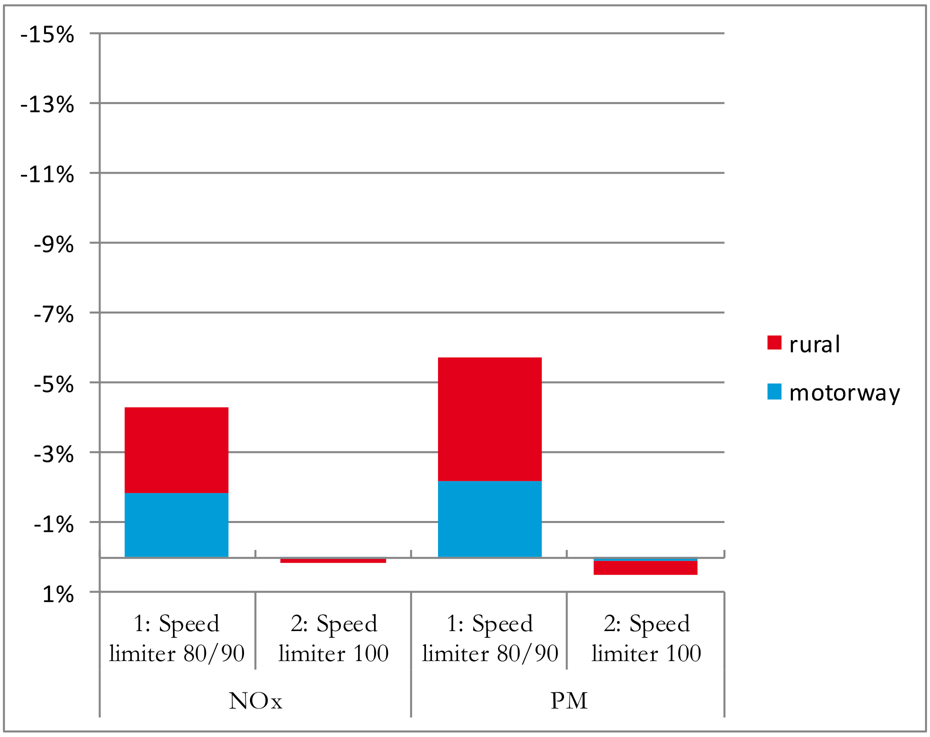
Figure 5-4 shows that the CO_2 emission reductions on rural roads are slightly higher, when expressed in terms of reduction of the total emissions. The effects in scenario 4 are exactly the same as in scenario 1, as the effect of speed limiters is much higher than the ISA effects. The effect of increasing the speed limiter speed is very small.

Figure 5-4: Emission effects for CO2 emissions – HCV scenarios



The emission effects for NO_x and PM at EU level are also higher for rural roads, as can be seen in Figure 5-5. The effects in scenario 2 are very small, especially for NO_x.

Figure 5-5: Emission effects for NO_x and PM emissions – HCV scenarios 1 and 2



5.6 Market impacts

Market impacts of a possible speed limits reduction or increase for HGVs emerge from the feedbacks provided by governmental contacts and stakeholders in the survey as well as from the direct interviews with road transport operators. Main considerations are reported below with respect to the two different scenarios and referring to:

- shifts between vehicle categories, in particular from HCVs to LCVs;
- transport operating costs;
- vehicle design;
- compliance costs, administrative costs, enforcement and fraud;
- level playing field and transport demand.

5.6.1 Scenario 1: speed decrease for HCVs

Scenario 1, which foresees speed limits reduction for both N2/N3 vehicles (from 90 km/h to 80 km/h) and M2/M3 vehicles (from 100 km/h to 90 km/h), is the scenario that encountered less favour among the survey respondents. As reported in section 3.7, the large majority of both Member States government representatives and stakeholders opposed the suggestion to further decrease speed limits for HCVs.

Shifts between vehicle categories

A major market impact that can be considered for Scenario 1 is the further differentiation of speed among LGVs and HGVs that may be a likely reason in road freight transport for a shift toward less restricted vehicles (i.e. from N2 to N1) also taking into account the current market tendency towards higher fragmentation of flows due to logistical reasons (e.g. less stocks and just in time) or to lower cargo loads mainly dependent on the economic downturn.

Transport operating costs

It is important to underline that the current economic crisis is also imposing to the operators a general reorganization of the logistic chain (for freight transport) or the service network (for commercial passenger transport) with a reduction in the number of logistics platforms, depots, interchange nodes and stops, and a consequent extension of the served area per vehicle. A further speed reduction may have therefore effects not only on vehicle's routing and schedule (for increased travel times) and on the number of vehicles needed, but also on the physical nodes.

According to some interviews with both road passenger and freight operators, a further reduction of speed limits for HGV might have a negative impact on safety, since drivers would be more exposed to fatigue and risk of sleepiness especially during long trips on motorways. Conversely, Bundesverband Güterverkehr Logistik und Entsorgung (BGL) states that such measure is already applied by a few companies and it has a positive influence due to less stress for drivers.

Vehicle design

The impact on vehicle design in terms of downsizing of engines' power for HCV M2/M3 and N2/N3 categories in Scenario 1 would not be so relevant for the same reasons already mentioned in section 4.5.4, i.e. it is only one of the various factors that influence the technology development of commercial vehicles.

Compliance costs, administrative costs, enforcement and fraud

No significant impacts are foreseen with reference to compliance and administrative costs as well as enforcement for Scenario 1.

Level playing field and transport demand

The differentiation of allowed speeds of HGVs and LGVs characterising Scenario 1 might have an impact in terms of distorted competition among road transport operators, as it would further penalise HGVs in favour of LGVs. (see also 3.4.5), though HGV and LGV are used in different market sectors. On the other hand, the potential impact of the Scenario measures on the overall transport demand and modal split is difficult to assess and quantify. Given the complexity of road freight transport sector, the extent of such an impact would depend on many different factors, such as the availability of alternatives, the specific characteristics and the length of the route, the logistic chain involved, etc.

5.6.2 Scenario 2: speed increase for HGVs only

Road passenger and freight operators opinions in relation to Scenario 2 (speed increase to 100 km/h for N2/N3 vehicles only) are in line with what already expressed by stakeholders and Member States government representatives, i.e. only a small minority would be in favour.

Some operators are in favour of a moderate increase of vehicle's speed (e.g. +5/10 km/h), but only under specific conditions, such as on three carriages motorways. Despite most respondents made reference to a general increase of safety conditions, due to technology innovations on the vehicle itself, the majority suggests to keep the current limits unchanged.

Shifts between vehicle categories

The reduction of speed difference among LGVs and HGVs envisaged in Scenario 2 is generally considered not to be enough relevant to induce different choices in terms of vehicles fleet. As already illustrated in section 3.4.5, there is a variety of reasons that might explain the different development of the HGV and LGV fleets in Europe that goes from differences in the EC regulation measures (considered to be largely in favour of LGV) to logistic trends toward cargos fragmentation.

Transport operating costs

The increase of the allowed speed might have a positive effect (not quantifiable) in terms of reduction of operating costs.

Vehicle design

As for Scenario 1, the impact on vehicle design in terms of downsizing of engines' power for HCV M2/M3 and N2/N3 categories would not be relevant.

Compliance costs, administrative costs, enforcement and fraud

No significant impacts are foreseen with reference to compliance and administrative costs as well as enforcement also for this Scenario.

Level playing field and transport demand

The impacts in terms of transport demand and competition distortion are not considered as substantial for this Scenario. In terms of competition distortion among HGVs and LGVs, the impact of this Scenario would be slightly positive, as it would reduce the speed gap between the two types of vehicles (although this is obtained by rising GHHGV speed rather that reducing LGVs one, as supported by the majority of the questionnaire respondents).

5.6.3 Scenario 3 and 4: ISA scenario

No specific market impacts are considered for Scenario 3, where speed limits are not changed and the ISA systems considered are only of "informative" nature.

For Scenario 4, with lower speed limits (80 km/h for N2/N3 and to 90 km/h for M2/M3) and "voluntary" driver feedback system, market impacts are similar to those of scenario 1, except for the case of impacts on vehicles' design. In this case, according to the vehicles' usage, the presence of the ISA systems, which are especially effective on rural and urban roads, might be an incentive for "rightsizing" of engines' power.

As already illustrated in section 3.6.3, the large majority of stakeholders and nearly the 1/3 of governmental contacts agree on the introduction of ISA system should be introduced to all commercial vehicles and most believe that "informative" or "voluntary" ISA systems should be more suitable than "mandatory" ones. Justifications for the introduction of "informative" ISA regard the fact these are more reliable to be implemented shortly and less expensive with respect to more stringent type of ISA systems. On the contrary stringent ISA systems are justified by the relevant benefits regarding road safety and commercial competition.

5.7 Main findings

Within this ex-ante evaluation the effects on road safety, emissions and the market have been evaluated for four scenarios. In the first scenario the speed set by the speed limiter was decreased for all HCVs: to 80 km/h for HGVs and 90 km/h for buses. In the second scenario, on the other hand, the speed set was increased to 100 km/h for HGVs. The speed set for buses remains the same at 100 km/h. The last two scenarios include an ISA system on top of the speed limiter device. In the third scenario the speed set by the limiter remain as today and the system is complemented with an advisory/informative ISA system. In the fourth scenarios the speed set by the limiter are decreased to 80 km/h and 90 km/h respectively and coupled with a voluntary ISA system.

Overall the effect on road safety was largest for the fourth scenario in which a decrease in speed limits was combined with a voluntary ISA system. In this scenario the number of fatal accidents decreases with 25%, corresponding to about 150 fatal accidents a year. In this scenario, the number of seriously injured decreases with 18% and overall there is a decrease of 11% in total accidents with HCVs involved. In this scenario we see a reduction in accidents for all road types - motorways, rural and urban - as ISA has an influence for all possible speed limits. Also in the third scenario the ISA dominates the road safety effects and leads to a decrease with 8% in fatal accidents, 3% in injuries and an overall reduction in accidents with 2%.

Decreasing the speed limit (scenario 1) leads to a decrease in fatal accidents of 5%, in injuries of 3% and in all accidents of 2%. This effect is slightly smaller than the one of scenario 3 in which the speed limits remain the same, but ISA is added. One of the reasons behind this is that ISA also influences road safety on urban roads, while reducing the speed limiter does not.

Scenario 2 leads to a small increase in fatal accidents (+1%) and serious injuries (+1%). Overall the number of accidents remains more or less stable. The effect for motorways is almost the reverse of that in the ex-post evaluation, a 7% increase of fatal accidents compared to a 9% decrease in the ex-post. In general, the effects are larger for HGVs than for buses and also larger for countries where the speed limit is higher than the speed set by the limiter.

Decreasing the speed limit (scenario 1) also leads to a further decrease in emissions as emissions of HGVs and buses are lowest in the range of 50 – 80 km/h. In scenario 2 the emissions are hardly affected. Only on motorways, emissions slightly increase as a result of a higher speed limitation. For ISA the biggest effect can be achieved in case of a mandatory system while driving on motorways, but this is not included in the scenarios. Advisory ISA has no effect on emissions.

The effect of ISA systems on emissions on rural roads is close to zero. Scenario 3 brings no reduction of emissions. For scenario 4 the additional effect of ISA is assumed to be very small for these vehicles, due to the dominant speed limiter effect. For buses the effects in scenario 1 are comparable with the HGV effects, only relatively smaller. In scenario 2 the effects for buses are 0%.

The overall emission reductions for the EU27 of CO_2, NO_x and PM are approximately 4% to 6% of the emissions by HCVs on motorways and rural roads in the EU27 in scenario 1 (corresponding to a reduction of about 9 Mtonnes of CO_2) and 0% in scenario 2 and 3. The results for scenario 4 are the same as in scenario 1.

With respect to the market impacts, the effects are not clear. On the one hand there is anecdotal evidence of companies driving at lower speeds than the speed limiter today. On the other hand, the majority of the interviewees was against a reduction of speeds. Increasing the speed limit does not get much support either. Overall, for scenario 1 it could be expected that further decreasing the speed could lead to a shift towards the less restricted LCV. Stakeholders also mentioned possible negative safety effects due to the longer driving times. Increasing the speed limiters speed would probably have no effect on shifts between vehicle types but could possibly lead to a positive effect with respect to the operating costs. No specific market impacts are considered for Scenario 3. For Scenario 4, market impacts are similar to those of scenario 1.

6 Ex-ante evaluation for LCVs

6.1 Introduction

This chapter discusses the results of the evaluation of various options for amending the current Speed Limitation Directive by extending the scope to LCVs. This includes both scenarios with regular speed limiters for LCVs and scenarios in which the Intelligent Speed Adaptation/Assistance (ISA) systems become mandatory.

This chapter is structured in a similar way as chapter 5. However, before presenting the scenarios and the results of the evaluation, a discussion on including M1 vehicles is included first, in section 6.2. Next, the scenario description is given in section 6.3. Then the results of the ex-ante evaluation are presented: in section 6.4 the impacts on speed, in section 6.5 on traffic safety, in section 6.6 on emissions and in section 6.7 the market impacts. Section 6.8 provides a synthesis of the evaluation. The various impacts have been quantified by applying the methodology described in chapter 2.

6.2 Inclusion of M1 vehicles

In the ex-ante analysis of scenarios for LCVs, preferably also scenarios in which commercially used M1 vehicles (mini buses) are subject to the obligation would be included. However, insufficient data is available with respect to vehicle-kilometres and safety data to distinguish commercially used M1 vehicles from other M1 vehicles. Both accident rates and vehicle-kilometres are available for all M1 vehicles together, but not differentiated to commercially used M1 vehicles and other M1 vehicles. Also, no other differentiations of accident and transport-volume data to relevant subcategories of M1-vehicles are available (such as M1 vehicles with no more than seven seats and with more than seven seats, including driver). Therefore, the scenarios defined and evaluated are limited to N1 vehicles.

In case the current Directive would be amended in such a way that also LCVs are covered, ways for including certain types of M1 vehicles could be considered. This may be necessary in order to avoid unintended shifts between N1 and M1 vehicles that could occur when only N1 would be included in the legislation. At the other, it is expected to be difficult to legally distinguish commercially used M1 vehicles from other M1 vehicles.

Several policy options for including some M1 vehicles could be considered, such as:

- Limiting the obligation on N1 vehicles to vehicles with a vehicle mass above for example 2000 or 3500 kilogrammes.
- Limiting the obligation to commercially used M1-vehciles with vehicles with 8 or 9 seats.
- Combinations of those.

This type of options could not be evaluated quantitatively and further analysis of the various options for distinguishing subcategories of LCVs are recommended as subject for further study.

6.3 Scenario definition

Four scenarios that describe different possible applications of speed limiters or ISA systems for N1-vehicles are evaluated. The first two scenarios focus on the installation of a speed limiter in N1-vehicles, while in the last two scenarios we introduce two different ISA systems.

6.3.1 Speed limiter scenarios

The following two speed limiter scenarios for LCVs are evaluated:

- Scenario 1 (LCV1): A speed limiter for all N1-vehicles set at 110 km/h.
- Scenario 2 (LCV2): A speed limiter for all N1-vehicles set at 100 km/h.

The reasoning behind these scenarios is as follows. A speed limit of 110 km/h seems feasible and realistic. A set speed limit of 120 km/h was considered to have too small effects and therefore not useful to assess. Also a speed limit of 100 km/h seems feasible and realistic and is considerably lower than the limit in Scenario 1. A lower limit, for example of 90 km/h or lower, would result in relatively high differences in speed between N1 and M1 vehicles and is not deemed realistic.

6.3.2 ISA scenarios

The argumentation for the type of ISA systems that are evaluated for LCVs is the same as for HCVs and was described in section 5.2.2. The two ISA scenarios for LCVs that are evaluated are as follows:

- Scenario 3 (LCV3): All N1-vehicles are equipped with an “Advisory/informing” or “warning” driver feedback with variable posted speed limit information.
- Scenario 4 (LCV4): All N1-vehicles are equipped with a “Voluntary” driver feedback with fixed posted speed limit information.

The argumentation for the type of ISA systems that are evaluated for LCVs is the same as for HCVs. Furthermore it should be noted that there is currently no mandatory application of speed limiters for LCVs. Scenarios with both speed limiters and ISA systems would therefore take two steps at once. The proposed scenarios with only ISA systems or speed limiters make it possible to compare the impacts of speed limiters with the impacts of ISA systems, as was also requested in the terms of reference for this study.

Scenario 3 would leave maximum freedom to drivers and is technically feasible. The driver is informed or warned on the speed limits through visual or auditory means when the driven speed exceeds the posted speed limit. The ISA system takes no invasive actions. In addition to the fixed speed limits, the recommended driving speed depends on the road type, traffic and weather conditions.

In scenario 4, the voluntary ISA system can be expected to have a much higher impact than scenario 3, based on the literature review and can still be regarded as a feasible scenario. The driving speed depends only on the posted speed limit for that road and the driver is presented with tactile feedback through the accelerator pedal when exceeding the speed limit. The driver experiences a higher pressure required on the operation of the accelerator pedal to increase driving speed.

6.3.3 Overview of all four scenarios

We can summarize the four scenarios for LCVs as follows.

Table 6-1: Summary of the scenarios for the ex-ante analysis for LCVs

	Speed limiter LCVs (type N1)	**ISA system**
Reference	no	no
LCV1	110 km/h	no
LCV2	100 km/h	no
LCV3	no	Advisory/open – variable speed limit information
LCV4	no	Half-open – fixed speed limit information

In all four scenarios for LCVs, the posted speed limits for all vehicle categories are not changed and also the speed set in the speed limiters of HCVs remains the same. The current speed limit for N1-vehicles in many countries is the same as for cars, between 110 km/h and 130 km/h (or no limit as on most of the motorways in Germany), so the effects of these scenarios will differ per country.

6.4 Impacts on speeds

Within this section the focus lies on the first and the second scenario as in these scenario a speed limiter is introduced. Table 6-2 shows the average speed and the standard deviation for the reference case (no speed limiter), scenario 1 (speed limiter at 110 km/h) and scenario 2 (speed limiter at 100 km/h). The impact on the speed on rural roads is included, as on some rural roads the speeds are equal or around 100 and 110 km/h, so speed limiters can have significant impacts there as well. High and low refer the member states with high or low posted speed limit; for more details see section 2.6.7.

The speed impacts for scenario 3 and 4 have not been quantified, as the impacts on safety and emissions will follow directly from the literature on ISA.

Table 6-2: Average speed and standard deviation for LCVs under different scenarios, motorways

				Before (without sped limiter)		*After*			
Member State type	Road type	Scenario	Posted speed limit	Average speed	Speed deviation	Speed limiter	Average speed	Speed deviation	Change in average speed
Low	Motorway	LCV 1	115	107	16	110	102	10	-5%
Low	Motorway	LCV 2	115	107	16	100	96	7	-10%
High	Motorway	LCV 1	130	115	16	110	106	7	-8%
High	Motorway	LCV 2	130	115	16	100	98	4	-15%
Low	Rural roads	LCV 1	90	80	14	110	80	14	0%
Low	Rural roads	LCV 2	90	80	14	100	79	13	-1%
High	Rural roads	LCV 1	100	90	14	110	89	13	-1%
High	Rural roads	LCV 2	100	90	14	100	88	11	-2%

6.5 Impacts on safety

This section presents the results of the ex-ante evaluation of impacts on road safety for LCVs.

6.5.1 Safety impacts at Member State level

The effect of the introduction of the speed limiter for LCVs varies per Member States like it did for HCVs, because some Member States have higher posted speed limits. For Member States with high posted speed limits the effect of the speed limiter and the reduction in average speed (and therefore of accidents) are higher. Table 6-3 and Table 6-4 show the results of the model in Member States with low and high posted speed limits[97].

Table 6-3: Impacts of different scenarios for LCVs on accident rates for Member States with low maximum speeds (based on Elvik, 2009)

		Scenario			
Road		LCV1 Speed limiter for LCVs at 110 km/h	LCV2 Speed limiter for LCVs at 100 km/h	LCV3 Advisory ISA for all LCVs	LCV4 Voluntary ISA for all LCVs
motorway	Average speed	-5%	-10%		
	Fatal accidents	-12%	-23%	-9%	-25%
	Serious injury accidents	-8%	-16%	-4%	-19%
	All injury accidents	-5%	-10%	-2%	-11%
rural	Average speed	-0%	-1%		
	Fatal accidents	-0%	-2%	-9%	-25%
	Serious injury accidents	-0%	-1%	-4%	-19%
	All injury accidents	-0%	-1%	-2%	-11%
urban	Average speed	0%	0%		
	Fatal accidents	0%	0%	-9%	-25%
	Serious injury accidents	0%	0%	-4%	-19%
	All injury accidents	0%	0%	-2%	-11%

97 The low posted speed limit is 115 km/h for LCVs on motorways. The high posted speed limit is 130 km/h for LCVs on motorways. For rural roads the low and high posted speed limits are 90 km/h and 100 km/h.

Table 6-4: *Impacts of different scenarios for LCVs on accident rates for Member States with high maximum speeds (based on Elvik, 2009)*

		Scenario			
Road		LCV1 Speed limiter for LCVs at 110 km/h	LCV2 Speed limiter for LCVs at 100 km/h	LCV3 Advisory ISA for all LCVs	LCV4 Voluntary ISA for all LCVs
motorway	Average speed	-8%	-15%		
	Fatal accidents	-19%	-30%	-9%	-25%
	Serious injury accidents	-13%	-22%	-4%	-19%
	All injury accidents	-8%	-15%	-2%	-11%
rural	Average speed	-1%	-2%		
	Fatal accidents	-1%	-6%	-9%	-25%
	Serious injury accidents	-1%	-4%	-4%	-19%
	All injury accidents	-1%	-2%	-2%	-11%
urban	Average speed	0%	0%		
	Fatal accidents	0%	0%	-9%	-25%
	Serious injury accidents	0%	0%	-4%	-19%
	All injury accidents	0%	0%	-2%	-11%

The decrease in average speed in the speed limiter scenarios is substantial. Between -5% and -8% in scenario 1, and between -10% and -15% in scenario 2. Therefore the effects on road safety are very large on motorways. This can be explained by the fact that on average LCVs drive faster than the maximum speed of the speed limiter (110 km/h and especially 100 km/h). Also, the speed deviation is high and therefore many LCVs drive much faster than the speed limiter.

On rural roads the effect is smaller, only for a speed limiter at 100 km/h on rural roads with high posted speed limits there is a small change in average speed and an effect on accidents.

The results for the ISA scenarios are comparable to those of the ex-ante evaluation for HCVs. Advisory ISA has a relative small effect on motorways, and a similar effect compared to scenario 2 for rural roads with a high maximum speed. Voluntary ISA has a significant effect on all road types, but smaller than the speed limiter on motorways.

6.5.2 Safety impacts at EU-level

The analysis was carried out for every Member State and the reduction percentages were applied to the accident data per Member State with LGVs involved. The aggregated results at the EU level are shown in Table 6-5, which shows the accident reduction rate for the four scenarios for LCVs, on motorways, rural roads and urban roads.

Table 6-5: Road safety effect for the LCV scenarios on the number of accidents at EU level

			Scenario			
Road type		Number of accidents	LCV1 Speed limiter for LCVs at 110 km/h	LCV2 Speed limiter for LCVs at 100 km/h	LCV3 Advisory ISA for all LCVs	LCV4 Voluntary ISA for all LCVs
motorway	Fatal accidents	249	-41 (-16%)	-69 (-28%)	-22 (-9%)	-62 (-25%)
	Serious injury accidents	1,211	-140 (-12%)	-245 (-20%)	-50 (-4%)	-225 (-19%)
	All injury accidents	7,041	-490 (-7%)	-900 (-13%)	-170 (-2%)	-805 (-11%)
rural	Fatal accidents	1,275	-15 (-1%)	-55 (-4%)	-111 (-9%)	-317 (-25%)
	Serious injury accidents	4,750	-44 (-1%)	-155 (-3%)	-197 (-4%)	-883 (-19%)
	All injury accidents	21,915	-149 (-1%)	-505 (-2%)	-530 (-2%)	-2,506 (-11%)
urban	Fatal accidents	813	0 (0%)	0 (0%)	-71 (-9%)	-202 (-25%)
	Serious injury accidents	6,339	0 (0%)	0 (0%)	-262 (-4%)	-1,179 (-19%)
	All injury accidents	45,333	0 (0%)	0 (0%)	-1,097 (-2%)	-5,183 (-11%)
all roads	Fatal accidents	2,337	-56 (-2%)	-124 (-5%)	-204 (-9%)	-582 (-25%)
	Serious injury accidents	12,300	-184 (-1%)	-400 (-3%)	-509 (-4%)	-2,287 (-19%)
	All injury accidents	74,289	-638 (-1%)	-1,405 (-2%)	-1,798 (-2%)	-8,494 (-11%)

The results show that the effect of the speed limiter in scenario 2 is more than double the effect in scenario 1. Because the number of accidents on rural and urban roads is much larger than on motorways, absolute the accident reduction is relatively large on those road types. ISA systems have a large overall effect.

Figure 6-1 shows the road safety effect on fatal accidents, expressed in a reduction of the total number of fatal accidents on all roads. The distinction between road types is clear, the ISA systems have a larger effect on rural and urban roads. The effect of the speed limiter of 100 km/h on motorways is very large. Due to the relatively high number of fatal accidents on rural and urban roads, the ISA scenarios have overall higher reduction rates than the speed limiter scenarios.

Figure 6-1: Road safety effect on fatal accidents – LCV scenarios

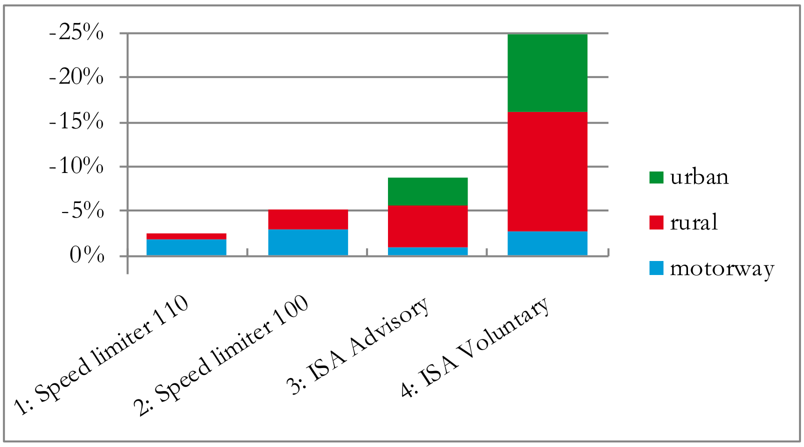


Figure 6-2 shows the road safety effect on serious injury accidents, expressed in a reduction of the total number of fatal accidents on all roads. The effect in scenario 2 is more than double the effect in scenario 1. The effect on rural roads is also notable.

Figure 6-2: Road safety effect on serious injury accidents – LCV scenarios

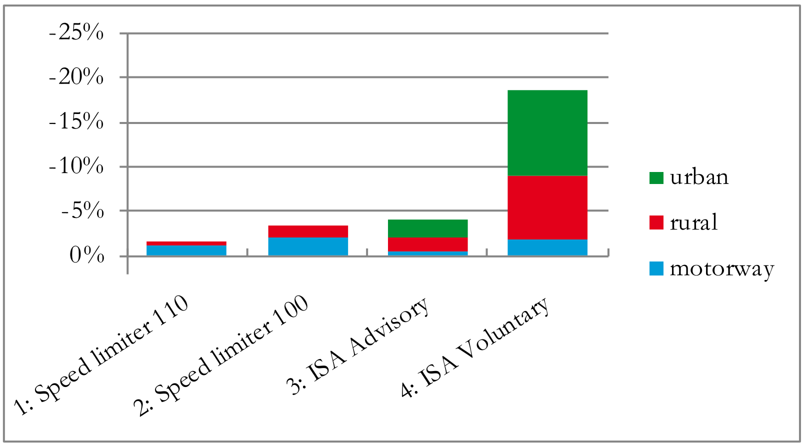
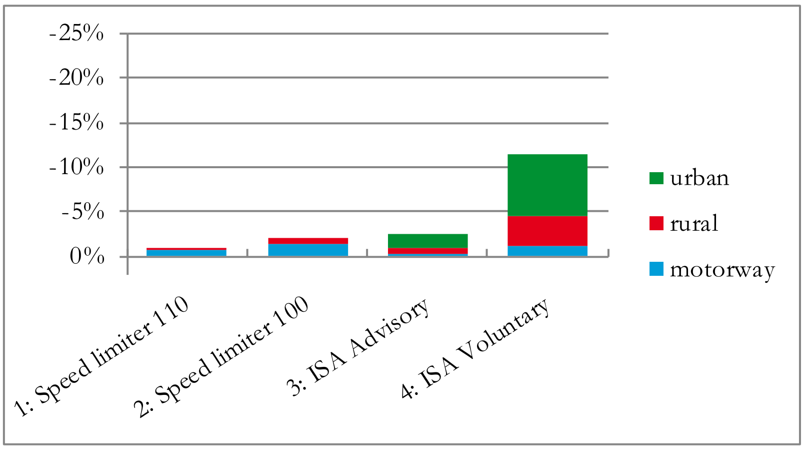


Figure 6-3 shows the road safety effect on all injury accidents, expressed in a reduction of the total number of fatal accidents on all roads. The effect of the ISA systems on the motorway is relatively small, compared to the speed limiters. The difference between the ISA systems stands out.

Figure 6-3: Road safety effect on all injury accidents – LCV scenarios



6.5.3 Safety impacts of changes in speed dispersion

For the ex-ante evaluation of the LCV scenarios also the effect of a change in speed dispersion was calculated, according to the studies of Taylor (2000) and Kloeden (2001). This was done only for scenario 1 and 2, because there was no simulation possible for the speed dispersions of the ISA scenarios. Table 6-6 shows the results. A positive sign corresponds to an additional improvement of the road safety (on top of the impacts from reductions in average speeds that were estimated in the previous two sections).

Table 6-6: Safety effect of the change in speed dispersion in HCV scenarios 1 and 2

Road		Scenario LCV1 Speed limiter for LCVs at 110 km/h	LCV2 Speed limiter for LCVs at 100 km/h
motorway	Taylor	++	+
	Kloeden	+/-	-
rural	Taylor	+	+
	Kloeden	+	+

The decrease of speeds for LCVs generally also has a positive effect on road safety according to the relationship between road safety and speed dispersion. However, for motorways the results are different. Taylor includes both average speed and speed deviation in his formula and this leads to a positive effect in scenario 1, as the average speed and speed deviation are reduced and the speed deviation. In scenario 2, the average speed is further reduced, but the speed deviation is larger compared to scenario 1, as the speed differences between cars and LCVs were increased. This becomes clear in the result of the calculation with the formula of Kloeden, which compares the speed of each individual vehicle with the average speed. In scenario 2 the passenger cars will drive faster compared to the reduced average speed and have a relative higher risk. This effect is dominant because of the high share of passenger cars. In this respect, the speed limiter has a negative effect. For rural roads the formulas of Taylor and Kloeden show similar results. A reduction in speed will reduce the overall speed differences on the road and has a positive effect on road safety according to the relationship between safety and speed dispersion.

6.5.4 Conclusion on safety impacts

The ex-ante evaluation on road safety of the LCV scenarios show a large reduction in average speed for the application of speed limiters. The accident reduction rate is very high on motorways. The number of fatal accidents is relatively low and therefore the overall effect on road safety is small. Compared with an estimation of the ISA effects, the accident reduction on motorways is much larger for the speed limiter scenarios. On rural and urban roads however the effects of ISA will be larger.

Overall, scenario 4 (with a voluntary ISA system) shows by far the largest improvements in traffic safety. The number of fatal accidents with N1-vehicles involved is expected to reduce by about 25%, corresponding to a reduction of about 600 fatal accidents annually.

6.6 Impacts on emissions

6.6.1 Emission impacts at Member State level

The emission impacts of the speed limiter scenarios were estimated using the VERSIT+ model of TNO and the emission impacts of the ISA scenarios based on literature. First the emission impacts are presented at Member State level, for an 'average' Member State with either low or high posted speed limits[98].

[98] The changes in speed shown here refer to changes in the average speed of the speed profile of an average vehicle. These can be different from the changes in average speeds shown in the section on the safety impacts, because the latter refer to changes in the average speed of the speed distribution (of all vehicles).

Table 6-7: Effect of different scenarios for LCVs on CO_2, NO_x and PM emissions for Member States with low posted speed limits

		Scenario			
Road		LCV1 Speed limiter for LCVs at 110 km/h	LCV2 Speed limiter for LCVs at 100 km/h	LCV3 Advisory ISA for all LCVs	LCV4 Voluntary ISA for all LCVs
motorway	Average speed	-2%	-8%		
	CO2	-3%	-9%	0%	-3%
	NOx	-15%	-33%	0%	-
	PM	-3%	-9%	0%	-
rural	Average speed	0%	-0%		
	CO2	0%	-0%	0%	0%
	NOx	0%	-2%	0%	-
	PM	0%	-0%	0%	-

Table 6-8: Effect of different scenarios for LCVs on CO_2, NO_x and PM emissions for Member States with high posted speed limits

		Scenario			
Road		LCV1 Speed limiter for LCVs at 110 km/h	LCV2 Speed limiter for LCVs at 100 km/h	LCV3 Advisory ISA for all LCVs	LCV4 Voluntary ISA for all LCVs
motorway	Average speed	-6%	-14%		
	CO2	-8%	-14%	0%	-3%
	NOx	-34%	-49%	0%	-
	PM	-8%	-14%	0%	-
rural	Average speed	-1%	-4%		
	CO2	-1%	-5%	0%	0%
	NOx	-6%	-21%	0%	-
	PM	-1%	-5%	0%	-

For scenario 1, where a speed limiter with a maximum speed of 110 km/h is introduced on LCVs, both the driving dynamics and average velocity are expected to decrease. As can be seen in Table 6-7, this results in lower emissions to up to approximately 34% in case of a posted speed limit of 130 km/h. The effects for NO_x are the largest and for CO_2 and PM about the same.

On rural roads with low posted speed limits the effect of the speed limiter are negligible as the speed limiter hardly affects the speed profile, i.e. the maximum speed without speed limiter would not are barely rise above 110 km/h. The effects for rural roads with high posted speed limits is also small, only for NO_x there is a reduction of 6%.

In scenario 2, an introduction of speed limiters on LCVs with a maximum velocity of 100 km/h, would result in an even higher emission reduction than with a maximum velocity of 110 km/h as can be seen in Table 6-7 and Table 6-8. On rural roads with low posted speed limits however, the speed limiter still hardly affects the speed and therefore emissions are also hardly decreased.

For the ISA scenarios the overall effect is very limited. As stated in section 2.5.3, ISA can have a positive effect on vehicle emissions. The biggest effect is achieved in case of a mandatory system while driving on motorways. In scenario 3 an advisory ISA system is introduced, but the effect on emissions can be assumed to be negligible for these vehicles. The voluntary ISA systems only has a noticeable effect on motorways of about 3.4% (see 2.5.3).

On rural roads, the maximum speed limiter velocity is higher than the posted speed limit. In theory, ISA could have an effect on the speed profiles of LCVs on rural roads. However, as explained in section 2.5.3, the effect of ISA on rural roads is very small. Therefore the overall marginal effect of ISA is assumed to be limited for LCVs.

6.6.2 *Emission impacts at EU level*

The emission reductions were applied to every Member State according to the posted speed limits per Member State. The result on EU level is presented in Table 6-9.

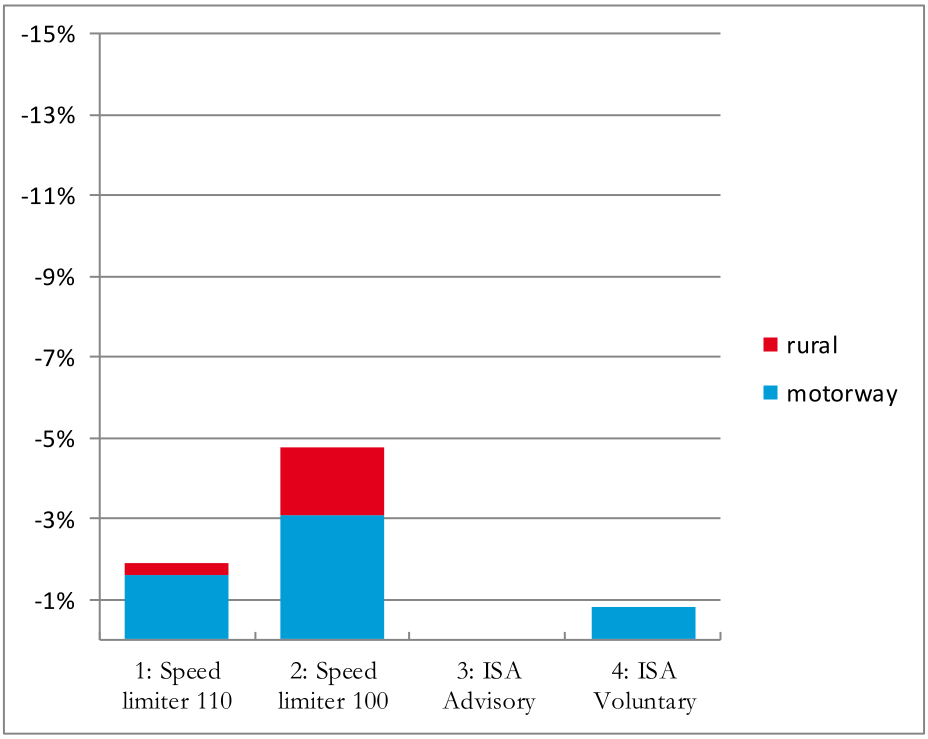
Table 6-9: Ex-ante emission reduction by LCVs on motorways and rural roads in EU27 (year: 2010)

		Scenario				
		Emissions (tonnes)	LCV1 Speed limiter for LCVs at 110 km/h	LCV2 Speed limiter for LCVs at 100 km/h	LCV3 Advisory ISA for all LCVs	LCV4 Voluntary ISA for all LCVs
motorway	CO2	8,282,120	-551,245 (-7%)	-1,072,876 (-13%)	0 (0%)	-281,592 (-3%)
	NOx	18,982	-4,819 (-25%)	-7,976 (-42%)	0 (0%)	-
	PM	1,494	-88 (-6%)	-180 (-12%)	0 (0%)	-
rural	CO2	26,685,603	-116,039 (-0%)	-599,756 (-2%)	0 (0%)	0 (0%)
	NOx	110,192	-2,405 (-2%)	-10,226 (-9%)	0 (0%)	-
	PM	7,173	-28 (-0%)	-145 (-2%)	0 (0%)	-
all non-urban roads	CO2	34,967,723	-667,283 (-2%)	-1,672,632 (-5%)	0 (0%)	-281,592 (-1%)
	NOx	129,174	-7,224 (-6%)	-18,202 (-14%)	0 (0%)	-
	PM	8,667	-115 (-1%)	-325 (-4%)	0 (0%)	-

The emission reductions for scenario 1 of CO_2, NO_x and PM are approximately between 1% to 6% of the emissions by LCVs on motorways and rural roads in the EU27 (Table 6-9). For scenario 2 the emission reductions of CO_2, NO_x and PM are higher, approximately between 4% to 14% of the emissions by LCVs on motorways and rural roads in the EU27.

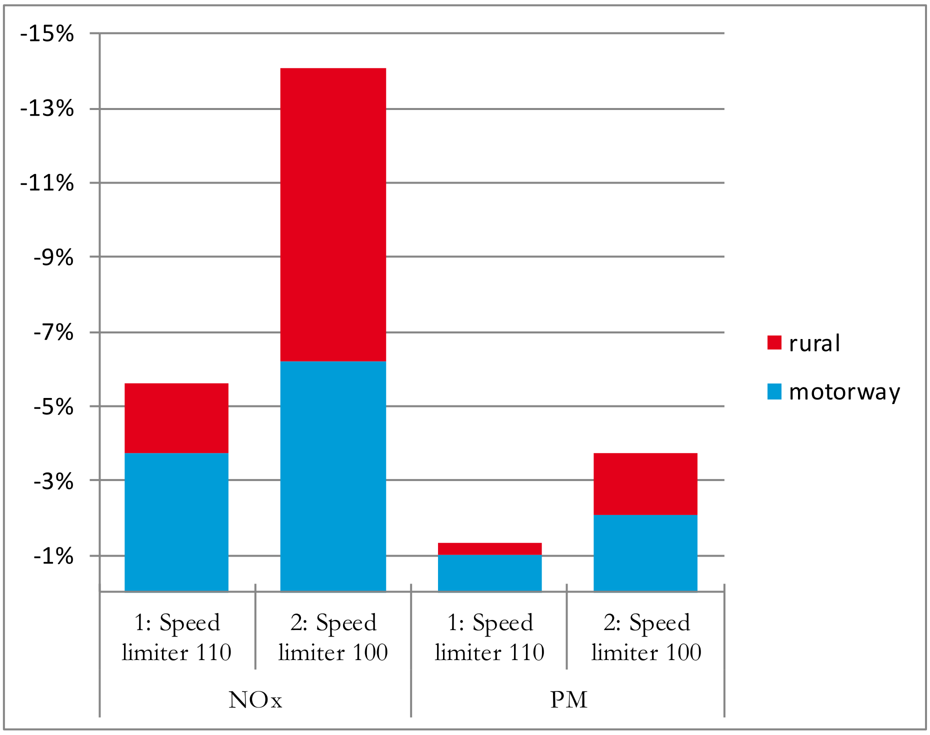
Figure 6-4 shows the emission effects for CO_2, expressed in the total emissions on all non-urban roads. It is clear that the effect in scenario 2 on CO_2 is much higher. The effect on motorways is higher than on rural roads.

Figure 6-4: CO_2 emission effects for different emissions – LCV scenarios



In Figure 6-5 it is clear that scenario 2 is much more effective for emission reduction. In particular the reduction of NO_x and PM emissions on rural roads is much higher in scenario 2. The emission reduction is higher for NO_x.

Figure 6-5: Emission effects for NO_x and PM emissions – LCV scenarios 1 and 2



6.7 Market impacts

The main sources for the analysis of market impacts of the scenarios are the stakeholders' and government representatives' survey, the interviews to transport operators and the literature review. Main considerations are reported here below respectively for:

- shifts between vehicle categories, in particular from HGVs to LGVs;
- transport operating costs;
- vehicle design;
- compliance costs, administrative costs, enforcement and fraud;
- level playing field and transport demand.

6.7.1 Scenarios 1 and 2: speed limiters for N1 vehicles

Market impacts related to scenarios 1 and 2 on the extension of the scope of the Speed Limitation Directive to N1 vehicles are differently evaluated by the audience of interviewed road freight transport operators as well as by governmental contacts and stakeholders participating to the survey.

Long-distance operators with HGV fleets but also local/regional specialized freight operators with more mixed fleets of N2 and also N1 vehicles are in favour of the introduction of speed limiters on LGVs. Both types of respondents predict a general improvement of safety conditions but also a general reduction of costs (fuel, other consumables, maintenance, etc.) and vehicles' stops due to engine breakages. One operator has also already installed speed limiters on its dedicated fleet of N1 vehicles delivering chips on a regional basis exactly for preventing damages, achieve fuel savings and especially for preventing aggressive driving and increase safety. On the other hand, express delivery couriers with a more extended network, mixed cargo shipments and more strict delivery times are in general against this solution.

It is also true that in all those cases where LGVs are used for local and urban goods distribution (i.e. when the greatest part of the trip takes place on roads where allowed speeds are well below the limitations posed by the Directive) the expected market impacts of the Directive extension to LGVs might be of minor relevance. With reference to the survey responses (as already reported in section 3.6.2.), nearly 30% of the governmental contacts and half of the stakeholders agree on the extension of speed limiters to N1 vehicles and the main reasons regard emission reduction and increase in road safety.

Shifts between vehicle categories

Scenarios 1 and 2 are considered by some stakeholders as well as by some interviewed operators as a step towards a more levelled playing field in road transport. By limiting the speeds of LCVs, the two scenarios make LGVs (N1 vehicles) a bit less "attractive" in comparison to HGVs (N2/N3 regulated vehicles). As repeated already in the previous sections related to market impacts, the choice of the commercial vehicles size (and therefore their development though the last years) is influenced by many factors other than speed limitation, but vehicle speed certainly plays a role.

The presence of a market distortion between regulated N3/N2 fleets and unregulated N1 fleets appears quite evident exactly by comparing the different vision of the interviewed operators: those who have already experienced the benefits of speed limiters, or have less time and revenue constraints, believe the extension would realign the current distortion among N2 and N1 vehicles, and on the contrary opponents foresee the risk of increased operating and organizational costs.

The extension of the Speed Limitation Directive to N1 vehicles in scenarios 1 and 2 might have an impact on the trend of this category not only from the perspective of HCVs fleet, but also with reference to passenger cars. Indeed, there might be a shift from LGVs to M1 vehicles (small vans and/or passenger cars) in the urban distribution sector, where in many cases passenger cars and small vans are already used for own account shipments, such as for example those for procurement of goods by small retail shops, bars and restaurants. This emerges from surveys conducted on urban freight transport typology and frequency[99], but unfortunately no specific studies have been found to substantiate such an hypothesis. This could be an argument to include commercially used M1 vehicles also to some extent (see section 7.3).

Transport operating costs

Lower speed for N1 vehicles is generally seen as a way to reduce vehicle operating and maintenance costs. For operators that already installed speed limiters to their fleets this was one of the main arguments for doing so and their experiences underline that cost savings can also be realised.

Vehicle design

According to different views, the extension of speed limiters to LGVs might have an impact on vehicle design in terms of engine power downsizing, especially if this is considered in synergy with the new CO_2 emission limits for vans that are under discussion and that will be likely applied in the next years. The 2010 study "Potential CO_2 reduction from optimal engine sizing for light commercial vehicles" of TNO and CE Delft suggests that low CO_2 emissions limits combined with speed limits will definitely move the market towards "optimal engine sizing".

Compliance costs, administrative costs, enforcement and fraud

The two scenarios where speed limitation devices are extended to N1 vehicles are those where compliance and administrative costs might have some impact. This is linked to the fact that LGVs are often owned by SMEs, micro enterprises or self-employed, in many working as sub-contractors of large distributors and/or logistic companies.

The issue of retrofitting exiting vehicles is a peculiarity of scenarios 1 and 2 and this is particularly relevant for vehicles carrying goods on own account: the fleet of these vehicles is renovated at lower pace in comparison to the one of large enterprises and therefore the implementation of the Directive extension would imply measures for the retrofitting of the existing fleet, also to avoid distorted conditions between new and old vehicles. This element was also confirmed by some road passenger transport operators who declared an immediate and not predictable impact of the cost of retrofitting the existing fleet in their adaptation of M2 vehicles.

The last consideration is related to fraud and enforcement. The information collected for the implementation of the current Speed Limitation Directive cannot be directly transferred in this case. The reflexions presented here above about the relevance of SMEs, micro enterprises and self-employed as well as the need to foresee retrofitting measures suggest that ad-hoc enforcement policies will have to be applied in order to avoid frauds and illegal behaviours.

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[99] See for example the survey carried out within the CityPorts project (Interreg Programme III B CADSES) or in the Netherlands (Utrecht Amsterdam Rotterdam), where "passenger car" accounts for almost 1/3 of the shipments (Dataverzameling Stedelijke Distributie, TU Delft, BESTUF 2006)

Level playing field and transport demand

Level playing field impacts of these two scenarios are already mentioned here above when discussing about the shifts between vehicles' categories and concern the fact that in both Scenario 1 and 2 speed limits for LGVs (N1 vehicles) and HGVs (N2/N3 regulated vehicles) are made more comparable, but also the possible consequence in the freight distribution sector, where a shift from LGVs to M1 vehicles (small vans and/or passenger cars) might occur.

The potential impacts of Scenario 1 and 2 on the overall transport demand are considered of minor entity, especially for all this cases where LGVs are used for freight distribution.

6.7.2 Scenarios 3 and 4: all N1 vehicles equipped with ISA systems

No major market impacts are considered for scenarios 3 and 4, which are characterised by different types of ISA systems (respectively "informative" in scenario 3 and "voluntary" in scenario 4) but don't foresee variation of the speed allowed for LCVs.

A likely effect of the implementation of ISA systems on LCVs vehicles will be a stricter respect of the posted speed limits on rural road, which would be more stringent for scenario 4 than for scenario 3. The different opinions of stakeholders and governmental representatives in relation to the ISA types are reported in section 3.6.3.

6.8 Main findings

Within this ex-ante evaluation the effects on road safety, emissions and the market has been evaluated for four scenarios. Within the first scenario the speed limiter was introduced for N1-vehicles with a maximum speed of 110 km/h. In the second scenario, the speed set was decreased to 100 km/h for N1-vehicles. The last two scenarios applied an ISA system instead of the speed limiter device. In the third scenario the N1-vehicles are equipped with an advisory/informative ISA system. In the fourth scenarios theN1-vehciles are equipped with a voluntary ISA system.

Preferably also scenarios in which commercially used M1-vehicles (mini buses) are subject to the obligation would have been included. However, due to data limitation this was not feasible. The results presented here for LGVs, however, can be expected to be representative for commercially used M1 vehicles, as the parameters determining the safety and emission impacts are largely the same.

The effects on road safety of the first two scenarios were analysed using the same approach as for the ex-post and ex-ante evaluation for HCVs. First the effect of the scenario on the average speed and the standard deviation was analysed. Second, using the speed-accident relationships, the effect on road safety was analysed. The road safety effects from the ISA systems were taken from literature.

Overall the effect on road safety was largest for the fourth scenario in which a voluntary ISA system is installed in all N1-vehicles. In this scenario the number of fatal accidents decreases with 25%, corresponding to about 600 fatal accidents a year. In this scenario, the number of seriously injured decreases with 19% and overall there is a decrease of 11% in total accidents with N1-vehicles involved. Like we saw in the ISA scenario for HCVs, in this scenario we see a reduction in accidents for all road types - motorways, rural and urban - as ISA has an influence for all possible speed limits. Also in the third scenario the ISA dominates the road safety effects and leads to a decrease with 9% in fatal accidents, 4% in injuries and an overall reduction in accidents with N1-vehciles involved with 2%.

Introducing speed limiters set at 100 km/h (scenario 2) results in smaller safety impacts than ISA: a reduction in fatal accidents of 5%, in injuries of 3% and in all accidents of 2%. In case the limiters are set at 110 km/h the impacts are even lower with 1-2% reduction rates in accidents with N1-vehcile involved. However, it should be noticed that on motorways the safety impacts of speed limiters for N1-vehicles are relatively high with 16% or 28%. These are much higher than in ISA scenario 3 and with the 100 m/h speed limiter even somewhat higher than in scenario 4.

The emission impacts are rather different from the safety impacts. The reason is that where most of the (sever and fatal) accidents take place on rural and urban roads (where ISA is most effectively), a large share of emissions takes place at motorways (where limiters are very effective). Furthermore, ISA systems have relatively small impacts on emission levels, where speed limiters can have significant effects.

The highest emission reductions are found for scenario 2 with the speed limiters set at 100 km/h. The emission reductions (on all non-urban roads) are for scenario 2 in the range of 4-5% for CO_2 (corresponding to a reduction of about 2 Mtonnes of CO_2) and PM and even 14% for NO_x. In scenario 1 (limiter at 110 km/h), the reduction in NO_x is still 6%, but the reduction in CO_2 and PM estimated at only 1-2%. The emissions reductions in the ISA scenarios are even smaller.

The evaluation of the market impacts is based on interviews with road freight transport operators as well as the survey results from governmental contacts and stakeholders. Scenarios 1 and 2 are considered by some stakeholders as well as by some interviewed operators as a step towards a more levelled playing field in road transport, but speed is not the only factor influencing the choice of the commercial vehicle size. There might be a shift from LGVs to M1 vehicles, which is an argument to include commercially used M1 vehicles also to some extent.

The extension of speed limiters to LGVs (or all LCVs) is generally seen as a way to reduce vehicle operating and maintenance costs. The reason is that is could help to reduce both fuel costs and accident costs. Furthermore, vehicle maintenance costs could be reduced.

In combination with new CO_2 emission limits for vans it could also lead to engine power downsizing. Concerning compliance costs, the Directive extension would imply measures for the retrofitting of the existing fleet and ad-hoc enforcement policies will have to be applied in order to avoid frauds and illegal behaviours. No major market impacts are considered for scenarios 3 and 4.

7 Conclusions and recommendations

7.1 Conclusions on the ex-post evaluation

Implementation of the Directive

According to the survey carried out in this project, no particular problems have been encountered for the implementation of the Speed Limitation Directive with few exceptions related to administrative and technical costs. For the Member States that replied to the questionnaire (63% of all Member States), all have applied the maximum speeds set out in the Directive and regularly check the vehicles' compliance with the Speed Limitation Directive; in most cases this done in roadside inspections and/or yearly roadworthiness tests.

Speed impacts

The impacts of the Directive on actual vehicle speeds are hard to estimate due to data limitations. When comparing the scarcely available historical data on traffic speeds, no clear effect of the Directive on the speed distribution could be found.

Safety impacts

The statistical analysis of the evolution of the accident risk of HCVs over time gave no clear evidence of the impact of the Directive on traffic safety. This is mainly due to three reasons. Firstly, there is not a single year of implementation of the Directive, which makes that the possible effect is spread over time. Secondly, together with the Directive many other regulations came into place which either directly or indirectly impacted traffic safety. Finally, as data limitations with regard to vehicle-kilometres per road type only allowed for analysing accidents rates for all road types together, the impacts of the speed limiters (mainly taking place on motorways) were not traceable in the overall accident statistics.

However, the speed distribution of 10 years ago might not be representative today for a situation without speed limiters, as the vehicles might drive much faster today. Hence, based on real data, more theoretical speed distributions where assumed as well as the effect of speed limiters on these distributions. Using these speed distributions with and without speed limiters, the impacts on safety and emissions were calculated.

The analysis that was based on relationships between the speed distributions and accident rates (and the impact of speed limiters on the speed distributions) showed that overall, the Directive had a positive impact on traffic safety. Overall the impacts are estimated to be a reduction of 9% of fatal accidents on motorways with HCVs involved, 4% of serious injuries and 3% of injury accidents. The reduction percentages for just HGVs are about the same as for all HCVs, but for buses these are higher with a reduction of 13% of fatal accidents, 7% of seriously injured and overall a reduction of 4% for all injury accidents on motorways with buses involved. However, as the number of accidents with buses is relatively small, the results should be treated with care as they are more uncertain.

The total reduction in the number of annual fatalities due to the Speed Limitation Directive is estimated at almost 50. These numbers should be regarded as indicative because the actual impacts on traffic speeds are relatively uncertain. Moreover, the speed-accident relationships have several limitations and are a simplification of the safety impacts.

Unfortunately, data is lacking to distinguish the road safety impacts of introducing speed limitation devices in vehicle categories N2 and M2.

Emission impacts

With respect to the effect on emissions, by comparing speed profiles, it can be concluded that the introduction of speed limiters lowers emissions of CO_2, NO_x and PM with 1% for HGVs and with 2% for buses for motorways with high posted speed limits. For motorways with low posted speed limits the effect on emissions is negligible. The higher the average speed is before the introduction of the speed limiter and the speed limiters speed, the higher the reduction in emissions. Overall, for the EU as a whole it is estimated that the introduction of speed limiters decreased total HCV emissions with 1%.

Market impacts

With respect to the market impacts the focus lies on the possible impacts on a shift between HCVs and LCVs, the transportation costs, vehicle design and enforcement and fraud. For none of these impacts clear evidence of problems were found. With respect to shifts towards LCVs, some countries did see this shift, but this could also be caused by other regulations (e.g. drinking and rest times, tachograph) and to other influences (internet shopping) – rather than by the Speed Limitation Directive. Fraud was not seen as a problem by the interviewees, but did come up as a problem in the literature from outside the EU.

7.2 Conclusions on the ex-ante evaluations

Within the ex-ante evaluations the effects on road safety, emissions and the market have been evaluated. Four scenarios for HCVs were evaluated and four for LCVs. Unfortunately, data is lacking to evaluate the impacts of extending the scope of the Directive to commercially used M1-vehicles. Therefore, the LCV scenarios were limited to LGVs (N1 vehicles).

Safety impacts

The analysis shows that overall the ISA scenarios have the highest reductions on road safety for both HCVs and LCVs, in particular when the system is not just informative but also gives active feedback (Voluntary ISA). For both HCVs and LCVs the scenario with such an ISA system (both scenarios 4) shows a reduction in the number of fatal accidents in the EU with HCVs/LGVs involved of about 25%, 18-19% for seriously injury accidents and 11% for all injury accidents with HCVs/LGVs involved. This corresponds to a reduction in the number of fatalities per year of respectively about 150 (ISA for HCVs) and 600 (ISA for LCVs).

Decreasing the speed limits to 80 km/h for HGVs and 90 km/h for buses (scenario 1) leads to a decrease in fatal accidents with HCVs involved of about 5%. A similar reduction percentage was found for the scenario with speed limiters for LGVs set at 100 km/h. These rates are lower than for the ISA scenarios because speed limiters do only affect motorway traffic and rural roads with relatively high posted speed limits; ISA systems have an impact on safety on all roads. Because the absolute number of accidents is larger for these road types, ISA systems have a larger overall effect on road safety.

It should be noticed, however, that speed limiters are an effective way to improve traffic safety on motorways. When introduced for LGVs, fatal accidents on motorways would be reduced by 16% or 28% (110 and 100 km/h speed limiter, respectively).

Emission impacts

The emission impacts are rather different from the safety impacts. The reason is that where most of the (severe and fatal) accidents take place on rural and urban roads (where ISA is most effective), a large share of emissions takes place at motorways (where limiters are very effective). Furthermore, ISA systems reduce vehicle speeds in traffic situations that are relatively dangerous, such as in case of road works or bad weather conditions. Limiting speed in such situations has relatively large impacts on the overall traffic safety, but small impacts on the total emissions.

The highest emission reductions for the HCVs are found when the speed set with the speed limiters is lowered to 80 km/h for HGVs and 90 km/h for buses. In that case emissions decrease with approximately 4% to 6% of the emissions by HCVs on motorways and rural roads in the EU27 (corresponding to a reduction of about 9 Mtonnes of CO_2). The (additional) impacts of ISA on emissions are insignificant.

For LCVs, the highest emission reductions are found for the scenario with a speed limit set at 100 km/h (scenario 2) with emission reductions on all non-urban roads of about 4-5% for CO_2 (corresponding to a reduction of about 2 Mtonnes of CO_2) and PM emissions and even 14% for NO_x. With a speed limiter set at 110 km/h, emissions reductions are less than half as high, while the emissions reductions achieved by ISA are close to zero, like for HCVs.

Overall it can be concluded that the speed limiters can have a high impact on emissions, especially on motorways. The effect of ISA systems is very limited.

Market impacts

The evaluation of the market impacts is based on interviews with road freight transport operators as well as the survey results from governmental contacts and stakeholders.

For HCV scenario 1 it could be expected that further decreasing the speed leads to a shift towards the less restricted LCVs and possibly leads to a positive effect with respect to the operating costs.

The LCV scenarios with speed limiters (scenario 1 and 2) are considered by some stakeholders as well as by some interviewed operators as a step towards a more levelled playing field in road transport. However it is also clear that speed is not the only factor influencing the choice of the commercial vehicle size. Especially for local and urban goods distribution the expected market impacts are small. There might be a shift from LGVs to M1 vehicles, which is an argument to include commercially used M1 vehicles also to some extent.

The extension of speed limiters to LCVs is generally seen as a way to reduce vehicle operating and maintenance costs, although difficult to quantify. In combination with new CO_2 emission limits for LCVs it could also lead to engine power downsizing resulting in additional CO_2 reduction.

Concerning compliance costs, the Directive extension would imply measures for the retrofitting of the existing fleet and ad-hoc enforcement policies will have to be applied in order to avoid frauds and illegal behaviours. No major market impacts are considered for the ISA scenarios, both for HCVs and LCVs.

Opinion of stakeholders and Member States

The majority of the interviewees is against a reduction of speeds for HCVs. Increasing the speed limit does not get much support either.

Concerning the LCV scenarios, the long-distance operators with HGV fleets but also local/regional specialized freight operators with more mixed fleets of N2 and also N1 vehicles are in favour of the introduction of speed limiters on LGVs. On the other hand, express delivery couriers with a more extended network, mixed cargo shipments and more strict delivery times are strongly against this solution. Overall nearly 30% of the governmental contacts and half of the stakeholders agree on the extension of speed limiters to N1 vehicles and the main reasons regard emission reduction and increase in road safety.

Finally there is much support for ISA. 35% of governmental contacts and 82% of the stakeholders believe that ISA system should be introduced to all commercial vehicles, above all in the form of informative or supportive systems.

7.3 Answers to the evaluation questions

Table 7-1 lists the evaluation questions that were the starting point for this study (see also section 2.10). In the right column of the table, the main answer to each question is summarized. For the full answers, we refer to sections listed in section 2.10.

Table 7-1: Evaluation questions

	Evaluation Question	**Answer**
Relevance	To what extent has the Speed Limitation Directive contributed to the improvement of road safety and environmental protection in the context of other factors/initiatives having effects on road safety, fuel consumption and CO2 emissions?	The Directive has improved road safety, mainly on motorways. The Directive had also some small impacts on emissions.
Effectiveness	What are the main results and impacts related to road safety, fuel consumption and CO2 emissions and level playing field of the measures set out in the Directive taking into account all categories of heavy commercial vehicles, with special focus on the use of heavy commercial vehicles of category M2 and N2 with maximum mass exceeding 3.5 tonnes but not exceeding 7.5 tonnes?	Fatal accidents on motorways with HCVs involved are estimated to be reduced by 9%. The Directive has had very small impacts on emissions and fuel consumption of HCVs (about 1% reduction). Insufficient data is available to make an estimation exclusively for M2 and N2 vehicles or any other subcategory of those. In consideration of the large amount of cross-border traffic, the maximum speed imposed by the Directive ensured a level playing field in the single market for HCVs.
	Are there any other significant results and impacts of the measures set out in the Directive than those mentioned above?	No other significant impacts are expected than those mentioned above. There might be some reduction in operating costs. Costs have however not been quantified in the frame of the present study
	Which factors have hindered the improvement of road safety, environmental protection and level playing field?	No specific factors were found.
	To what extent could further decreasing the speed limits as laid down in the Directive and the use of various types of ISA systems improve the impacts achieved by the implementation of the Directive?	Simply reducing the speed set by the limiters is expected to reduce both fatal accidents with HCVs involved and HCVs' emissions with about 5%. Introduction of an ISA system that provides feedback to the driver (a so-called 'voluntary' type of ISA) could reduce the number of fatal accidents with HCVs involved by 25%, but would have hardly any impacts on emissions.
	Would the application of speed limitation devices with specific speed limits to light commercial vehicles be necessary in view of	Extending the scope of the Directive to LCVs has potentially very significant impacts on road safety and

	road safety, fuel consumption and CO2 emissions and the application of ISA systems?	emissions. The application of ISA for LCVs are expected to have similar reduction rates as mentioned above for HCVs. Due to the higher number of fatalities involved in accidents with LCVs, the reduction in the absolute number of fatalities is much higher than for HGVs.
Sustainability	What are the main problems with implementation of the Directive in Member States? Is there any evidence on existence of fraud? If relevant, what is the extent and dynamics of fraudulent practices?	Very few problems are observed. These are linked to technical cost, administrative burdens and device manipulation. No particular problems related to frauds emerged.
	Given the technological developments, would exploitation of speed limitation devices be still appropriate in 5 years?	Yes, this would still be appropriate, because speed limiters are complementary to ISA systems, particularly for reducing emissions and improving traffic safety on motorways. Furthermore 'mandatory' (intervening) types of ISA are not expected to be sufficiently mature within 5 years.
Efficiency	Is there a scope for administrative burden and compliance/enforcement cost reduction while implementing the Directive?	Except from few implementation problems no particular difficulties emerged. No significant costs were raised by stakeholders.
	Is there a scope for limiting burdens for SMEs and micro-enterprises without significantly hindering the achievement of safety and emission reduction objectives of the Directive? Could SMEs and micro-enterprises be excluded from the scope of the Directive?	No differences were observed in relation to the behaviour of small/medium enterprises (SMEs) in comparison to large enterprises with respect to the Directive provisions.
	Would it be possible to achieve the same level of road safety and environmental protection more efficiently by other means (e.g. infrastructure improvements, advanced solutions in vehicle construction, better enforcement of traffic rules)?	There are many other policies that can contribute to the improvement of safety and emissions reduction. Speed limiters can be regarded as being very effective and complementary to other policies as they address specifically the reduction of excessive driving speeds that have significant impacts on safety and emissions. ISA systems are seen to be complementary to speed limiters, given that 'mandatory' systems are not yet mature enough to replace these.
	Could ISA systems be efficient enough to replace or complement existing speed limitation devices? Would these technologies be mature enough for widespread implementation?	ISA systems of the type 'informative' or ' voluntary' are mature enough for widespread implementation within 5 years. Replacing existing speed limiters by ISA is not recommended and does not get much support among stakeholders.
Utility	In the light of the targets set by the White Paper on Transport, can the impacts achieved by the implementation of the Directive be considered as sufficient in medium and long term?	For meeting the long term objective with respect to road safety and emissions reductions, the impacts achieved by the current Directive cannot be considered to be sufficient on its own. This highlights the complementary function of this initiative to other measures aiming at improving reoad safety and reducing emissions.
EU added value	Why should the introduction of speed limitation devices to commercial vehicles be regulated at EU level, and not left up to each Member State to decide?	The main argument for legislation at the EU level regarding the introduction of speed limitation devices to commercial vehicles, is to ensure a level playing field across Member States and vehicle categories.

7.4 Policy discussion and conclusions

The results of the ex-post evaluation suggest that there is no need to change the speed set for speed limiters for HCVs. There is moreover not much support among stakeholders and Member States for doing so.

On the other hand, based on the ex-ante evaluation, there are several options for improving the effectiveness of the Speed Limitation Directive.

For reducing accidents and emissions, a combination of ISA and speed limiters is most effective. ISA is very effective for improving safety (particularly for LCVs); speed limiters can well contribute to reduction of emissions. The impacts on emissions of speed limiters are probably higher than estimated in this study because of two additional effects that can be expected in the long term: some reduction in the transport volume and engine power downsizing. Therefore, there are still good arguments for applying speed limiters for the next 5 years, potentially integrated with an ISA device.

The highest safety reductions could be achieved by requiring all commercial vehicles to be equipped with an ISA system that provides tactile feedback to the driver. This could then be combined with the existing speed limiters. Extending the scope of the Directive to LCVs is expected to have large safety effects with a reduction of about 600 fatal accidents a year.

Overall it is clear from this study and previous studies on the subject that speed limiters and ISA can achieve significant safety and emission benefits with an overall positive cost-benefit ratio. There are many other policies that can contribute to the improvement of safety and emissions reduction. Speed limiters and ISA can be regarded as being complementary to other policies as they address specifically the reduction of excessive driving speeds that have significant impacts on safety and emissions.

They contribute to key policy objectives of the 2011 White Paper on Transport, in particular with respect to safety and climate: moving close to zero fatalities in road transport in 2050 and reducing GHG emissions in 2050 by 60% compared to 1990 level. In line with the first goal, the EU aims at halving road casualties by 2020 and has the ambition to be a world leader in safety and security of transport in all modes of transport. In this context speed policy can be regarded as necessary, but on its own not sufficient. The main argument for the EU to keep playing a role in speed policy is to ensure a level playing field for all commercially used vehicles across Member States.

In the evaluation carried out in this study it was not feasible to simulate scenarios with subsets of N1 or M1 vehicles covered by the Directive, due to the scarcity of available data. Assessing the various options for distinguishing subcategories of LCVs are recommended as subject for further study.

Other elements that could be further investigated are the costs associated to the Speed Limitation Directive, including implementation costs, compliance costs, administrative costs, etc.

7.5 Recommendations

The main policy recommendations of this study are:

- to keep the current obligation of speed limiters for HCVs and to keep the level of the maximum speeds of the speed limiters at the current levels;
- to further explore options for improving the effectiveness of the Speed Limitation Directive, in particular by:
  - requiring all commercial vehicles to be equipped with a ‘voluntary’ type of ISA (i.e. that provides tactile feedback to the driver);
  - requiring speed limiters for LCVs (N1 vehicles and possibly also a subset of M1 vehicles, see next bullet);
- to investigate how commercially used M1 vehicles could covered by the legislation and what vehicle parameters could be used to distinguish them from other M1 vehicles;

- to further investigate options for including all or subsets of N1 vehicles, and in the case of subsets of N1 vehicles, to investigate how such a subset could defined;
- to set up a monitoring system for analysing the impacts of (amendments of) the Speed Limitation Directive.

Annexes

Ex-post evaluation on the installation and use of speed limitation devices

ANNEX 1: Member State questionnaire

QUESTIONNAIRE on the implementation of directive 92/6/EEC, as amended by directive 2002/85/ec, on speed limitation devices and relevant effects.

To help process the replies to this questionnaire, please provide any written information in one of the EU official languages but preferably in English.
COUNTRY
PERSON RESPONDING TO THIS QUESTIONNAIRE **Name:** **Position (Job Title):** **Authority/organisation:** **Administrative address:** **Tel.:** **Fax:** **E-mail address:**
<u>Please return by15/04/2013 your completed questionnaire to:</u> **Caterina Rosa** **e-mail: rosa@trt.it** **tel.:+39 02 57410380** **address : TRT TRASPORTI E TERRITORIO srl, Via Rutilia 10/8, 20141 Milano (Italy)**

Contract N° MOVE/C4/SER/2012-301/SI2.645986

Under Service framework contract N°MOVE/A3/350-2010

Title: "Ex-post evaluation of Directive 92/6/EEC on the installation and use of speed limitation devices for certain categories of motor vehicles in the Community, as amended by Directive 2002/85/EC"

Authors:

The present questionnaire is proposed within the framework of the preparation of ***the Evaluation study on Speed Limitation Devices.***

The study is carried out by a consortium of consultancy and research firms: Transport & Mobility Leuven, TNO, CE Delft and TRT Trasporti e Territorio under a contract with the European Commission.

The overall objective of this study is to assist the European Commission with the evaluation of the current Directive 92/6/EEC, as amended by Directive 2002/85/EC, on the installation and use of speed limitation devices for certain categories of motor vehicles in the European Union and to explore and assess options for revising the Directive.

In this respect the study combines an ex-post evaluation of the current Directive 92/6/EEC as amended with an ex-ante evaluation of options for amendments. The impact assessments and evaluations will be developed on the basis of data and information collected through the present questionnaire, literature review and interviews with stakeholders.

In particular the first step is to gather most of the relevant information/data through this survey. These constitute an input for the calculation of the impacts on vehicle speeds, safety, fuel consumption, emissions and the transport market for both:

- Ex-post evaluation of speed limitation Directive for Heavy Goods Vehicles (HGVs) and buses;
- Exploration and assessment of options for amending the Directive regarding HGVs and buses and extending its scope with Light Commercial Vehicles (LCVs).

QUESTIONNAIRE Notes

The time series data required in this questionnaire is very detailed and often split into specific categories (e.g. vehicle categories, categories of roads and types of accidents). In case you are not able to provide detailed data, we would very much appreciate your effort to provide summary figures (e.g. data for the total of heavy vehicles, data for all roads, data regarding accidents without further classifications etc.).

Please note that figures for vehicle categories M1, N1, M3, M2, N3, N2 will be asked. As mentioned in Directive 2002/85/EC, the categories of vehicles shall be understood to be those defined in Annex II to Directive 2001/116/EC i.e.:

- Category M3: *Vehicles designed and constructed for the carriage of passengers, comprising more than eight seats in addition to the driver's seat, and having a maximum mass exceeding 5 tonnes.*
- Category M2: *Vehicles designed and constructed for the carriage of passengers, comprising more than eight seats in addition to the driver's seat, and having a maximum mass not exceeding 5 tonnes.*
- Category M1*: Vehicles designed and constructed for the carriage of passengers and comprising no more than eight seats in addition to the driver's seat.*
- Category N3: *Vehicles designed and constructed for the carriage of goods and having a maximum mass exceeding 12 tonnes.*
- Category N2: *Vehicles designed and constructed for the carriage of goods and having a maximum mass exceeding 3.5 tonnes but not exceeding 12 tonnes.*
- Category N1: *Vehicles designed and constructed for the carriage of goods and having a maximum mass not exceeding 3.5 tonnes.*

The questionnaire is structured in four sections:

- Section 1: Implementation of Directive 2002/85/EC amending Directive 96/6/EEC
- Section 2: Impacts of Directive 2002/85/EC
- Section 3: Quantitative data
- Section 4: Options for amending directive 2002/85/EC

Thank you very much in advance for filling out this questionnaire.

SECTION 1: IMPLEMENTATION OF DIRECTIVE 2002/85/EC AMENDING DIRECTIVE 96/6/EEC

The Directive 2002/85/EC amending Directive 96/6/EC required Member States to bring its provisions into force by 1st January 2005 at the latest (Directive 2002/85/EC, Art. 2).

In this section information on the implementation of the Directive is asked in order to find out what kind of implementation difficulties have been encountered.

0 Could you please indicate the maximum speed allowed to vehicles for different type of roads?

Speed limit in km/h	**M3**	**N3**	**M2**	**N2**	**M1**	**N1**
Motorways						
Interurban roads						
Urban roads						

** This question will be reported only in the questionnaires which will be sent to those countries for which the information is not completely available at http://ec.europa.eu/transport/road_safety/going_abroad/index_en.htm*

1 Could you please explain how rules of Directive 96/6/EEC as amended are enforced?

Answer:

2 Could you please indicate when checks on M3, N3, M2, N2 vehicle compliance with Directive 96/6/EEC as amended are carried out in your country?

- Every year
- Every two years
- Other (please specify)

Answer:

3 Could you please indicate the maximum speed used for speed limiters for heavy goods vehicles and buses that are registered in your country? How is this tested and enforced?

Answer:

4 Did you find any problems for the implementations of the provisions set in the Directive?

Answer:

In particular:

4.1 Is there any evidence on existence of frauds? If relevant, which are the dynamics of fraudulent practices?

Answer:

4.2 Did you experience substantial costs and administrative burden linked to the implementation of the directive? Do you see a scope for reducing the administrative burden and costs for compliance/enforcement?

Answer:

4.3 Did you find any differences between small/medium enterprises (SME) and large enterprises behaviours with respect to the Directive provisions (e.g. different frequency of illegal behaviours/frauds)? Is there any facilitation to SMEs?

Answer:

Please add further comments if needed.

5 Apart from the Directive 2002/85/EC, are there any further national policies focusing on speed limitation of trucks and buses? If yes, please explain the measures adopted

Answer:

SECTION 2: IMPACTS OF THE DIRECTIVE 2002/85/EC

Directive 92/6/EEC required Member States to oblige the installation of speed limitation devices on M3 vehicles having a maximum weight exceeding 10 metric tons and on N3 vehicles before 1 October 1993 (Directive 92/6/EEC, Art. 2, Art. 3, Art. 7).

Directive 2002/85/EC extended the obligation to M3 vehicles having a maximum mass between 5 and 10 tons, as well as to M2 and N2 vehicles, within January 2005 at the latest(Directive 2002/85/EC, Art. 1, Art. 2).

The questions in the following sections go through the effects of the installation on M2, N2, M3 and N3 of speed limitation devices on:

- the stock of the relevant vehicles categories;
- the speed limits and speed profiles for buses/coaches and freight vehicles;
- pollutant emissions;
- road safety;
- the market, with focus on: vehicle design, vehicle shift, compliance costs, frauds.

2.1 IMPACTS OF SPEED LIMITATION DEVICES ON THE STOCK OF VEHICLES

6 Have you observed a relation between the implementation of Directive 2002/85/EC and the trend in vehicles stock? e.g. has the obligation of installing speed limitation devices in category M2 and N2 vehicles affected the stock of these vehicles during the time or has a shift between various categories of commercial vehicles taken place?

Answer:

2.2 IMPACTS OF SPEED LIMITATION DEVICES ON AVERAGE SPEEDS AND SPEED PROFILES

7 Are there available analyses/studies (Pilot studies, Surveys, Impact Assessments, Evaluation studies, etc.) at national scale on the impacts of speed limitation devices on vehicle speed and speed profiles for buses/coaches and freight vehicles (e.g. impacts on traffic flows/management, possible congestion problems, etc.)? If so, where can these be found and what are the key results and conclusions from these studies?

Answer:

2.3 IMPACTS OF SPEED LIMITATION DEVICES ON EMISSIONS

8 Are there analyses/studies available (Pilot studies, Surveys, Impact Assessment, Evaluation studies, etc.) at a national scale on the impacts of the speed limitation devices on:

- fuel consumption and CO2 emissions
- other pollutant emissions (NOx, mass of particulates - PT)

If so, where can these be found and what are the key results and conclusions from these studies?

Answer:

9 Which national policies with significant impact on emissions and impacts for heavy vehicles have been implemented since 2002?

Answer:

2.4 IMPACTS OF SPEED LIMITATION DEVICES ON ROAD SAFETY

10 Are there analyses/studies available (Pilot studies, Surveys, Impact Assessment, Evaluation studies, etc.) at a national scale of the effects of speed limitation devices on road safety i.e. accident rates? If so, where can these be found and what are the key results and conclusions from these studies?

Answer:

11 Which national policies with significant impact on accident rates and impacts for heavy vehicles have been implemented since 2002?

Answer:

12 Is there any information or studies available about driver behaviour change after the installation of speed limitation devices (van or truck drivers are often tempted to reach the maximum speed set by the limiters that, inter alia, makes overtaking between two vehicles too long with various dangerous effects, including "micro"-congestion)?

Answer:

2.5 MARKET IMPACTS OF SPEED LIMITATION DEVICES

13 Are there available analyses/studies (Pilot studies, Surveys, Impact Assessment, Evaluation studies, etc.) at a national scale on the impacts of speed limitation devices on:

- vehicle design(e.g. engines)
- shifts between heavy goods vehicles and light commercial vehicles
- transport demand
- frauds

If so, where can these be found and what are the key results and conclusions from these studies?

Answer:

SECTION 3: QUANTITATIVE DATA

This section aims at collecting quantitative data differentiated to vehicle category, type of roads and accidents related to specific issues of the previous questions i.e.: stock of vehicles, speed detected, road safety.

In case you cannot provide the detailed data required below, please send us the relevant more aggregated information you have. Please also provide us with websites or relevant studies other than those you already mentioned in previous questions.

3.1 STOCK OF VEHICLES

14 Could you please indicate the stock of vehicles for each vehicle category since 1999, as reported in the table below?

Years	M3			N3	M2	N2	M1	N1
	Max mass > 10 tons	5 tons**< max mass≤** 10 tons	**Total**					
1999								
2000								
2001								
2002								
2003								
2004								
2005								
2006								
2007								
2008								
2009								
2010								
2011								
2012								

Answer:

15 Is there data available on vehicle kilometre registered per vehicle category (M3, M2, N3, N2, M1, N1 vehicles) and per road type (motorways and interurban roads)? When available, please provide us with time series of this data (1999/2000-2012) or an analysis of such data. If this data is available, please also indicate where these can be found?

Answer:

3.2 DATA ON SPEED DETECTED

16 Is there data available on speed detected (both average speed and variation in speeds observed), differentiated per vehicle category (category M3, M2, N3, N2, M1, N1 vehicles)? When available, please provide us with time series of this data (1999/2000-2012) or an analysis of such data. If this data is available, please also indicate where these can be found?

Answer:

17 Is there data available on speed detected, differentiated per type of roads, e.g. motorways and interurban roads? When available, please provide us with time series of this data (1999/2000-2012) or an analysis of such data. If this data is available, please also indicate where these can be found?

Answer:

3.3 DATA ON ROAD SAFETY

18 Is there more detailed data available on accidents recorded than the data reported in the CARE database? When available, please provide us with time series of this data (1999/2000-2012) or an analysis of such data. If this data is available, please also indicate where this can be found?

In particular the following data differentiation would be important:

- Number and severity of accidents per vehicle category (M3, M2, N3, N2) and type of road (motorways and interurban roads)
- Number and severity of accidents provoked by the excessive heavy vehicle speed differentiated per type of road (motorways and interurban roads)
- Number and severity of accidents caused by heavy vehicles below 7.5 tons differentiated per vehicle category (M3, M2, N2) and type of road (motorways and interurban roads)
- Number and severity of accidents caused by heavy vehicles weighting more than 7.5 tons, differentiated per vehicle category (M3, N3, N2) and type of road (motorways and interurban roads)

Answer:

3.4 DATA ON FRAUDS DETECTED

19 Is there data available on the number and type of frauds detected? When available, please provide us with time series of this data (1999/2000-2012) or an analysis of such data. If this data is available, please also indicate where these can be found?

Answer:

SECTION 4: OPTIONS FOR AMENDING DIRECTIVE 2002/85/EC

Options for amending Directive2002/85/E Care investigated in the present section.

The focus is on six main options:

1) Keep the current speed limits for heavy goods vehicles
2) Increase the speed limits for heavy goods vehicles
3) Decrease of speed limits for heavy goods vehicles
4) Extend the requirement for using speed limitation devices to light goods vehicles (N1 category)
5) Introduce speed limitation devices for light passenger vehicles like minibuses/vans (M1 category)
6) Introduce ISA (Intelligent Speed Assistance/Adaptation) systems for some or all commercial vehicles

The aim is to be provided with relevant opinions in view of possible Directive amendments.

20 The European Commission is evaluating the possibility to introduce some of the following amendments to Directive 2002/85/EC. Please indicate the option/s you could agree with.

1) Keep the current speed limits for heavy goods vehicles

2) Increase the speed limits for heavy goods vehicles

3) Decrease limits for heavy good vehicles

4) Extend speed limitation devices to light goods vehicles(N1 category)

5) Introduce speed limitation devices to light passenger vehicles like minibuses/vans (M1 category)

6) Introduce Intelligent Speed Assistance/Adaptation systems for all commercial vehicles

In case of selection, please specify which type of ISA system should be introduced:

6.1) Informative or Advisory: this gives the driver feedback in the form of a visual or an audio signal

6.2) Supportive or Warning: this works in the form of increasing the upward pressure on the pedal or cancelling a driver's throttle demand if it demands more throttle than is required to drive at the speed limit

6.3) Mandatory or Intervening: this prevents any speeding, for example, by reducing fuel injection or by requiring a "kick-down" by the driver if he or she wishes to exceed the limit

7) Introduce Intelligent Speed Assistance/Adaptation systems for some commercial vehicle categories. Please indicate the vehicle categories and the type of ISA systems according to the above mentioned definitions

Vehicle categories:______________________

Type of ISA systems

Informative or Advisory

Supportive or Warning

Mandatory or Intervening

8) Other alternative options for amendment

Please explain what amendment and for which reasons:

Answer:

21 Could you please justify your selection/s? In case you have any information on the impacts which would result from the above mentioned amendments, please provide us with these.

Answer:

Thank you for completing this questionnaire!

ANNEX 2: Stakeholder/expert questionnaire

QUESTIONNAIRE on the implementation of directive 92/6/EEC, as amended by directive 2002/85/ec, on speed limitation devices and relevant effects.

To help process the replies to this questionnaire, please provide any written information in one of the EU official languages but preferably in English.
COUNTRY
PERSON RESPONDING TO THIS QUESTIONNAIRE **Name:** **Position (Job Title):** **Authority/organisation:** **Administrative address:** **Tel.:** **Fax:** **E-mail address:**

Please return by19/04/2013 your completed questionnaire to:

Caterina Rosa

e-mail: rosa@trt.it

tel.:+39 02 57410380

address : TRT TRASPORTI E TERRITORIO srl, Via Rutilia 10/8, 20141 Milano (Italy)

Contract N° MOVE/C4/SER/2012-301/SI2.645986

Under Service framework contract N°MOVE/A3/350-2010

Title: "Ex-post evaluation of Directive 92/6/EEC on the installation and use of speed limitation devices for certain categories of motor vehicles in the Community, as amended by Directive 2002/85/EC"

Authors:

The present questionnaire is proposed within the framework of the preparation of ***the Evaluation study on Speed Limitation Devices.***

The study is carried out by a consortium of consultancy and research firms: Transport & Mobility Leuven, TNO, CE Delft and TRT Trasporti e Territorio under a contract with the European Commission.

The overall objective of this study is to assist the European Commission with the evaluation of the current Directive 92/6/EEC, as amended by Directive 2002/85/EC, on the installation and use of speed limitation devices for certain categories of motor vehicles in the European Union and to explore and assess options for revising the Directive.

In this respect the study combines an ex-post evaluation of the current Directive 92/6/EEC as amended with an ex-ante evaluation of options for amendments. The impact assessments and evaluations will be developed on the basis of data and information collected through a detailed questionnaire sent to all EU transport ministers/competent offices, literature review and interviews with stakeholders (including this specific survey).

QUESTIONNAIRE Notes

The time series data required in this questionnaire is very detailed and often split into specific categories(e.g. vehicle categories, categories of roads and types of accidents). In case you are not able to provide detailed data, we would very much appreciate your effort to provide summary figures (e.g. data for the total of heavy vehicles, data for all roads, data regarding accidents without further classifications etc.).

Please note that figures for vehicle categories M1, N1, M3, M2, N3, N2 will be asked. As mentioned in Directive 2002/85/EC, the categories of vehicles shall be understood to be those defined in Annex II to Directive 2001/116/EC i.e.:

- Category M3: *Vehicles designed and constructed for the carriage of passengers, comprising more than eight seats in addition to the driver's seat, and having a maximum mass exceeding 5 tonnes.*
- Category M2: *Vehicles designed and constructed for the carriage of passengers, comprising more than eight seats in addition to the driver's seat, and having a maximum mass not exceeding 5 tonnes.*
- Category M1*: Vehicles designed and constructed for the carriage of passengers and comprising no more than eight seats in addition to the driver's seat.*
- Category N3: *Vehicles designed and constructed for the carriage of goods and having a maximum mass exceeding 12 tonnes.*
- Category N2: *Vehicles designed and constructed for the carriage of goods and having a maximum mass exceeding 3.5 tonnes but not exceeding 12 tonnes.*
- Category N1: *Vehicles designed and constructed for the carriage of goods and having a maximum mass not exceeding 3.5 tonnes.*

The questionnaire is structured in three sections:

- Section 1: Impacts of Directive 2002/85/EC
- Section 2: Quantitative data
- Section 3: Options for amending directive 2002/85/EC

Thank you very much in advance for filling out this questionnaire.

SECTION 1: IMPACTS OF THE DIRECTIVE 2002/85/EC

Directive 92/6/EEC required Member States to oblige the installation of speed limitation devices on M3 vehicles having a maximum weight exceeding 10 metric tons and on N3 vehicles before 1 October 1993 (Directive 92/6/EEC, Art. 2, Art. 3, Art. 7).

Directive 2002/85/EC extended the obligation to M3 vehicles having a maximum mass between 5 and 10 tons, as well as to M2 and N2 vehicles, within January 2005 at the latest(Directive 2002/85/EC, Art. 1, Art. 2).

The questions in the following sections go through the effects of the installation on M2, N2, M3 and N3 of speed limitation devices on:

- the market;

- the stock of the relevant vehicles categories;

- the speed limits and speed profiles for buses/coaches and freight vehicles;

- pollutant emissions;

- road safety;

1.1 MARKET IMPACTS OF SPEED LIMITATION DEVICES

1 Are there available analyses/studies (Pilot studies, Surveys, Impact Assessment, Evaluation studies, etc.) on the impacts of speed limitation devices on:

- vehicle design(e.g. engines)
- shifts between heavy goods vehicles and light commercial vehicles
- transport demand
- frauds

If so, where can these be found and what are the key results and conclusions from these studies?

Answer:

1.2 IMPACTS OF SPEED LIMITATION DEVICES ON THE STOCK OF VEHICLES

2 Have you observed a relation between the implementation of Directive 2002/85/EC and the trend in vehicles stock? e.g. has the obligation of installing speed limitation devices in category M2 and N2 vehicles affected the stock of these vehicles during the time or has a shift between various categories of commercial vehicles taken place?

Answer:

1.3 IMPACTS OF SPEED LIMITATION DEVICES ON AVERAGE SPEEDS AND SPEED PROFILES

3 Are there available analyses/studies (Pilot studies, Surveys, Impact Assessments, Evaluation studies, etc.) on the impacts of speed limitation devices on vehicle speed and speed profiles for buses/coaches and freight vehicles (e.g. impacts on traffic flows/management, possible congestion problems, etc.)? If so, where can these be found and what are the key results and conclusions from these studies?

Answer:

1.4 IMPACTS OF SPEED LIMITATION DEVICES ON EMISSIONS

4 Are there analyses/studies available(Pilot studies, Surveys, Impact Assessment, Evaluation studies, etc.) on the impacts of the speed limitation devices on:

- fuel consumption and CO2 emissions
- other pollutant emissions (NOx, mass of particulates - PT)

If so, where can these be found and what are the key results and conclusions from these studies?

Answer:

1.5 IMPACTS OF SPEED LIMITATION DEVICES ON ROAD SAFETY

5 Are there analyses/studies available (Pilot studies, Surveys, Impact Assessment, Evaluation studies, etc.) on the effects of speed limitation devices on road safety i.e. accident rates? If so, where can these be found and what are the key results and conclusions from these studies?

Answer:

6 Is there any information or studies available about driver behaviour change after the installation of speed limitation devices (van or truck drivers are often tempted to reach the maximum speed set by the limiters that, inter alia, makes overtaking between two vehicles too long with various dangerous effects, including "micro"-congestion)?

Answer:

SECTION 2: QUANTITATIVE DATA

This section aims at collecting quantitative data differentiated to vehicle category, type of roads and accidents related to specific issues of the previous questions i.e.: stock of vehicles, speed detected, road safety.

In case you cannot provide the detailed data required below, please send us the relevant more aggregated information you have. Please also provide us with websites or relevant studies other than those you already mentioned in previous questions.

2.1 STOCK OF VEHICLES

7 Is there available data on the stock of vehicles for each vehicle category (M3 with maximum mass > 10 tons, M3 with 5 tons< max mass≤ 10 tons, M3 as total, N3, M2, N2, M1, N1) since 1999?

Answer:

2.2 DATA ON ROAD SAFETY

8 Is there more detailed data available on accidents recorded than the data reported in the CARE database? When available, please provide us with time series of this data (1999/2000-2012) or an analysis of such data. If this data is available, please also indicate where this can be found?

In particular the following data differentiation would be important:

- Number and severity of accidents per vehicle category (M3, M2, N3, N2) and type of road (motorways and interurban roads)
- Number and severity of accidents provoked by the excessive heavy vehicle speed differentiated per type of road (motorways and interurban roads)
- Number and severity of accidents caused by heavy vehicles below 7.5 tons differentiated per vehicle category (M3, M2, N2) and type of road (motorways and interurban roads)
- Number and severity of accidents caused by heavy vehicles weighting more than 7.5 tons, differentiated per vehicle category (M3, N3, N2) and type of road (motorways and interurban roads)

Answer:

2.3 DATA ON FRAUDS DETECTED

9 Is there data available on the number and type of frauds detected? When available, please provide us with time series of this data (1999/2000-2012) or an analysis of such data. If this data is available, please also indicate where these can be found?

Answer:

SECTION 3: OPTIONS FOR AMENDING DIRECTIVE 2002/85/EC

Options for amending Directive2002/85/EC are investigated in the present section.

The focus is on six main options:

1) Keep the current speed limits for heavy goods vehicles
2) Increase the speed limits for heavy goods vehicles
3) Decrease of speed limits for heavy goods vehicles
4) Extend the requirement for using speed limitation devices to light goods vehicles (N1 category)
5) Introduce speed limitation devices for light passenger vehicles like minibuses/vans (M1 category)
6) Introduce ISA (Intelligent Speed Assistance/Adaptation) systems for some or all commercial vehicles

The aim is to be provided with relevant opinions in view of possible Directive amendments.

10 The European Commission is evaluating the possibility to introduce some of the following amendments to Directive 2002/85/EC. Please indicate the option/s you could agree with.

1) Keep the current speed limits for heavy goods vehicles

2) Increase the speed limits for heavy goods vehicles

3) Decrease limits for heavy good vehicles

4) Extend speed limitation devices to light goods vehicles(N1 category)

5) Introduce speed limitation devices to light passenger vehicles like minibuses/vans (M1 category)

6) Introduce Intelligent Speed Assistance/Adaptation systems for all commercial vehicles

In case of selection, please express your attitude towards the following types of ISA according to the options “Positive/Neutral/Negative”:

6.1) Informative or Advisory: this gives the driver feedback in the form of a visual or an audio signal

6.2) Supportive or Warning: this works in the form of increasing the upward pressure on the pedal or cancelling a driver's throttle demand if it demands more throttle than is required to drive at the speed limit

6.3) Mandatory or Intervening: this prevents any speeding, for example, by reducing fuel injection or by requiring a "kick-down" by the driver if he or she wishes to exceed the limit

7) Introduce Intelligent Speed Assistance/Adaptation systems for some commercial vehicle categories. Please indicate the vehicle categories and the type of ISA systems according to the above mentioned definitions

Vehicle categories:______________________

Type of ISA systems

Informative or Advisory

Supportive or Warning

Mandatory or Intervening

8) Other alternative options for amendment

Please explain what amendment and for which reasons:

Answer:

11 Could you please justify your selection/s? In case you have any information on the impacts which would result from the above mentioned amendments, please provide us with these.

Answer:

Thank you for completing this questionnaire!

ANNEX 3: Posted Speed limits on different types of roads for different types of vehicles in EU Member States

speed limit	urban roads			non-urban roads			Motorways/expressways		
(km/h)	M1, N1	N2/N3	M2/M3	M1, N1	N2/N3	M2/M3	M1, N1	N2/N3	M2/M3
BE	50	50	50	90	90	75	120	90	90
BG	50	-	-	90	-	-	130	-	-
CZ	50	50	50	90	80	90	130	80	130
DK	50	50	50	80	70	80	130	80	80
DE	50	50	50	100	60/80	60/80	130 recommended	80	80/100*
EE	50	50	50	90	90	90	90	90	90
IE	50	50	50	100	80	80	120	90	100
EL	50	50	50	90	80	80	130/110	85/80	100/90
ES	50	50	50	90/100**	70/80	80/90	120***	80	90
FR	50	50	50	90	80	90	130/110	90/80	100/90
IT	50	50	50	90	80 (up to 12 tons) and 70 (beyond 12 tons)	80	130	100 (up to 12 tons) and 80 (beyond 12 tons)	100
CY	50	50	50	80	64	80	100	80	100
LV	50	50	50	90	80	90	112	96	112
LT	50	50	50	70/90	70/80	70/80	100/130	80/90	90/100
LU	50	-	-	90	-	-	130	90	100
HU	50	50	50	90	70	70	130/110	80	80
MT	50 (M1) 40 (N1)	40	40	80 (M1) 60 (N1)	60	60	80(M1) 60 (N1)	60	60
NL	50	50	50	80	80	80	130/120/100	80	100/80
AT	50	50	50	100	70	80	130	80	100
PL	50	50	50	90	70	70	120/140	80	80/100 *
PT	50	50	50	90	80	80	120/100	90/80	100/90
RO	50	50	50	90/100	80/90	80/90	130	110	110
SI	50	50	50	90	90	90	130	90	90/100
SK	50	50	50	90	90	90	90/130	90	90/100
FI	50	50	50	80	80	80	80/100/120 (vans 80 or 100)	80	80/100
SE	50	50	50	70	70	70	110	90	90
UK	32/48	32/48	32/48	97/112	64/80	97/112	112	97	112

This table makes abstraction from special speed limits for dangerous goods, buses with standing passengers and specific weather conditions.

* If special equipment

** 90/100 passenger cars, 80/90 light vans, 70/80 vans and light HGVs

*** 120 passenger cars, 100 light van, 90 vans and light HGVs

Sources:

For most countries: http://ec.europa.eu/transport/road_safety/going_abroad/index_en.htm

For the UK: http://en.wikipedia.org/wiki/Road_speed_limits_in_the_United_Kingdom

For Latvia: http://www.mfa.gov.lv/lv/london/konsulara-informacija/autotransporta-vadisana/

For Ireland: http://www.citizensinformation.ie/en/travel_and_recreation/roads_and_safety/road_traffic_speed_limits_in_ireland.html

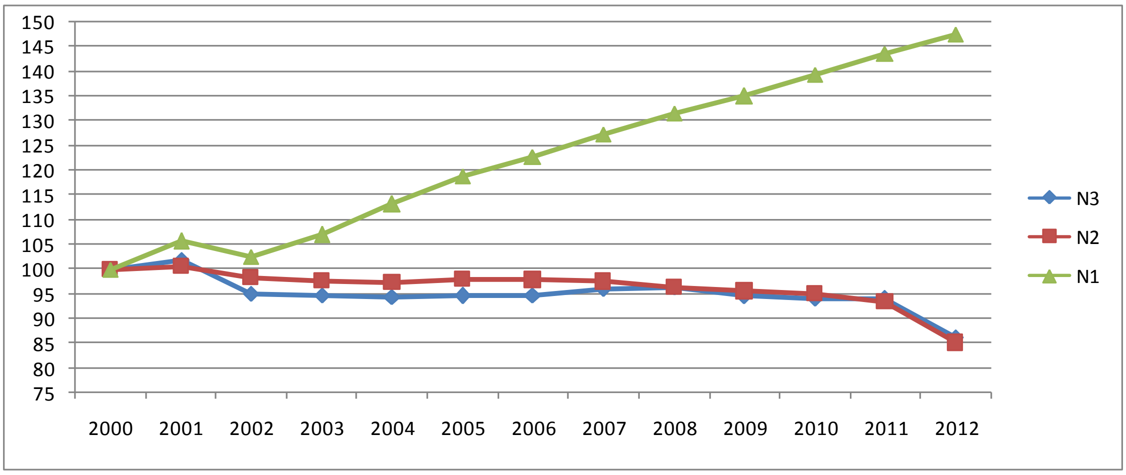
For Luxembourg: https://www.tispol.org/guides/luxembourg.pdf

ANNEX 4: Trends of vehicle stock

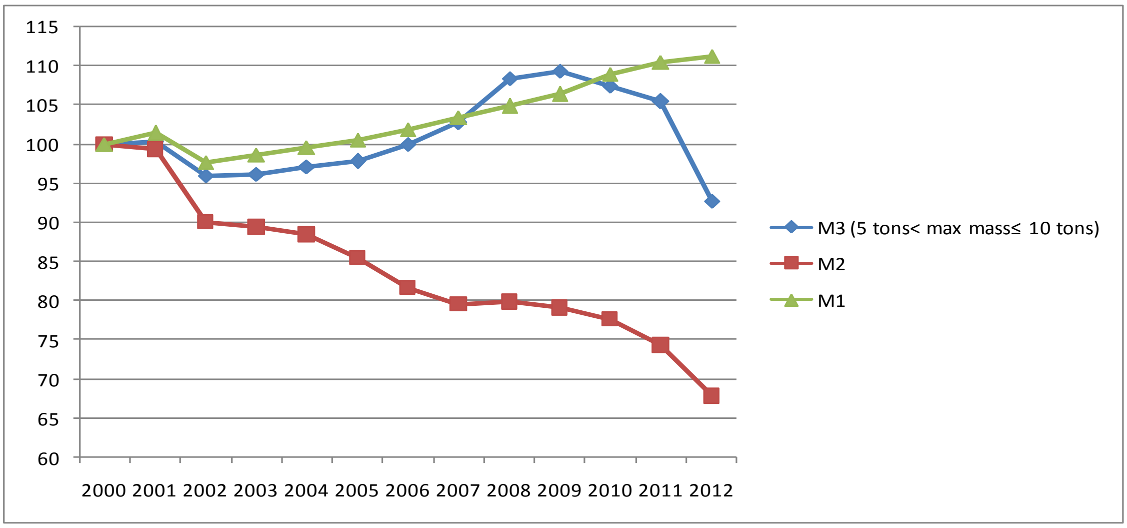
Belgium

The opinion of the Federal Public Service Mobility of Belgium is that the correlation between speed limitation devices and the trend of vehicles' stock is not known. On the basis of data provided and elaborated accordingly, N1 vehicles have had a higher growth trend with respect to both N2 and N3 vehicles. In particular these have been growing since 2002, while N2 and N3 vehicles have been decreasing. Anyway no particular changes in vehicles' trend occurred in the period of the Directive implementation (after 2006).
Also analysing the M vehicles' trend, no particular shift from heavier to lighter vehicles seems to occurred after the year 2006. M1 growth trend has been higher with respect to M2, which on the contrary has been decreasing for the whole period. M1 registers a higher growth trend also with respect to M3 (with 5 tons<max mass<10 tons) in the period 2000-2007. In 2007-2010 M3 grew higher than M1 vehicles, but after 2010 they started to decline.

Trend of the stock of vehicles N1, N2, N2 for the years 2000-2012.



Trend of the stock of M vehicles M3 for the years 2000-2012

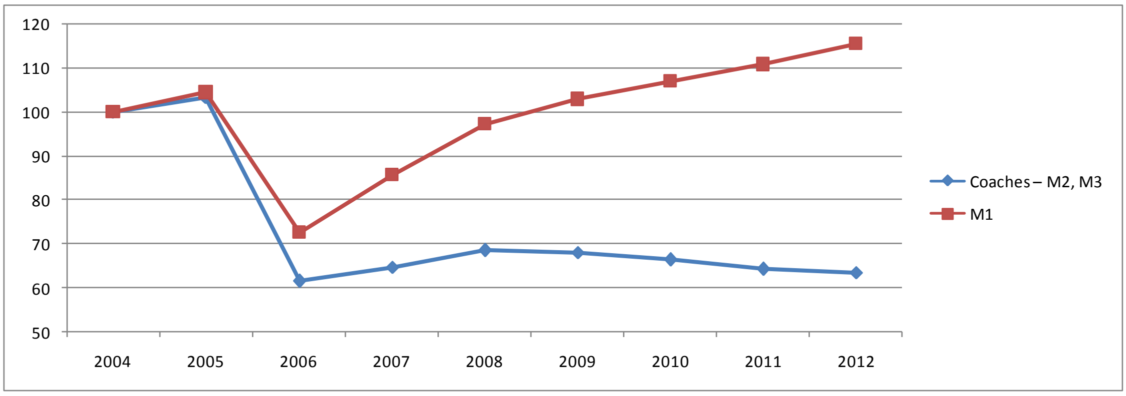


Bulgaria

According to the governmental contact of Bulgaria responding to the questionnaire no relation between the implementation of Directive 2002/85/EC and the trend in vehicle stock has been observed.

Data on M vehicles differentiated per M2/M3 and M1 have been provided. In the following graph it can be observed that both trends declined in 2006 which is the year of Directive implementation. Since 2005 the trend of M2/M3 has been lower with respect to M1 trend.

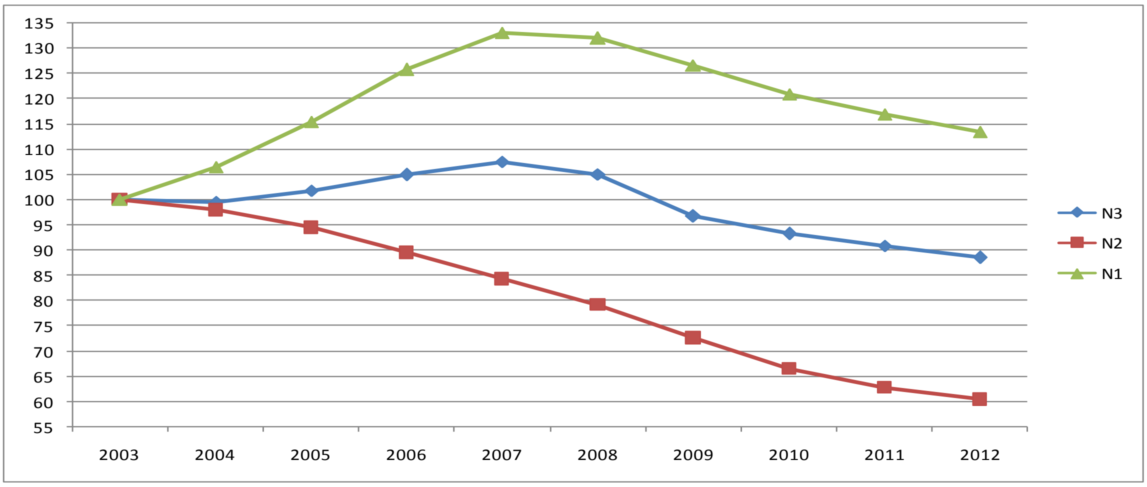
Trend of the stock of vehicles M2/M3 and M1 for the years 2004-2012.



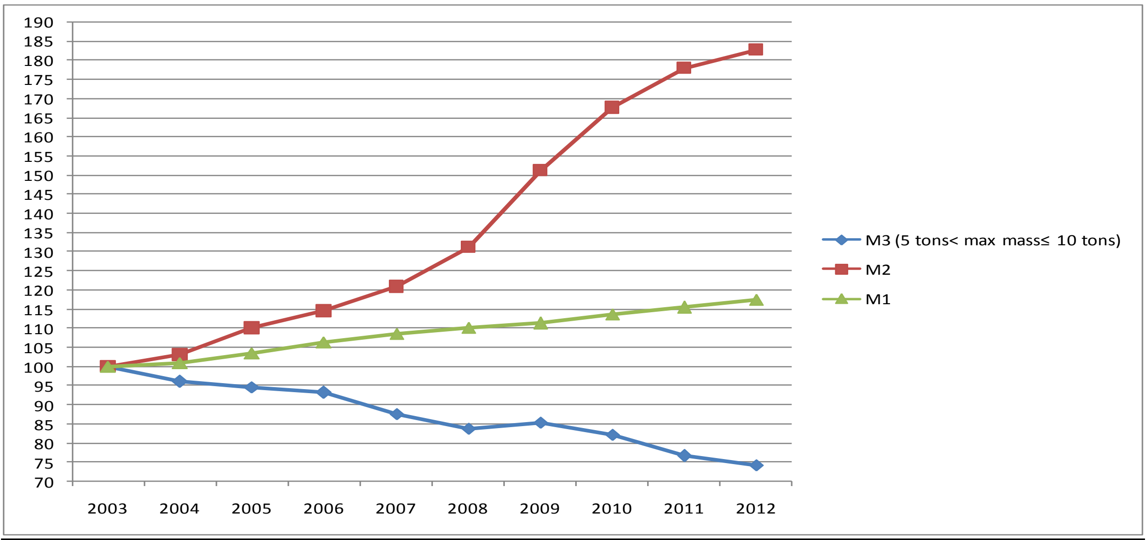
Denmark

On the basis of the data provided by the Danish Transport Authorities, no relation between the implementation of the Speed limiters Directive (in 2005) and the trend in vehicle stock seems to emerge. N1 vehicles grow at a higher rate with respect both to N3 and N2 vehicles, but no particular changes seem to occur after the year of the Speed Limiters Directive implementation. No shift from heavier to lighter vehicles can be observed for M vehicles as well: M2 grow at higher rates with respect both to M3 and M1 long the whole period.

Trend of the stock of vehicles N3, N2, N1 for the years 2003-2012.



Trend of the stock of vehicles M3 (5 tons< max mass≤ 10 tons), M2, M1 for the years 2003-2012.

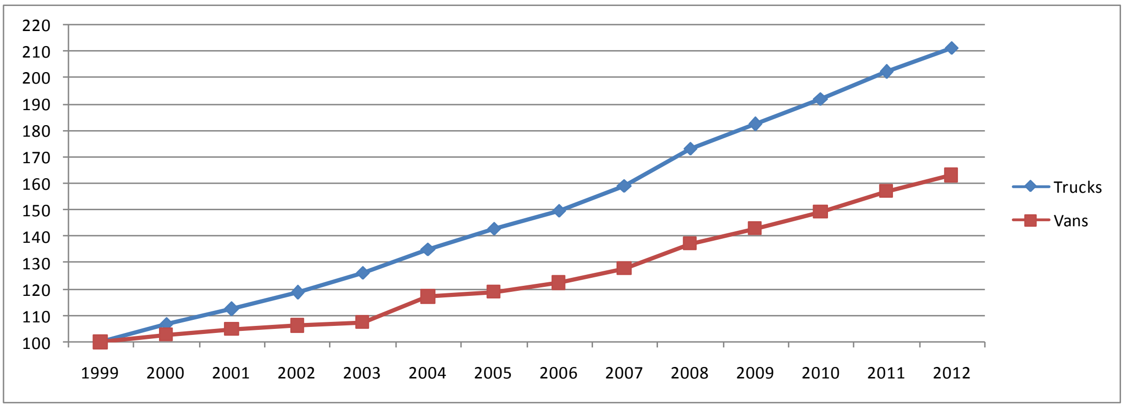


Finland

According to the governmental contact of Finland responding to the questionnaire no relation between the implementation of Directive 2002/85/EC and the trend in vehicle stock has been observed. The data provided by the governmental contact, do not show any relation.

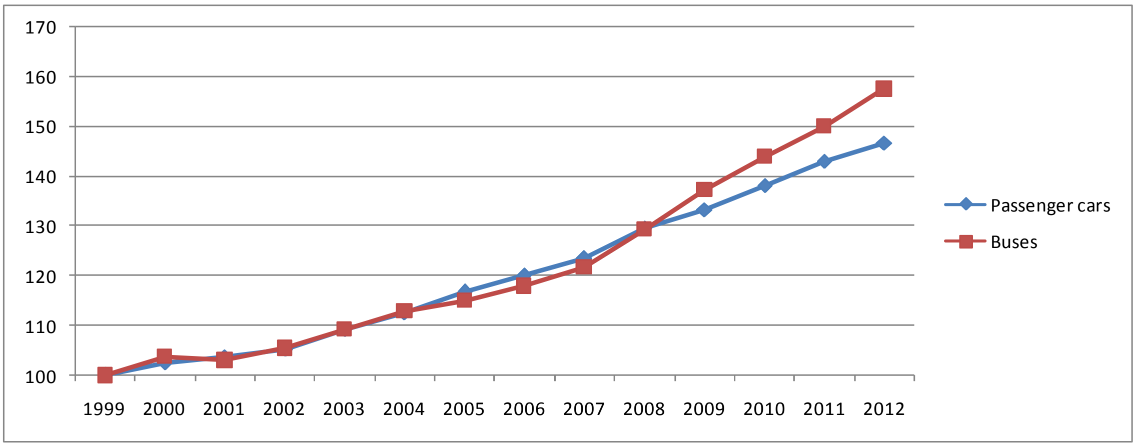
As for good vehicles there can be observed that heavy vehicles (HGVs) have been growing at a higher rate with respect to lighter vehicles for all the time period.

Trend of HGVs and vans for the years 1999-2012.



As for passenger vehicles similar growth trends can be observed until 2008. After, buses started growing at a higher rate with respect to passenger cars.

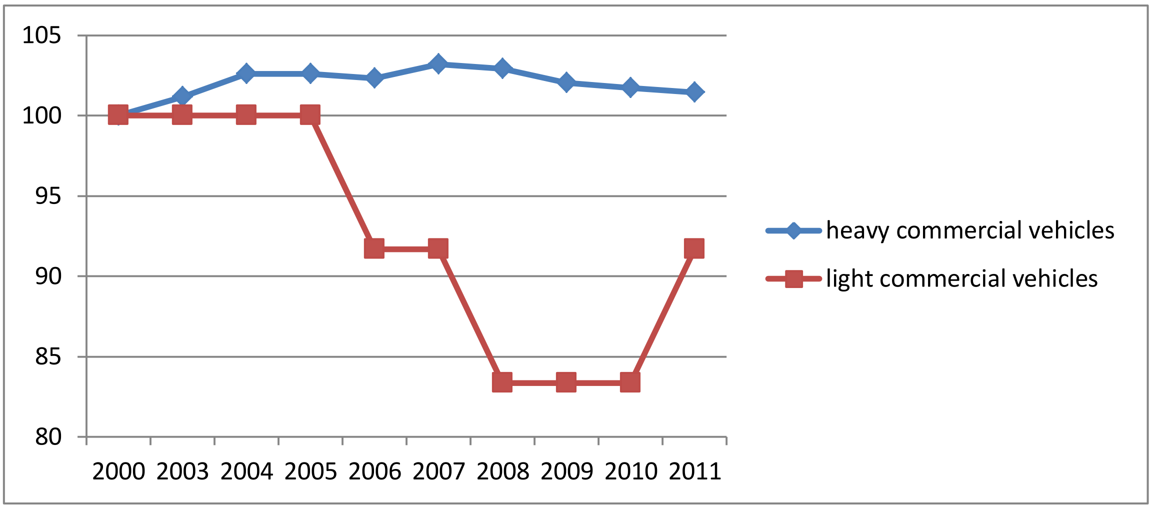
Trend of passenger cars and buses for the years 1999-2012.



France

On the basis of data on commercial vehicles available from the Committee of French auto manufacturers (Association Prévention routière), the following graph has been elaborated.

Trend of heavy and light commercial vehicles for the years 2000-2011.



Heavy commercial vehicles include vehicles weighing more than 3,5 tons and vehicles weighing more than 20 tons while light vehicles include commercial vehicles weighing less than 3,5 tons.

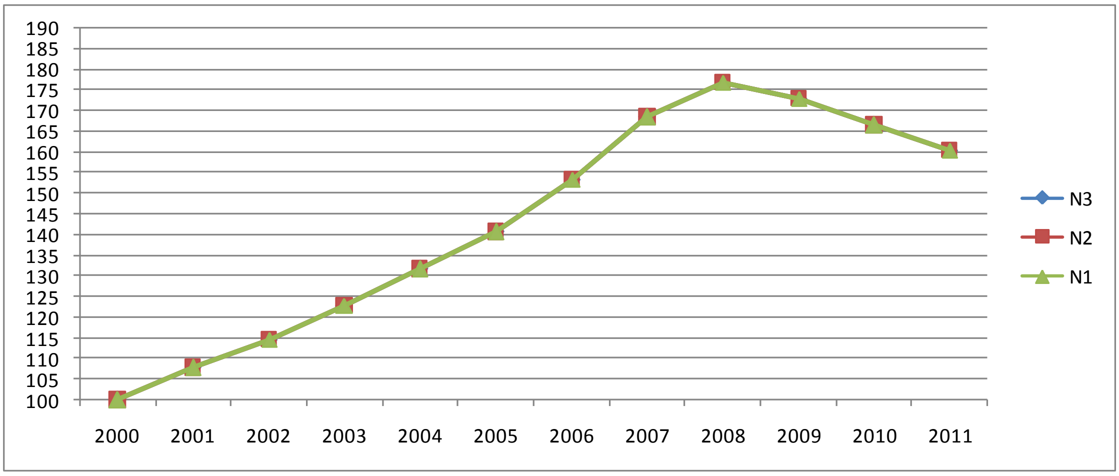
As emerges from the graph it seems that no relation between the Directive implementation and stock of vehicles exists. In fact heavy commercial vehicles have a nearly constant and higher growth trend with respect to light vehicles which on contrary, after the Directive implementation in 2005, show a decreasing trend.

Ireland

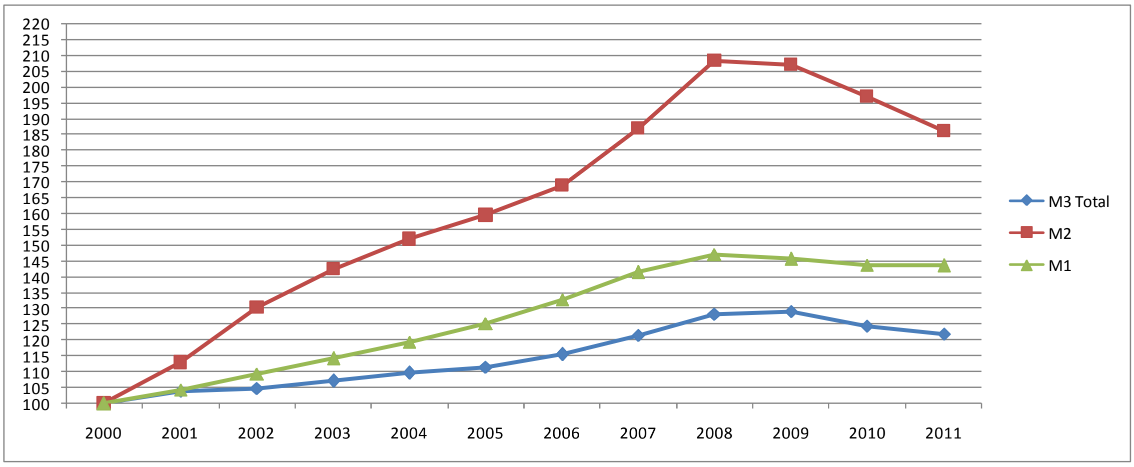
According to the Road Safety Authority (RSA) there are no data which could provide the existence of a possible relation between the registered stock of vehicles and the implementation of Directive 2002/85/EC which was transposed in 2006.

RSA provided time series data for the period 2000-2011 for M and N vehicles. Nevertheless the time series for N vehicles seem not to be convincing: the growth rate of N1, N2, N3 are the same for each year.

Trend of the stock of vehicles N3 , N2, N1 for the years 2000-2011.



Trend of M stock of vehicles for the years 2000-2011.

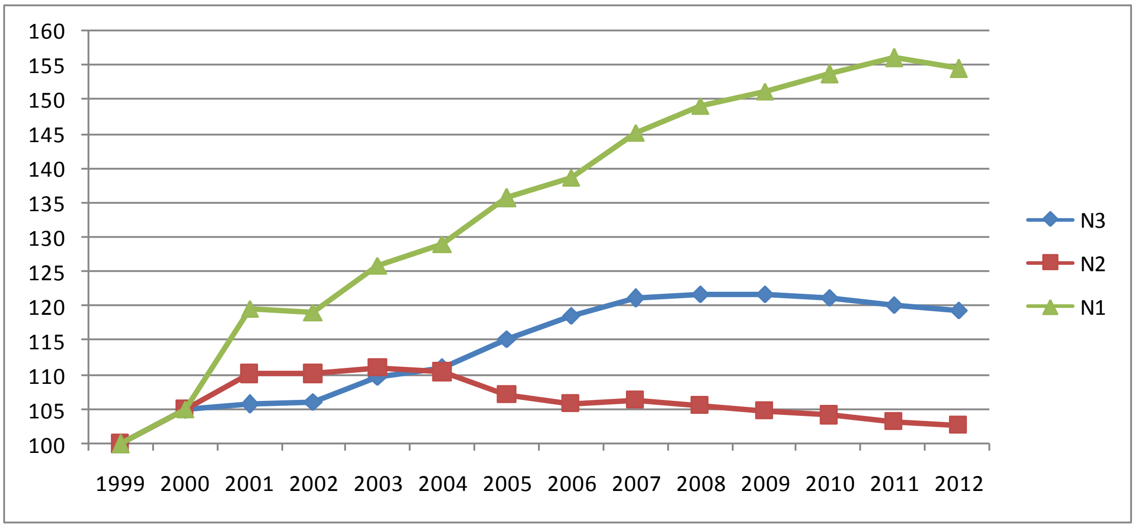


As for M vehicles, M2 registers the highest growth rate along the period while the M3 registers the lowest. No particular changes can be observed after 2006 but only a further increase of M2 vehicles growth rate. Thus no relation seems to emerge.

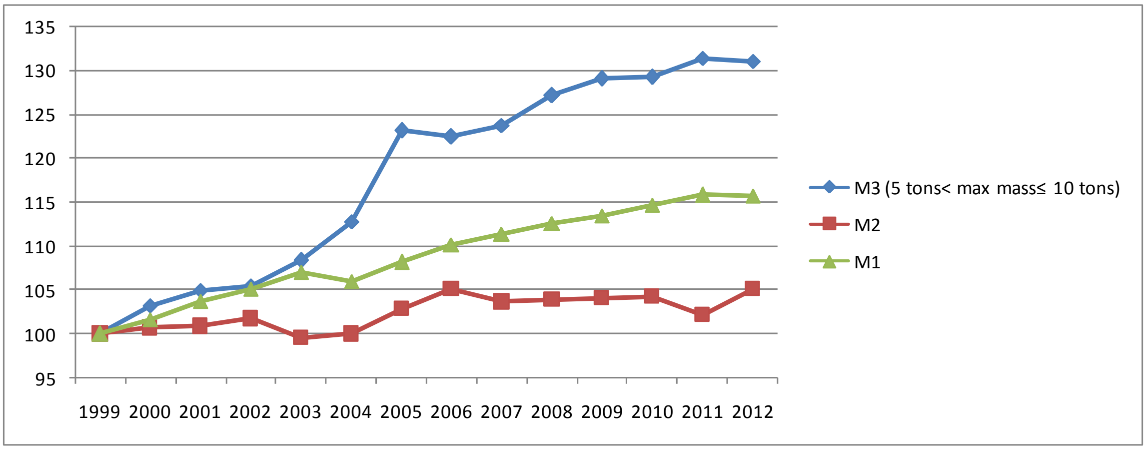
Italy

In Italy the implementation of Directive 2002/85/EC seems not to have affected the trend in N vehicle stock. N1 vehicles have been increasing more than N2 and N3 since 2000 but no particular changes occurred in 2005, the year of directive implementation. As for M vehicles, no relation between the Directive and the vehicle trend seems to emerge since M3 vehicles (5 tons< max mass≤ 10 tons) have been registering a higher growth trend with respect both to M2 and M1since 1999.

Trend of the stock of vehicles N3 , N2, N1 for the years 1999-2011



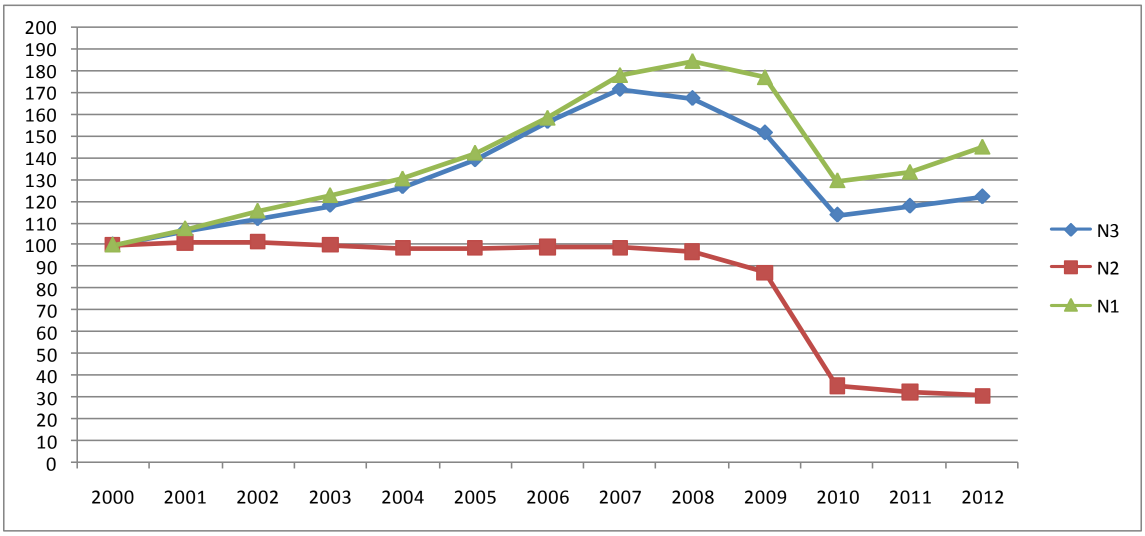
Trend of M stock of vehicles for the years 1999-2012.



Latvia

In Latvia until 2006 N3 and N1 vehicles show nearly the same growth trend, after the growth rate of N1 becomes clearly higher with respect to N3. For all the period the N2 trend is much lower with respect to the other two categories. All three vehicle categories show a decrease after 2008.

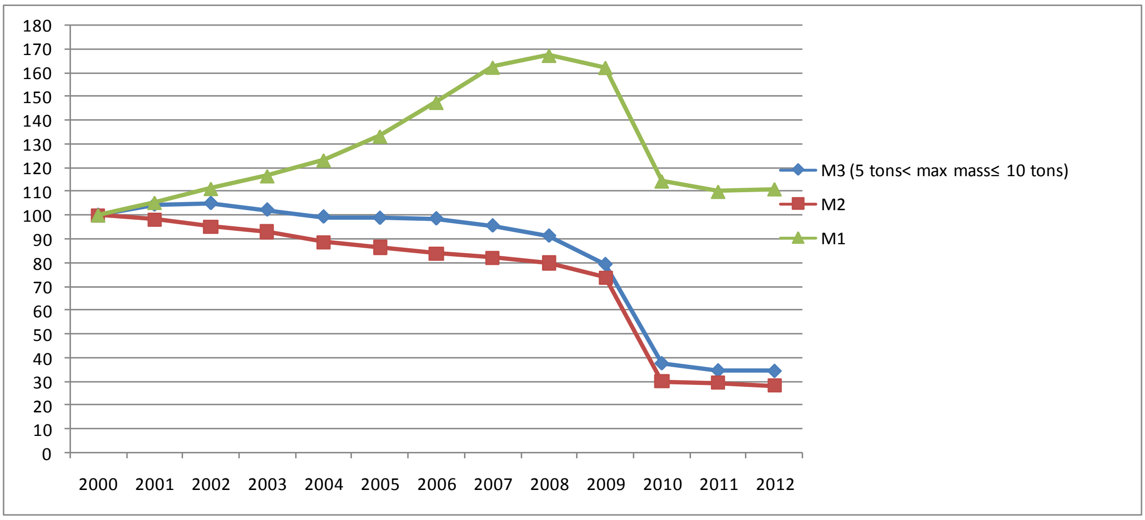
Trend of N stock of vehicles for the years 2000-2012.



As for M vehicles, the M1 growth rate is always much higher with respect to that of both M2 and M3.

In both cases a shift from heavier to lighter commercial vehicles could be possible, but no particolar discontinuities emerge at the time of Directive implementation.

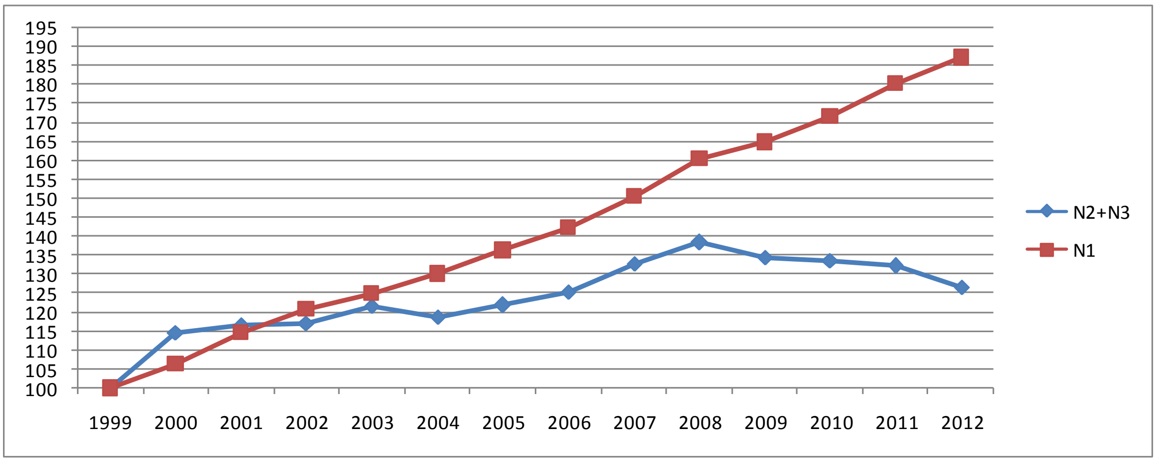
Trend of M stock of vehicles for the years 2000-2012.



Luxembourg

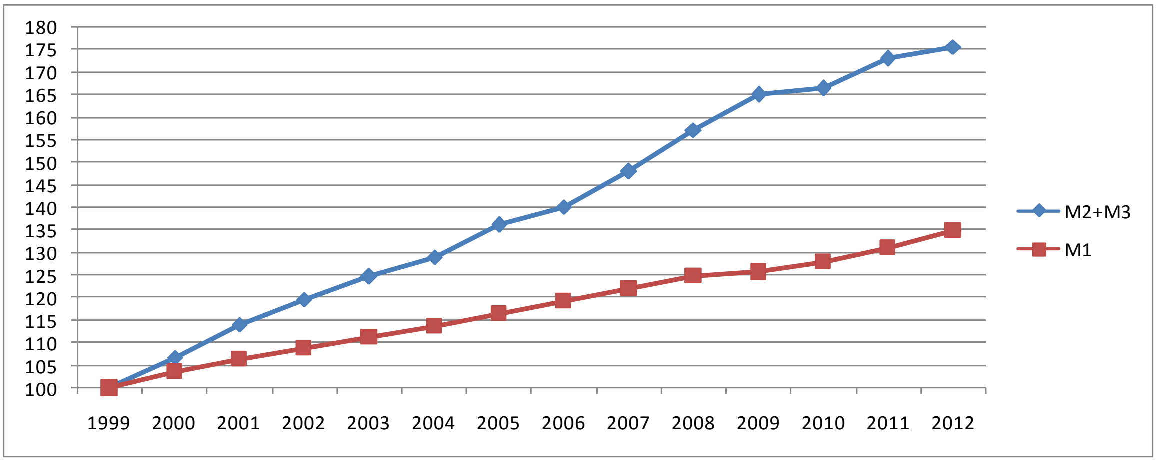
Data for Luxembourg have been provided jointly for N2 and N3 and for N1, jointly for M3 and M2 and for M1. According to the department of transport of the *Ministere du Developpement durable et des Infrastructures*, no impact on the stock of M2/N2 vehicles was noted at the time when the Directive was implemented (2005). However, the number of N1 vehicles has increased much quicker then that one of the N2/N3 vehicles, without being known if this asynchronous increase is linked or not to the speed limiter obligation.

Trend of N stock of vehicles for the years 1999-2012.



As for M vehicles, on the contrary, M2 and M3 increased at a higher rate with respect to light passenger vehicles.

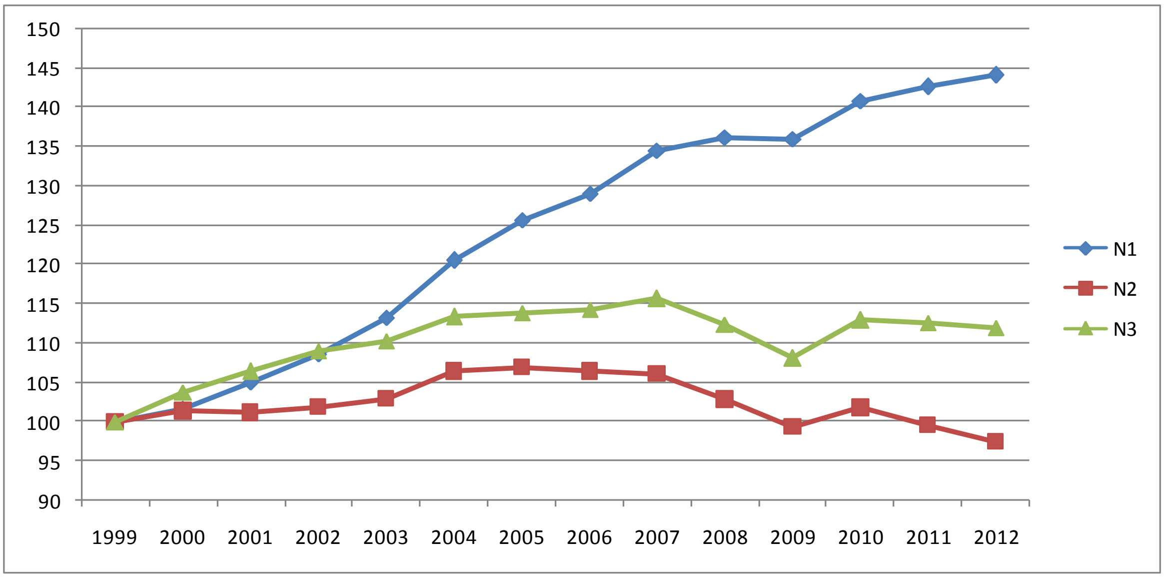
Trend of M stock of vehicles for the years 1999-2012.



United Kingdom

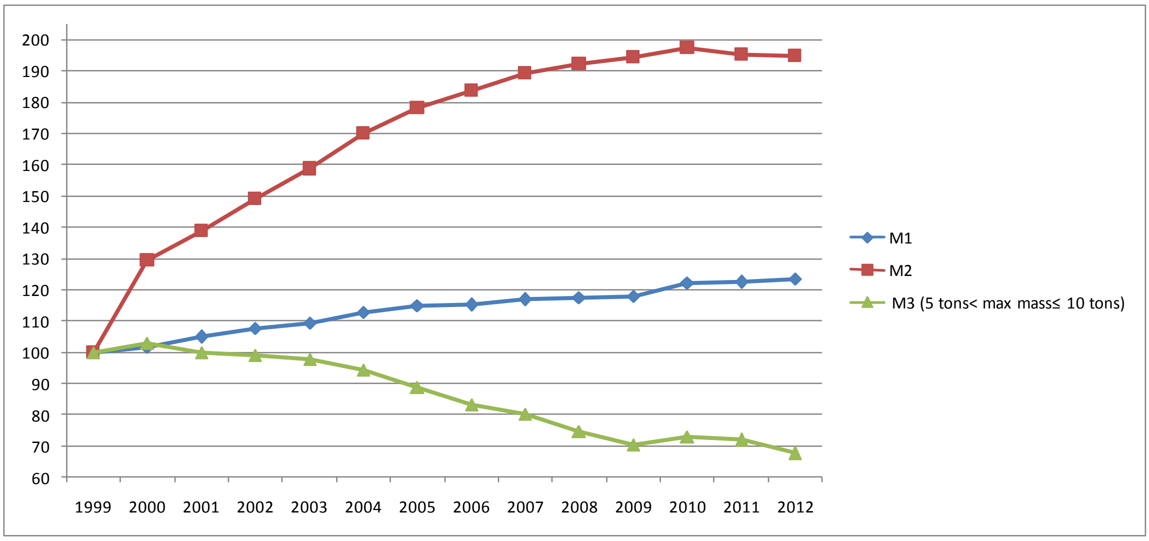
In UK N2 and N3 vehicles have a similar trend and both have a much lower growth rate with respect to N1 vehicles. The gap increases from 2003, two years before the implementation of Directive on speed limitation devices. Accordingly there could be the possibility of a shift from N2 and N3 vehicles to N1 although no particular changes occurred at the time of the Directive implementation.

Trend of the N stock of vehicles for the years 1999-2012.



As for M vehicles, M2 shows the highest growth rate while M3 the lowest. The gap between M1 and M3 increases after year 2003 but since the two vehicle categories are not contiguous, it is difficult to suppose a shift from the heaviest to the lightest vehicle categories. Anyway no discontinuities at the time of Directive implementation emerge.

Trend of M stock of vehicles for the years 1999-2012.



ANNEX 5: Stakeholders workshop participants

Stakeholder conference for the project "Ex-post evaluation of Directive 92/6/EEC on the installation and use of speed limitation devices for certain categories of motor vehicles in the Community, as amended by Directive 2002/85/EC"

June 10th 2013 13:30h-17:00h

Albert Borschette Conference Centre, 36 rue Froissart, in 1040 Brussels, meeting room AB 1A

List of attendants:

Mr Rob Aarse– Transport en Logistiek Nederland (TLN)	Mr Gianfranco Burzio– European Automobile Manufacturers' Association – ACEA
Mr Oliver Carsten – ETSC and PACTS	Ms Silke Conrad – Daimler
Ms Charlotte Creiser – EURALIA	Mr Jos Dings – Transport & Environment
Mr Hans Thomas Ebner – Verband der Automobilindustrie e. V. (VDA)	Mr Jonathan El-Nigomi– Nordic Logistics Association
Mr Maxime Flament – ITS Europe and ERTICO	Mr Olivier Fontaine – OICA
Mr Bernd Gottselig – Ford of Europe	Mrs Tanja Haberzettl– DEKRA e.V.
Mr Nicholas Hodac – Ford of Europe	Mr Frederic Keymeulen – UETS (European Road Haulers Association)
Mr Rainer Krautscheid–BASt + BMVBS	Ms Katherine Lancaster – UK Department for Transport
Mr Agustín Martín Lasanta– CETM	Mr Vincent Legagneur– Toyota Motor Europe NV/SA
Ms Isabelle Maître – French Road Transport Association	Mr Jeannot Mersch – FEVR
Mr Fernando Navarro Sordo – CETM	Mr Jan Nemec – International Road Transport Union (IRU)
Mr Dirk Saile– Bundesverband Güterverkehr Logistik und Entsorgung (BGL) e.V	Mr William Todts – Transport & Environment
Ms Ellen Townsend – European Transport Safety Council (ETSC)	Mr Stephane Verwilghen – ASECAP
Mr Karim Yahia – ACEA	Mr Stephane Dreher – NOKIA/HERE
Mr Rudolf Koronthály (DG MOVE)	Mr Roberto Ferravante (DG MOVE)
Mr Casto Lopez Benitez (DG MOVE)	
Ms Odile Arbeit de Chalendar (DG MOVE)	Mr Peter Broertjes (DG ENTR)
Ms Eef Delhaye (TML)	Mr Angelo Martino (TRT)
Mr Huib van Essen (CE Delft)	Mr Maarten 't Hoen (CE Delft)

ANNEX 6: List of ministries/competent offices, experts and stakeholders contacted

List of EU ministries/competent offices contacted

Country	Institution/Organization
AT	Federal Ministry for Transport, Innovation and Technology, Dept. "Technology and Road Safety
BE	Service public federal, Mobilitè et trasports
BE	DG Road Transport & Road Safety Service Regulations vehicles
BG	Ministry of Transport, Executive Agency "Automobile Administration"
CY	Ministry of Communication and works
CZ	Ministry of Transport
DK	Ministry of Transport
EE	Ministry of Economic Affairs and Communications
FI	Ministry of Transport
FR	Ministère de l'Ecologie, du Développement durable et de l'Energie
DE	Ministry of Transport

EL	Ministry of Infratsructure, transport and networks
HU	Ministry of the National Development
IE	Department of Transport, Tourism and Sport
IT	Ministry of economic development and infrastructure
LV	Ministry of Transport
LT	Ministry of Transport and Communications
LU	Department of transport
MT	Ministry for infrastructure, transport and communication
NL	Ministry of infrastructure and environment
PL	Ministry of Transport, Construction and Maritime Economy
PT	Ministry of Economy and development
RO	Ministry of transport
SK	Ministry of transport, Road transport department
SI	Ministry of infrastructure and spatial planning
ES	Ministero de Fomento, Direccion de Carreteras
SE	Ministry for Infrastructure
UK	Secretary of State for transport

List of the members of the high level group on road safety

Country	**Name**	**Function/Position**	**Institution/Organization**	**e-mail**
AT	Eva M. Eichinger-Vill	Head of Dept.	Federal Ministry for Transport, Innovation and Technology, Dept. "Technology and Road Safety	eva.eichinger-vill@bmvit.gv.at
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UK	Daryl lloyd	Daryl.Lloyd@dft.gsi.gov.uk
UK	Pat Kilbey	pat.kilbey@dft.gsi.gov.uk

List of the stakeholders

Country	Name
	PSA Peugeot-Citroen
	MAN
	Ford
	FIAT-CHRYSLER
	TOYOTA
	CONTINENTAL
	Bosch
	DENSO International Europe

	Light Sight Safety Initiative
	Koch Consulting
	Mobileye
	ADAS-Management Consulting
	Delphi
	AUTOLIV
BE	Attaché - Policy Unit Road transport and road safety
BE	Belgian Road Safety Institute
BE	Transport & Logistieks Vlaanderen
CH	BFU-Swiss Council for Accident Prevention
CZ	DEKRA Automobila
DE	Bundesministerium für Verkehr, Bau und Stadtentwicklung
DE	German Road Safety Council
DE	Verband der Automobilindustrie
DK	Ministry of Transport. Center for Veje og Broer
DK	Nordic Traffic Safety Council
DK,NO,SE	Nordic Logistics Association
EL	Centre for Research and Technology Hellas / Hellenic Institute of Transport
ES	Permanent Representation
ES	CETM-Confederación Española de Transporte de Mercancías
ES	CNAE-Spanish Confederation of Driving Schools
EU	European Automobile Manufacturers Association (ACEA)
EU	ACEM-Motorcycle Industry in Europe
EU	CLEPA- European Association of Automobile Suppliers
EU	FEMA- The Federation of European Motorcyclists' Associations
EU	ECF- European Cyclist Federation
EU	FEVR- European Federation of Road Traffic Victims
EU	ERTICO- Intelligent Transport Systems and Services for Europe
EU	ETSC- European Transport Safety Council
EU	ASECAP- European Association with tolled motorways, bridges and tunnels
EU	EuroNCAP-European New Car Assessment Programme
EU	UNECE- United Nations - Economic Commission for Europe
EU	EARPA- European Automotive Research Partners Association

EU	ECTRI- European Conference Transport Research Institutes
EU	ETRMA-European Tyre & Rubber Manufacturers' Association
EU	Transport& Environment
EU	ETF-European Transport Workers Federation
EU	ECR - Euro Control Route
EU	CEA-Insurance Europe
EU	UETR European Road Hauliers Associacion
FI	Finnish Transport Safety Agency
FR	Association Prévention routiere
FR	Laboratoire Interactions Véhicules-Infrastructure-Conducteurs
HR	MP Educon
HU	KTI Institute for Transport Sciences Non Profit Ltd.
IT	Centro di Ricerca per il Trasporto e la Logistica
IT	DEKRA Automotive Italy
IT	Fondazione ANIA per la sicurezza stradale
NL	Rijkswaterstaat Centre for Transport and Navigation Safety
NL	Business Europe
NL	SWOV – Dutch Transport Safety Research Organisations
NO	Norwegian Public Roads Administration
SE	The Swedish Transport Agency
SE	Swedish Transport Administration
SE	NTF-Swedish National Society for Road Safety
SI	Slovenian Traffic Safety Agency
UK	ITS Leeds
UK	UK Parliamentary Advisory Council
World	International Organization of Motor Vehicle Manufacturers (OICA)
World	FIA- Fédération Internationale de l'automobile
World	FIM- Fédération Internationale de Motocyclisme
World	IRU-International road transport union
World	CORTE
World	UICR-International Union of Professional Drivers

ANNEX 7: Implementation of the speed limitation directive and enforcement of checks

Implementation of the speed limitation Directive

Country	Implementation
BE	Directive 92/6/EEC was transposed through the Royal Decree of 15 March 1995. Directive 2002/85/EC was transposed through the Royal Decree of 15 March 2006.
BG	The requirements of the Speed Limitation Directive are transposed in Bulgarian Road Transport Law and Ordinance No 13 regarding the requirements for the obligatory use of speed limitation devices which are fitted in the motor vehicles.
DK	Danish law (Road Traffic Act and Parliamentary regulation of vehicle design and equipment)
EE	The rules of the Speed Limitation Directive are enforced with the Estonian Road Traffic Act (adopted on 17.03.2011, RT I 2010, 44, 261) and the Regulation of the Ministry Economic Affairs and Communications of 2 November 2010 nr 94 on the requirements for the installation of speed limitation devices and the control of the conditions and procedures for use of speed limitation devices (RT I, 29.12.2010, 115)
EL	The Speed Limitation Directive, • was introduced in the national law with the Ministerial Decision No. 39622/3313/1992 (GG issue No. B' 639) • was supplemented by theMinisterial Decision No. 5400/399/1995 (GG issue No. B' 142) • and was amended by theMinisterial Decision No. 39184/2034/2004 (GG issue No. B' 1336)
HU	The Speed Limitation Directive is enforced byRegulation N6 from 1990 of the minister of environment, communication and transport. It includes relevant prescriptions on speed limitation devices.
IE	The Speed limitation Directive is implemented by the Statutory Instruments • S.I. No. 831/2005 — European Communities (Installation and Use of Speed Limitation Devices in Motor Vehicles) Regulations 2005 • S.I. No. 339/2006 — European Communities (Installation and use of Speed Limitation Devices in Motor Vehicles) (Amendment) Regulations 2006
IT	The Speed limitation Directive is implemented through the Decreto Ministeriale 19 novembre 2004 (G.U. n. 50 del 2.3.2005) and the Circular n. 5520/M361 of 25.03.2005, dealing with both new vehicles and retrofitting of in use vehicles.
LI	The rules of the Speed Limitation Directive are enforced via national legislative acts. Thesenational rules cover installation of speed limitation devices and roadworthiness.
LU	• Arrêté grand-ducal du 16/12/1992. Mémorial Grand-Ducal B • Règlement grand-ducal du 13 janvier 2005 modifianta) l'arrêté grand-ducal modifié du 23 novembre 1955 portant règlement de la circulation sur toutes les voies publiques;b) le règlement grand-ducal modifié du 27 janvier 2001 fixant les modalités de fonctionnement d'un système de contrôle technique des véhicules routiers;c) le règlement grand-ducal modifié du 17 juin 2003 relatif à l'identification des véhicules routiers, à leurs plaques d'immatriculation et aux modalités d'attribution de leurs numérosd'immatriculation
LV	The Directive has been implemented through the document "Requirements for vehicles to be equipped with a speed-limiting devices and the procedures for using them", adopted by the Cabinet of Ministers of Latvia on the 23rd of December 2002.
PO	Provisions of Directive 92/6/EEC as amended can be found in Polish Road Traffic Act (art. 66 par. 1a, 1b, 1c).
RO	The legal framework for implementing the mandatory installation of the speed limitation devices was established in 2003 by the Government Decision no. 899/2003 on the implementation of the conditions on the type approval of the control device in the road transport, on authorizing the speed limitations devices, as well as on the conditions of installation, calibration, adjustment and testing of the control devices in road transport and speed limitation devices. The following regulations represent the legal framework for putting into practice those provisions, as well as the control on the installation and use of the speed limitation devices:

	- The regulations on the installation, calibration and testing of the tachographs and the speed limitation devices, as well as on licensing of the economic operators performing these activities – RNTR 8, approved by the Order no. 181/2008 of the Minister of Transport; - The regulations on technical conditions that road vehicles must meet, so as to be allowed to roll on the public roads in Romania RNTR 2, approved by the Order no. 211/2003 of Minister of Public Works, Transport and Housing, as amended; - The regulations on the individual approval, of identity cards and the certification of the road vehicles, authenticity – RNTR 7, approved by the Order no. 2132/2005 of the Minister of Transport, Construction and Tourism, as amended; - The regulations on the certification of the compliance of the registered road vehicles with the technical regulations on road traffic safety, the environment protection and the use according to the destination – RNTR 1, approved by the Order no. 2133/2005 of the Minister of Transport, Construction and Tourism, as amended. - Government Ordinance no. 27/2011 on road transport; - Government Decision no. 69/2012 establishing infringements and sanctions for breaking of provisions of Regulations (EC) no. 1071/2009, 1072/2009, 1073/2009 and Government Ordinance no 27/2011.
SK	The Speed Limitation Directive is implemented by the Regulation of Slovak Government No. 153/2006 and No. 154/2006.
UK	The domestic legislation implementing the directive on speed limitation devices is: SI 2004/2102 The Road Vehicles (Construction and Use) (Amendment) (No.2) Regulations 2004

Sources: Questionnaires Replies; for LU and UK: eur-lex.europa.eu/

Frequency of Checks on vehicles' compliance with the Speed Limitation Directive and enforcement of relevant rules

Country	Frequency of checks on vehicle compliance	Enforcement of Directive rules
AT	Every 2 years	Compliance to Directive rules is verified through technical roadside inspections
BE	Every two years	The test on speed limiters can be done through an analogue speedometer or a digital speedometer. In the first case the analogue speedometer measure the set speed twice while the digital speedometer measure the set speed by maintaining this for more than a minute. An inspection plaque that self-destructs if an attempt is made to remove it, is affixed to a component of the vehicle that cannot be replaced during use. The inspection plaque shows the heading “inspection of the speed limitation device”, the name, address and the registration number of the fitter, the date of inspection and the set speed.
BG	Every 2 years	The enforcement of the rules of this directive are verifiedduring the periodic technical inspections and roadside checks by competent control authorities
DK	Every year	
EE	Every year	The enforcement of rules are verified during the periodic roadworthiness tests for motor vehicles and their trailers (according Directive 2009/40/EC).and during the technical roadside inspection of the roadworthiness of commercial vehicles (according Directive 2000/30/EC). Checks on the maximum speed used for speed limiters for heavy vehicles and buses is assessed through a test on the calibration of speed limitation device.
FI	Every year During technical inspections, the Calibration certificate is required.	Compliance with Directive rules is verified through traffic checks carried out by the police
EL	-Every year : visual inspection (of the speed limiter) is carried out during the periodical verification of M3, N3, M2, N2 vehicles, according to Directive 2009/40/EC. - Visual inspection (of the speed limiter) is carried out during the technical roadside inspections of M3, N3, M2, N2 vehicles,	

	according to Directive 2000/30/EC.	
HU	Every year	The test to check the maximum speed used for speed limiters is performed by an authorized specialized workshop which issues a certificate for the vehicle. This certificate is valid for two years.
IE	Every year	Enforcement of the Speed Limitation Directive is achieved through a combination of a speed limiter check at a vehicle's annual roadworthiness test, coupled with checks carried out by RSA Vehicle Inspectors / National Police Force at the roadside.
IT	Every year	Compliance with the Speed limitation Directive provisions is verified through the periodicaltechnical inspection (PTI) of M2, M3, N2, N3 vehicles which is yearly carried out . During PTI the integrity of the speed limiter seals are checked. Random speed police control are performed on the road. Vehicles subject to speed limiters are tested and calibrated on rolling benches in technical centrethat are authorized by the Italian Ministry. The signal to the speed limiter is mechanically sealed in order to avoid manipulation
LI	Every two years	
LU	Every two years in relation with the bi-annual calibration of the tachograph	Enforcement is ensured through speed controls by the Police on the roads and during the periodical technical inspection of the vehicles(i.e. every 6 months for all vehicles > 3.5 t) The max. speedof the speed limiters is tested at the first installation of the speed limiter by the authorised workshops.
LV	Every year	
PO	Inspections on N2 and N3 vehicles are carried out by Automobile Inspection Stations every year while inspections on M2 and M3 vehicles are carried out after one year at first and after , checks are carried out every two years.	Speed limiters are checked as a part of periodic roadworthiness checks and during road side check if it's possible. If vehicle is recorded with on board speed camera exceeding allowed limitation vehicle might be directed to appropriate workshop to check speed limiter.
RO	Every two years, during the periodical checks.	The inspections regarding the compliance with the legal regulations in force, on the installation of the speed limitation devices on vehicles are performed as follows: - Before the admission to public road circulation of the authorized road vehicles; - After the vehicles' registration relating on the periodical technical inspection; - At the initial check of the speed limitation devices as soon as they are installed; - Every two years, after the installation of the speed limitation devices, during the periodical checks; - Whenever it's in use, during the inspections performed by the enforcement authorities
SK	Every year	
UK	Whenever vehicles are checked at the roadside	Enforcement is ensured through roadside checks of vehicles and regular visits to calibration centres to ensure standards are maintained in accordance with the Regulations Specific checks on speed limits set for speed limiters are carried out through tachograph records and automatic speed measurement devices to help identify compliance

ANNEX 8: Studies on speed limitation devices and relevant impacts suggested by governmental contacts and stakeholders

Studies on the impacts of speed limitation devices on average speeds and speed profiles.

Stakeholder	Studies	Dimension
Centro di ricerca sui trasporti e la logistica	VárhelyA., Mäkinen T., 2001, The effects of in-car speed limiters: field studies, Elsevier, Transportation Research, Part C 9 (2001) 191-211	European

Studies on the impacts of speed limitation devices on emissions

Stakeholder	Studies	Dimension
Centro di ricerca sui trasporti e la logistica	Transport Canada, 2008, , Speed Limiter Case study and Industry Review, prepared by Knowles Canada.	National (Canada)
ITS Leeds	Carslaw D. C., Goodman P.S., Lai F.C.H., Carsten O.M.J., 2010, Comprehensive analysis of the carbon impacts of vehicle intelligent speed control, Elsevier.	
CETM	Treatise Training in Environmental Transport, 2005, La Conducción Eficiente, un nuevo estile de conducción que logra importantes ahorros de carburante, reducción de emisiones y que mejora le seguridad de la conducción.	National (Spanish)
European Cyclists' Federation	European Federation for Transport and Environment, 2005, Road Transport speed and climate change.	European
	Kellera J., Andreani-Aksoyoglua S., Tinguelya M., Flemmingb J., Heldstabc J., Kellerc M., Zbindend R., Prevot A., 2008, The impact of reducing the maximum speed limit on motorways in Switzerland to 80 km h-1 on emissions and peak ozone, Environmental Modelling & Software.	National (Switzerland)
	Smita R., Poelmanb M. and Schrijver J., 2008, Improved road traffic emission inventories by adding mean speed distributions, Atmospheric Environment	Simulations
	Panis L. , Broekx D. ; Beckx C. , 2006, Impact of 30 km/h zone introduction on vehicle exhaust emissions in urban areas, London Association for European Transport. (http://uhdspace.uhasselt.be/dspace/bitstream/1942/1366/1/impact%20of%2030.pdf)	National (Belgium)
	Wang Z., Walton C., 2006, An Investigation on the Environmental Benefits of a Variable Speed Control Strategy.	International

	Thomas R., 2006, Assessing the benefits of options to improve the UK's air quality. Local transport today ltd. United Kingdom	National (UK)
	van Beek W., Derriks H., Wilbers P., Morsink P., Wismans L., van Beek P., The effects of speed measures on air pollution and traffic safety	-
	Olde M.J.T., Van Beek P., StemerdingM.P., HavermansP.F., 2005, Reducing speed limits on highways: Dutch experiences and impact on air pollution, noise-level, traffic safety and traffic flow, London Association for European Transport.	National (Netherlands)
	Cameron M., Potential benefits and costs of speed changes on rural roads	National (Australia)
	Sucharov L.J. , Brebbia C.A., BenitezF., Veurman J., Gense N.L.J., Wilmink I.R., Baarbe H.I, Emissions at different conditions of traffic flow, Wit Press Ashurst Lodge, Ashurst Southampton, United Kingdom.	National (Netherlands)
	Federal Environmental Agency, 2003, Reducing CO2 emissions in the transport sector . A status report by the Federal Environmental Agency -A description of measuresand update of potentials Language of the document: English	-
	Mao-B, Chen-H, Chen-S, 2002, Sustainability assessment of speed regulation of urban traffic, International association of traffic and safety sciences, 6-20, 2-chome yaesu, chuo-ku, tokyo 104-0028, Japan	National (Japan)
	Haworth N., Symmons M., 2001, The relationship between fuel economy and safety outcomes, Monash University. accident research centre (muarc), Australia	-
	Haworth N., Symmons M., 2001, Driving to reduce fuel consumption and improve road safety, Monash University, Victoria, Australia	-
	Taylor M., Dyson C.B., Woolley J.E. , 2001, Lower urban speed limits: trading off safety, mobility and environmental impact, Tasmania, Department of infrastructure, energy and resources, Australia	National (Australia)
	Taylor M. , 2000, Network modelling of the traffic, environmental and energy effects of lower urban speed limits, ARRB Transport Research LTD, Victoria, Australia	-
	EH Pechan and Associates, 1997, The effects of raising speed limits on motor vehicle emissions.	National (UK)

	Mullen M.A., Wilson JH Jr , Gottsman L., Schroeer W.L., 1997, Emissions impact of eliminating national speed limits: one year later.	National (USA)
	Emissions Impact of Elimination of the National 55 mph Speed Limit 01.08.96	National (USA)
	Wernsperger F., Sammer G., 1995, Results of the scientific investigation accompanying the pilot trial of 30 kph limit in side streets and 50 kph limit in priority streets, PTRC Education and Research Services LTD, United Kingdom. Language of the document: English	National (Austria)
	Sammer G., 1994, General 30 kph speed limit in the city: the results of a model project inthe city of Graz , Transportation Research Institute, Technion-israel institute, Technion city, Haifa, 32000, Israel	National (Austria)
	Davis A., 1994, Speed: a human and planetary health hazard, Royal Society for the prevention of accidents (ROSPA), United Kingdom	-
	Fergusson M., 1994, Communications. the effect of vehicle speeds on emissions, Butterworth-heinemann ltd, United Kingdom.	National (UK)
	Joergensen C.H., Krawack S., Soerensen M.M., Therkelsen H., 1993, Transport planning and policy: the Danish experience	National (Denmark)
	World Wide Funf for Nature, Friends of the earth, 1992, The effect of vehiclespeed on emissions. an update, Earth resources research, United Kingdom	National (UK)
	Den-Tonkelaar-Wam , 1991, Calculation of the optimal driving speed of cars and lorries (minimal emissions and fuel consumption) on highways with different speed limits, tno milieuwe tenschappen tno, Netherlands Language of the document: Dutch	National (Netherlands)
	Den-Tonkelaa R-Wam, 1991, Speed limits, effects and benefits in terms of energy efficiency and reduction of emissions, Elsevier science publishers , Amsterdam, Netherlands	National (Netherlands)
	Howard D, TRANSNET, 1991, Reducing carbon dioxide from transport: a costed strategy, Green Party, London, United Kingdom	National (UK)
	TRANSPORTRAADET , 1990, Traffic, energy and carbon dioxide. strategies for the reduction of fuel consumption and exhaust emissions, Solna, Sweden Language of the document: Swedish	National (Sweden)

	Thunberg B, Hammarstroem U., Karlsson B., Moelle R.S. , Perby H.,1990, Title: traffic and exhaust emissions - A Forecast up t the year 2015. calculation of emissions on the basis of different assumptions, Statens Vaeg och trafikinstitut, Linkoeping, Sweden. Language of the document: Swedish	National (Sweden)
	Den-Tonkelaar-Wam , 1987, The Introduction of a new policy of speed limits on motorways on the emission of air polluting materials, Nederlandse organisatie voor toegepast natuurwe tenschappelijk onderzoek Tno, Delft, Netherlands. Language of the document: Dutch	National (Netherlands)
Transport & Environment	De Vlieger I.,. Schrooten L, Pelkmans L., Panis L., 2005, 80 km/h maatregel voor vrachtwagens Wetenschappelijke screening van het effect op de uitstoot van CO2 en schadelijke emissies	-
	Rexeis M., Hausberger S., Heinz S., 2011, Lkw-Tempolimits und Emissionen, Auswirkungen der Einhaltung der Lkw-Tempolimits auf Autobahnen auf Emissionen und Lär	-
	National research Council of the National Acadamies, 2010, Technologies and approaches to reducing the fuel consumption of medium- and heavy-duty vehicles, Washington, D.C.	National (U.S.A.)
	Transport & Environment, 2011, How clean are Europe's cars? An analysis of carmaker progress towards EU CO2 targets in 2010	European
	Transport & Environment, 2011, Q&A - EU transport spending: The 'Cohesion' fund and 'Connecting Europe Facility'	European
	Transport & Environment, 2012, Briefing: Biofuels and ILUC	European
	Transport & Environment, 2012, Briefing: Implementing the FQD	European

Studies on the impacts of speed limitation devices on road safety

Country /stakeholder	**Studies**	
SK	National plan for road safety increasing focused for second half of the year 2005 with the perspective to the year 2010 as approved by government decree No. 391/2005 dated on May 18th , 2005	National (Slovakia)
	Road safety enhancement strategy in the Slovak Republic in the years 2011 to 2020 as approved by government decree No. 798/2011 dated on December 14th , 2011	National (Slovakia)
UK	Bishop R., Murray D.C., MC Donald W., Hickman J., Bergoffen G., 2008, CTBSSP Synthesis 16, Safety Impacts of Speed Limiter Device Installations on Commercial Trucks and Buses, Transportation Research Board, Washington D.C.	International
Centro di ricerca sui trasporti e la logistica	Paine M., Paine D., Faulks D., Speed Limiting Trials in Australia,	National (Australia)
European Cyclists' Federation	FKA Automotive research, 2012, Safer Cleaner, How small changes to lorry design can make a big difference, Transport & Environment	European
	Den Boer E., Brouwer F., Smokers R., Verbeek M., 2010, Speed limiters for Vans in Europe, Environmental and safety impacts, CE Delft.	European
	Hanowski R., Research on the safety impacts of speed limiter device installations on commercial motor vehicles, Virginia Tech Transport Institute	
	U.S. Department o transportation, Federal Motor CarrierSafety Administration, 2012, Research on the Safety Impacts of Speed Limiter Device Installations on Commercial Motor Vehicles: Phase II	International

	Ceder A.,The Effect of Installing Speed Limiter on the Amount and Severity of Interurban Road Accidents, the Ran Naor Foundation.	National (Israel)
	Transport Canada, 2008, Learning from Others: An International Study on Heavy Truck Speed Limiters	International
ETSC-European Transport Safety Council	ETSC, Knowledge for Leadership-The Road Safety performance Index, Assessing Road Safety performance across Europe, PIN Flash N.16, Tackling the three main killers on the roads, A priority for the forthcoming EU Road safety Action Programme, Brussels.	European
	ETSC, 2008, "Road Safety as a right and responsibility for all" A Blueprint for the EU's 4th Road Safety Action Programme 2010-2020, Brussels	European
	ETSC, 2012, ETSC's Contribution to CARS 21 WP1 on Road Safety, Brussels	European
	Somcic G., Townsend E., 2008, Managing Speed Towards Safe and Sustainable Road Transport, ETSC, Brussels	European
	ETSC, 2011, PRAISE": Preventing Road Accidents and Injuries for the Safety of Employees, Driving for Work: Managing speed, Brussels	European
Trafikverket, Swedish transport Administration	Elvik R., 2009, The Power Model of the relationship between speed and road safety, Update an new analysis, Institute of transport Economics, Norwegian Centre for Transport Research, Oslo	National (Sweden)
VDA Verband de Automobilindustrie	BAST, DEKRA, UDV, VDA, 2013, Project Report Safety of Light Commercial Vehicles, VDA-Verband de Automobilindustrie, Berlin	National (Germany)
FORD	International Transport Forum, IRTAD, Road Safety Annual Report 2013	International
Transport & Environment	Smith T., Knight I., Analysis of accidents involving light commercial vehicles in the UK	National (UK)
	Varhelyi A., Makinen T., 2000, The effects of in-car speed limiters: field studies, transportation Research. Elsevier.	European
	De Mol J., Vlassenroot S., En Georges A., Abnormaal veel ongevallen met bestelwagens	European

Studies on ISA systems provided by stakeholders

Stakeholder	Studies	Dimension
Centro di ricerca sui trasporti e la logistica	Servin O., Boriboonsomsin K., Barth M., 2006, An Energy and Emissions Impact Evaluation of Intelligent Speed Adaptation,	
ITS Leeds	Lai F., Carsten O., Tate F., 2011, How much benefit does Intelligent Speed Adaptation deliver: An analysis of its potential contribution to safety and environment, Elsevier.	National (UK)
CETM	FTSA- Fundación Instituto Tecnológico, 2007, Descripción y evidencia scientíficas de la eficacia del Control inteligente de velocidad	
Belgian Road Safety Institute	Carsten O., Fowkes M., Lai F., Chorlton K., Jamson S., Tate F. , Simpkin B., 2008, ISA-UK Intelligent Speed Adaptation, Final Report, University of Leeds,	National (UK)
	Biding T., Intelligent Speed Adaptation (ISA), Results of large-scale trials in Borlänge, Lidköping, Lund and Umeå during the period 1999-2002	National (Sweden)
ETSC-European Transport Safety Council	Goodwin F., Achterberg F., Beckmann J., 2006, Intelligent Speed Assistance, Myths and Reality, ETSC position on ISA, ETSC, Brussels	European
	Kullgren A., Stigson H., Achterberg F., Townsend E., 2005, In-Car Enforcement Technologies today, ETSC, Brussels	European
FEVR European Federation of Road Traffic Victims	Carsten O., Intelligent Speed Adaptation (ISA) as an Alternative Sanction, University of Leeds, Road Safety Authority , International Conference on recidivist behavior and drivers rehabilitation programmes.	National (UK)

Transport &Environment	Carsten O., Lai F., Chorlton K.,Goodman P., Carslaw D., Hess S., 2008, Speed Limit Adherence and its effect on Road Safety and Climate Change, University of Leeds.	
Norwegian Public Roads Administration	Vaa, T. Assum, T., Elvik, R. (2012): Driver support systems: Estimating road safety effects at varying levels of implementation. TOI report 1202/2012.	

ANNEX 9: National policies/measures with significant impacts on emissions and road safety

National policies/measures with significant impacts on emissions, implemented since 2002

Country	National policies/measures
EE	Introduction of gas vehicles : gas buses for public transport.
EL	Circulation ban for heavy vehicles on national roads on rush days and hours in the directions of entrance to and exit from big cities
HU	Ban of HGV traffic during weekends
	General prohibition of overtaking of HGV's since 1st January 2011. (Highway Code)
IT	Promotion of cleaner vehicles like EVs and NGVs. Local specific measure for traffic restrictions.
SK	Transport policy of Slovak Republic till the end of year 2015 as approved by the government decree No. 445 dated on June 8th. 2005
	Strategy of transport development in Slovak Republic till the year 2020 as approved by government decree No. 158 dated on March 3rd. 2010
	Program for development of intelligent transport systems named National system of transport information as approved by government decree No. 22 dated on January 14th. 2009

National policies/measures with significant impacts on road safety, implemented since 2002, provided by ministerial contacts

Country	National Policies/measures with significant impacts on road safety
DK	Mandatory control of mirror adjustment (Road traffic Act)
	Overtaking prohibited on motorways on certain times or distances (Danish Road Legislation)
	Road construction to avoid "black spots"
EL	Circulation ban for heavy vehicles on national roads on rush days and hours in the directions of entrance to and exit from big cities
	Traffic Code
	Law No. 3446/2006
	Ministerial Decision No. 28366/2098/2006 on the classification of certain categories of used vehicles using an ABS
HU	Ban of HGV traffic during weekends
	General prohibition of overtaking for HGV's

IE	Safety belts on buses (S.I. No. 367/2011 — Road Traffic (Restraint Systems in Organised Transport of Children) Regulations 2011)[100]: Since 31 October 2010 all bus owners, have been required to present certification at their vehicle's roadworthiness test showing that the safety belts fitted to the vehicle are of an acceptable standard. Furthermore regulations were introduced in October 2011 making it a legal requirement that all buses involved in the organised transport of children must be fitted with appropriate and fit for purpose safety belts or restraint systems. Organised transport in this regard is a group of 3 or more children undertaking a journey where the children's transport is the primary reason for the journey. This includes school transport bus services, school trips or other organised outings such as sporting or social events, etc. The organised transport of children does not include the transport of children on bus services offered to the general public (i.e. scheduled urban or inter-urban bus services)
	Maximum weights (Statutory Instrument No. 43 of 2013)[101]: From 1st April 2013, six axle articulated vehicle combinations have been permitted to operate at a gross combination weight of 46 tonnes, provided they satisfy the requirements of an 'appropriate motor vehicle' and 'appropriate semi-trailer' respectively; and conform to the following standards: • Tractor units and semi-trailers already in service will require Electronic Braking Systems (EBS). Anti-lock Braking Systems (ABS) are not sufficient. • New tractor units first registered on or after 1st April 2013 (in addition to requiring EBS) will also need Vehicle Stability Function (VSF) which is more commonly known as Electronic Stability Control (ESC). Semi-trailers first licensed on or after 1st April 2013 (in addition to requiring EBS) will also need to have Roll Stability Control (RSC).
RO	Implementation and enforcement of provision of social legislation (AETR Agreement) even for national transport operations
	Implementation and enforcement of professional training of drivers of HGV and PSV
	Implementation and enforcement of legislation on transport of dangerous goods (ADR Agreement) even for national transport operations
IT	Several information campaign were performed to increase awareness and train professional drivers.
SK	Road safety enhancement strategy in the Slovak Republic in the years 2002 to 2010
	Road safety enhancement strategy in the Slovak Republic in the years 2011 to 2020
UK	In 2002, the government seeks views on banning mobile phones whilst driving. £6 million was made available to improve road safety in most deprived cities. A new motorcycle safety campaign is launched, as is a campaign urging parents to check their child's car seat every trip.
	In December 2003 the new offence of using a hand held mobile phone while driving is introduced. Seatbelt campaign THINK! Wear a seatbelt....You don't get a second chancefeatures an online interactive crash simulator. Radio drink driving campaign timed to coincide with early morning pub opening during Rugby Union World Cup.Congestion Charging introduced in London.
	In 2004, the first three year review of the Government's road safety strategy is published.
	In 2005, the Roads Policing Strategy published jointly by Dept for Transport, Home Office and Association of Chief Police Officers. The police are given the power to seize uninsured vehicles being driven on the road - those which are not reclaimed may be sold off or crushed.
	In 2006, the Road Safety Act passed. The act made provision for a wide range of road safety matters including: drink driving, speeding, driver training, driver and vehicle licensing.
	In 2007, the new THINK! drink-drive advert launched, emphasising the consequences of a drink-drive conviction.
	In 2008, Learning to Drive consultation, reforming car driver training and testing, published.

[100]http://www.rsa.ie/en/RSA/Your-Vehicle/Vehicle-Standards/Components/Safety-Belts-on-Buses/

[101]http://www.rsa.ie/en/RSA/Your-Vehicle/Vehicle-Standards/Weights--Dimensions-/46-tonne-weight-limit/

	Driver Certificate of Professional Competence (DCPC) was introduced for bus and coach drivers.
	In 2009, the first national THINK! campaign about drug driving launched. The department introduced Road Casualties Online to its website, a web based tool which allows members of the public to perform their own analysis and examination of Reported Road Accident Statistics. Driver Certificate of Professional Competence (DCPC) was introduced for lorries.
	In 2010, the Government-commissioned independent North Review of drink and drug driving published. Specific funding for safety cameras abolished and local safety funding mainstreamed. Significant changes to practical car tests with 'independent driving' introduced. Driver Certificate of Professional Competence (DCPC) was introduced for lorry drivers. National Driver and Rider Standards published.
	In 2011, the Strategic Framework for Road Safety was published, setting out the Government's approach to continuing to reduce killed and seriously injured casualties on Britain's roads. Continuous Insurance Enforcement (CIE) scheme introduced making it an offence to keep any vehicle which has no valid insurance unless a valid Statutory Off Road Notification (SORN) declaration has been made to the Driver and Vehicle Licensing Authority (DVLA). National Driver and Rider Training Standards published

ANNEX 10: Availability of quantitative data

Stock of vehicles

Type of data on the stock of vehicles per country provided

Country	Time series	Vehicle categorization
AT	2008-2012	M1, M2+M3, N1, N2, N3.
BE	2000-2012	M3 , M3 (5 tons< max mass≤ 10 tons),, M2, M1, N3, N2, N1
BG	2004-2012	Coaches (M2- M3); Heavy vehicles (N1- N2- N3); Traction vehicle (N3)
DE	2001-2012	Cars, campers, buses, trucks, semitrailers.
DK	2003-2012	M3 (max mass>10 tons; 5 tons< max mass≤ 10 tons),, M2, M1, N3, N2, N1
EE	2009-2012	M3 (max mass>10 tons; 5 tons< max mass≤ 10 tons),, M2, M1, N3, N2, N1
FI	1999-2012	Passenger cars, Trucks, Vans, Buses
	2011-2012	M3 (max mass>10 tons; 5 tons< max mass≤ 10 tons), M2, M1, N3, N2, N1
EL	2007-2012	M3 (max mass>10 tons; 5 tons< max mass≤ 10 tons), M2, M1, N3, N2, N1
FR	2000-2011	Commercial vehicles weighing more than 3,5 tons, commercial vehicles weighing more than 20 tons, commercial vehicles weighing less than 3,5 tons
HU	2009-2011	Passenger cars, buses, lorries, road tractors
IE	1999-2011	M3, M2, M1, N3, N2, N1
IT	1999-2012	M3 (max mass>10 tons; 5 tons< max mass≤ 10 tons); M2, M1, N3, N2, N1
LI	-	-
LU	1999-2012	N2-N3, M2-M3, M1, N1
LV	1999-2012	M3 (max mass>10 tons; 5 tons< max mass≤ 10 tons); M2, M1, N3, N2, N1
PO	2005-2012	M3 (max mass>10 tons; 5 tons< max mass≤ 10 tons); M2, M1, N3, N2, N1
RO	2007-2012	M3 (max mass>10 tons; 5 tons< max mass≤ 10 tons); M2, M1, N3, N2, N1
SK	2007-2012	M3 (max mass>10 tons; 5 tons< max mass≤ 10 tons); M2, M1, N3, N2, N1
UK	1999-2012	M3 (max mass>10 tons; 5 tons< max mass≤ 10 tons); M2 , M1, N3, N2, N1
NO	2000-2012	M3, M2, M1, N3, N2, N1

Type of data on vehicle kilometer registered per vehicle category and per road type provided

Country	Time series	Data provided

AT	1999-2011	Data per type of road (Urban, rural and motorway) and type of vehicles (N1, N2+N3, M2+M3)
FI	1999-2009	Data per vehicle category (M3-M2; N3-N2; M1-N1)on main roads
HU	-	Annual Average Daily Traffic, motorized vehicle's traffic, Heavy goods vehicles' traffic, commercial vehicles (Data on vehicle kilometre a day)
IT	2000-2012	Data per vehicle category (M1+N1, M2+M3+N2+N3)
	2010	Data per vehicle category (M1+N1, M2+M3+N2+N3) and type of road (motorways and interurban roads)
LV	2005-2012	Data per vehicle category (M3, M2, M1, N3, N2, N1)
SK	2007-2012	Data per vehicle category (M3 (max mass>10 tons; 5 tons< max mass≤ 10 tons); M2, M1, N3, N2, N1)
UK	2006-2011	Data per vehicle type (cars, motorcycles, buses and coaches, light vans, good vehicles, motor vehicles, pedal cycles) and road type (rural, urban, major and minor roads) (https://www.gov.uk/government/statistical-data-sets/tra02-traffic-by-road-class-and-region-kms)

Speed detected

On the basis of the replies received, data on speed detected are available only for few countries. The table below reports the data on speed detected per country as asked to the ministries of transport in the questionnaire.

Type of data on speed detected provided per EU country

Country	Time series	Categorization
FI	1999-2012	Average speed and standard deviation per M3-M2, N3-N2; M1-N1 and per road type (one carriage-way road, motorways)
IT	2012	Speed detected per vehicle category (M1+N1, M2+M3+N2+N3) and road type (motorways and interurban roads)
SK	-	Average speed of motor vehicles divided for urban roads and rural roads
UK		Average speeds on locally managed A roads during the weekday morning peak(*https://www.gov.uk/government/statistical-data-sets/cgn02-flow-weighted-vehicle-speeds*)
		Free-flow speeds by road type and vehicle type (*https://www.gov.uk/government/statistical-data-sets/spe01-vehicle-speeds*)
NO	2004-2012	Average speed distribution according to different speed limitation

Road safety

Data on road safety per country has been required on the basis of the following differentiation:

- Number and severity of accidents per vehicle category (M3, M2, N3, N2) and type of road (motorways and interurban roads);
- Number and severity of accidents provoked by the excessive heavy vehicle speed differentiated per type of road (motorways and interurban roads);
- Number and severity of accidents caused by heavy vehicles below 7.5 tons differentiated per vehicle category (M3, M2, N2) and type of road (motorways and interurban roads);

- Number and severity of accidents caused by heavy vehicles weighting more than 7.5 tons, differentiated per vehicle category (M3, N3, N2) and type of road (motorways and interurban roads).

The following type of data has been directly provided by the questionnaire respondents

Type of data on road safety

Country	Years	Data provided
AT	1999-2011	Severity of accidents (accidents, injuries, fatalities) per area (urban and outside urban area) and type of vehicle (N1, N2+N3, M2+M3)
BG	2011-2012	Severity of accidents (accidents, injured, killed) per heavy vehicles and coaches; Severity of accidents (accidents, injured, killed) per urban roads and other roads
FR	2000 2008-2011	Annual reports on road accidents. Some main figures regard road deaths per age group, user category, regions, type of roads, type of accidents, Distribution of accidents by default enabled, lack of insurance and leaving the scene, presumed responsibility of the users involved in an injury accident, Figures on safety related to speed, the use of seatbelt, alcohol,phone. (Figures differ per annual report, details available at http://www.securiteroutiere.gouv.fr/content/download/4471/40656/version/3/file/Document+de+travail+ONISR+2011_vers5.xls)
IE	1999-2011	Severity of accidents (Fatal, serious and minor), per road type (Interurban roads and motorways) per N (N1, N2, N3) and M(M3, M2,) vehicles.
IT	2007-2011	Total accidents and accidents provoked by high speed per vehicle category (N2+N3, M2+M3) and type of roads (motorways and interurban)
PO	2001-2012	Road accidents reports for each year with specifications on automotive and motor vehicle accidents, time and place of creation road accidents, accidents causes, victims of traffic accidents and pedestrian safety etc. (http://statystyka.policja.pl/portal/st/1302/76562/Wypadki_drogowe__raporty_roczne.html#top)
SK	1999-2012	Severity of accidents and their consequences per M (M2+M3) and N vehicles (N2+N3)
EU	2000-2009	Figures on : • yearly average percentage change in mean speed of cars and vans per type of roads(motorways, urban and rural) • mean speed of cars and vans (in km/h) per type of roads(motorways, urban and rural) • percentage of cars and vans exceeding the speed limitsdifferentiated per type of roads (motorways, urban and rural) (http://www.etsc.eu/documents/05.05%20-%20PIN%20Flash%2016.pdf)
EU	2001-2008	Figures related to the progress in reducing drink driving deaths (http://www.etsc.eu/documents/05.05%20-%20PIN%20Flash%2016.pdf)
EU	2005-2009	Figures on seat belt wearing (http://www.etsc.eu/documents/05.05%20-%20PIN%20Flash%2016.pdf)
EU	Different time bands	Figures on the collision involving • heavy goods, • light goods vehicles, • buses and coaches for specific years. Figures are differentiated per type of roads, distance travelled and include different time bands (details available at http://www.etsc.eu/documents/ETSC_PIN_Flash_24.pdf)

Frauds detected

Type of data on frauds detected provided by governmental contacts.

Country	Years	Type of data
PO	2008-2011	Defects detected on checks enforced.

Reports on fraud suggested by stakeholders

Stakeholder	Reports
Association Prévention routière	Ministèrede l'Interieur, Le Comportement des usagers de la route, Bilan statistique de l'année 2011.
European Transport Safety Council, ETSC	ETSC, 2011, PRAISE": Preventing Road Accidents and Injuries for the Safety of Employees, Tackling Fatigue: EU Social Rules and Heavy Goods Vehicle Drivers, Brussels

ANNEX 11: Time series analysis: technical approach and results for the Individual countries

The following statistics are provided as a result of the analysis:

- Dependent variables:
    - Fatal accidents where HGVs or "buses and coaches" are involved
    - Accident risk for fatal accidents where HGVs or "buses and coaches" are involved
- Presented formats
    - Absolute, unprocessed data.
    - Centred moving means: this means that we take the centred moving mean of the 2*5 year uncentred moving means. Centred moving means provide a yearly indication relative to the absolute, unprocessed data where small-scale influences are controlled for
- Linear trend-line, with associated R^2: an indication for the predictability of the number of accidents as a result of safety effects that are associated with time periods (explained variance by time).
- Individual year effects: the number of accidents above or below the expected number of accidents when short-term fluctuations are controlled for.

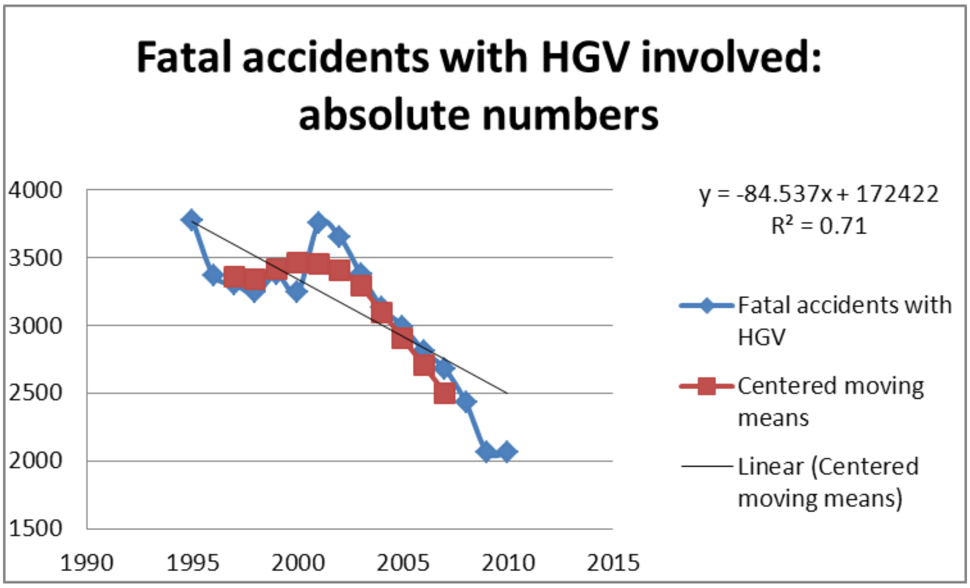
Data are presented for:

- Time period: 1995 to 2011 (when possible)
- Countries: EU15 composite (main report) and individual countries (annex). Only for the EU15 the data series are long enough to allow for this analysis.

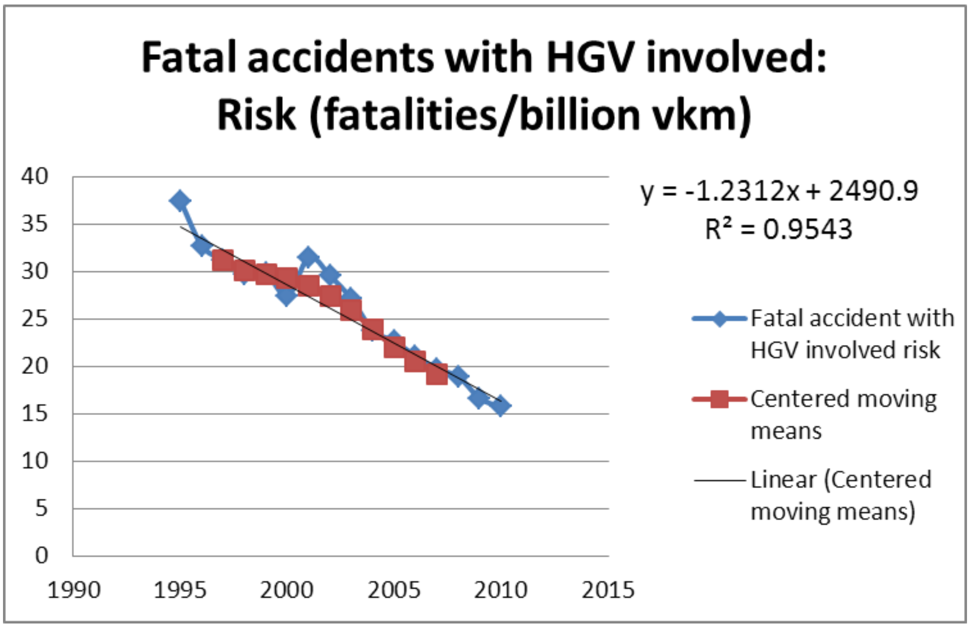
Results for EU15 composite

The graphs below present graphically the findings of the time series analysis for the EU15 composite Member States. Composite as the accident data for the individual countries are summed to come to one number for the EU15 as a whole.

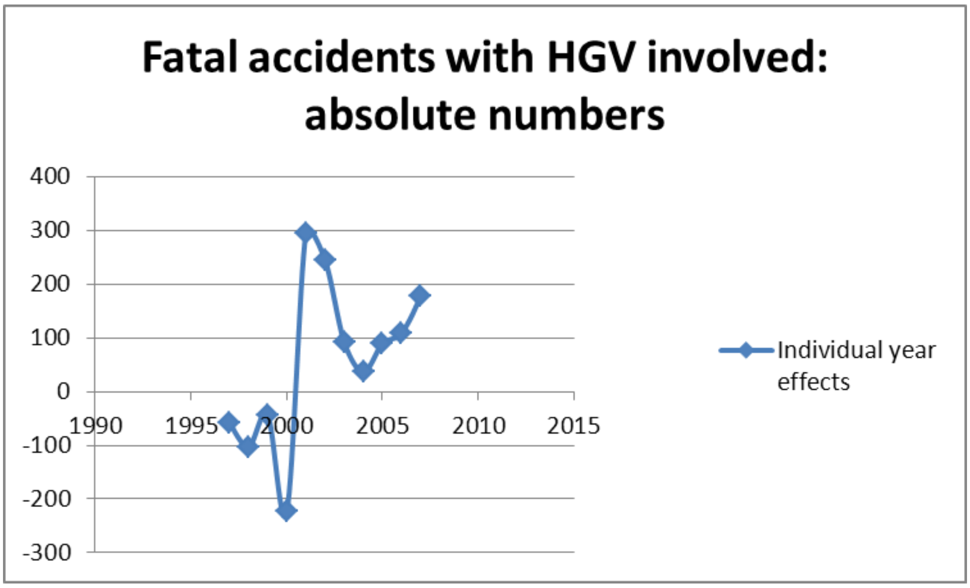
Heavy goods vehicles (HGVs)



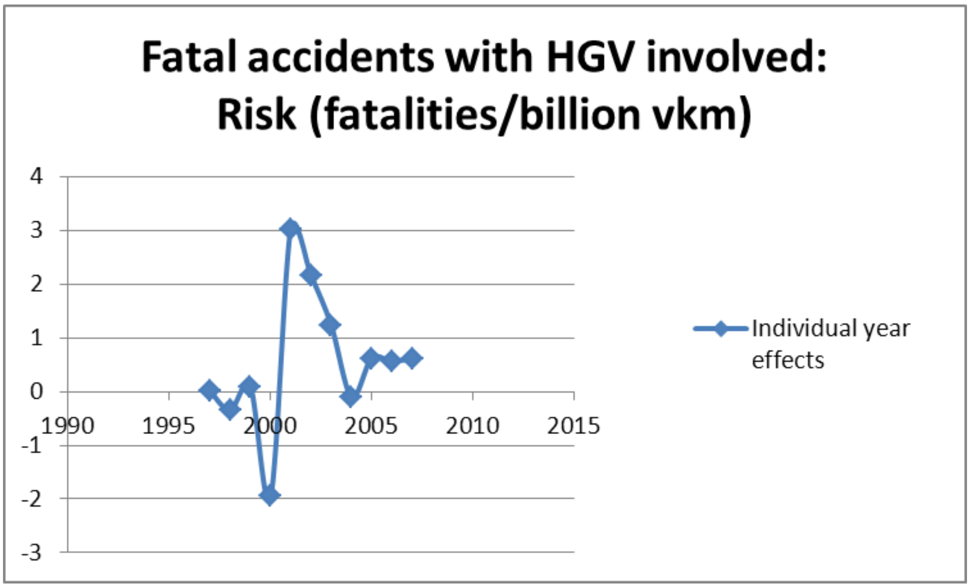
Over the period from 1995 until 2010, we find a reduction in the number of fatal accidents with where HGVs are involved (from 3.778 to 2.062). When controlling for temporal fluctuations, we find a similar reduction, although over a shorter period of time (from 3.457 to 2.504 over the period from 2002 up to 2008). Noteworthy is the relative high R^2 value of 0.71 for the linear trend-line, indicating that the majority of the reduction can be explained by a sole parameter (time). The R^2 indicates how well data points fit a line or curve. In this case, an R^2 close to 1 suggest that a linear trend-line in which the "year" is the only explanatory would be a very good model. This would also imply that there is not really an element – such as the implementation of a Directive – missing in the estimation. A polynomial (2nd order) trend-line allows for an R^2 of 0.99, suggesting a more complex time effect could be in order. This may be the cause of the introduction of a set of measures at or around one year.



However, when looking at the same data, but controlled for the number of vehicle kilometers ran by HGV, this effect seems to have been reduced. A first order linear trendline achieves an R^2 of 0.95, suggesting a linear effect over time instead of the sharp cut-off indicated above. This suggests that a maintained, yet stable reduction in the fatal accident risk per vehicle kilometer ran has been achieved over the period of 1995 up to 2008.

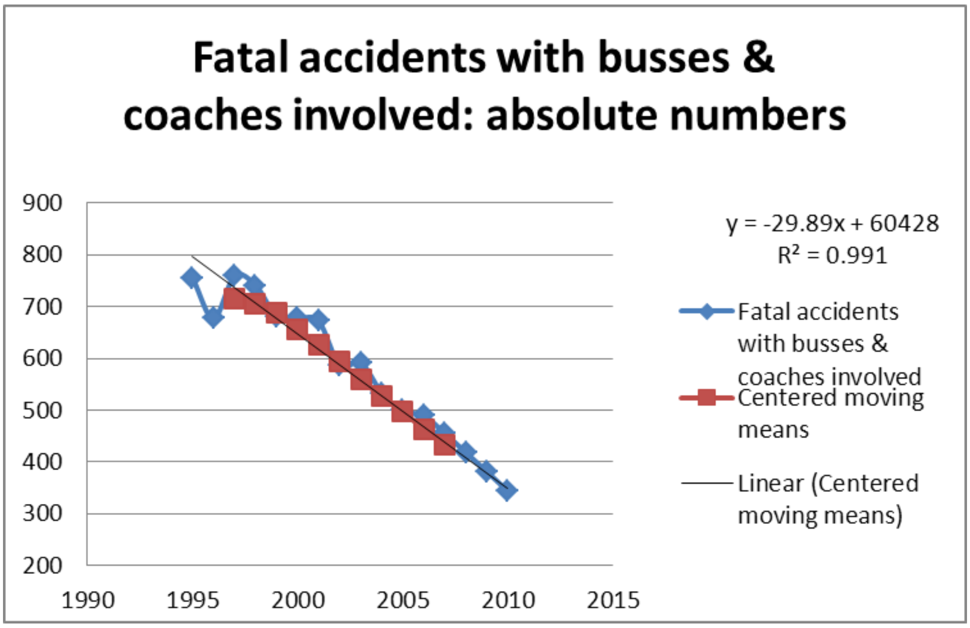


When looking at the specific difference between the centred moving means and the number of fatal accidents with HGV involved, we notice a dual effect. Whereas the period of 1995 up to 2000, slight negative values can be found, this switches over the period from 2001 up to 2008. The interpretation for negative values is as follows: the reported number of fatal accidents is lower that what might have been expected based on the surrounding time period. The interpretation for positive values is as follows: the reported number of fatal accidents is higher than what might have been expected based on the surrounding time period. In itself, this is not a negative element. Together with the decrease of the number of fatal accidents, it indicates that the evolution in the reduction of fatal accidents is in particular stronger than the unique situation presented in that year.

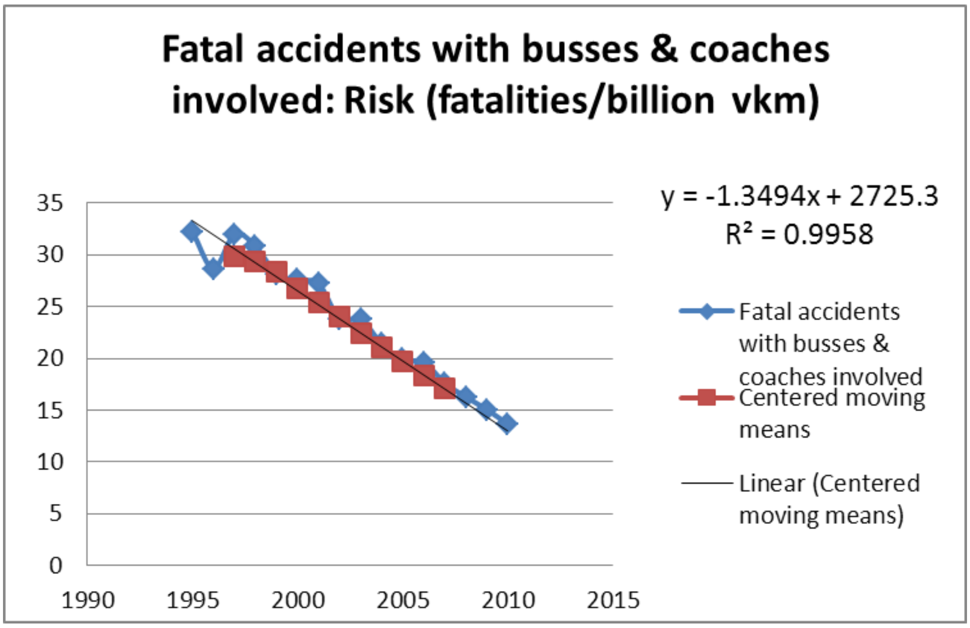


In relation to the fatal accident risk, the following findings can be reported. Whereas most of the yearly values are close to 0, indicating that the yearly value is very much in line with the centred moving average, a slight discrepancy can be noticed over the period from 2001 to 2003. During this period, a slightly higher yearly fatal accident risk could be found, indicating that the values for those years are slightly worse than the surrounding years. Or, alternatively and in compound with the overall decrease, that a stronger than average reduction could be found in the years following.

Buses and coaches

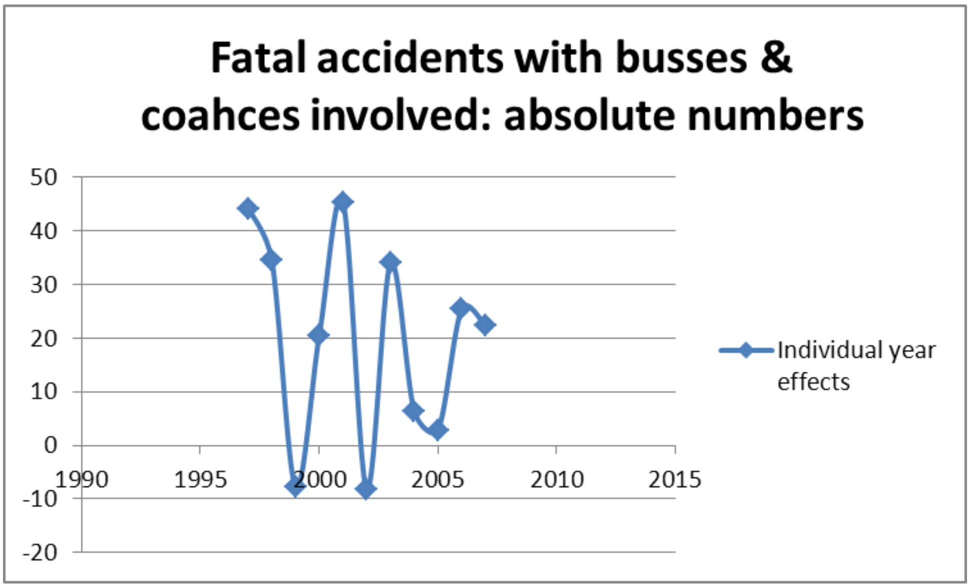


Over the period from 1997 to 2010, we find a reduction in the number of fatal accidents with where buses or coaches are involved (from 759 to 343). When controlling for temporal fluctuations, we find a similar reduction (from 715 to 432 from 1997 to 2008). Noteworthy is the high R^2 value of 0.99 for the linear trendline, indicating that the majority of the reduction can be explained by a sole linear parameter (time).

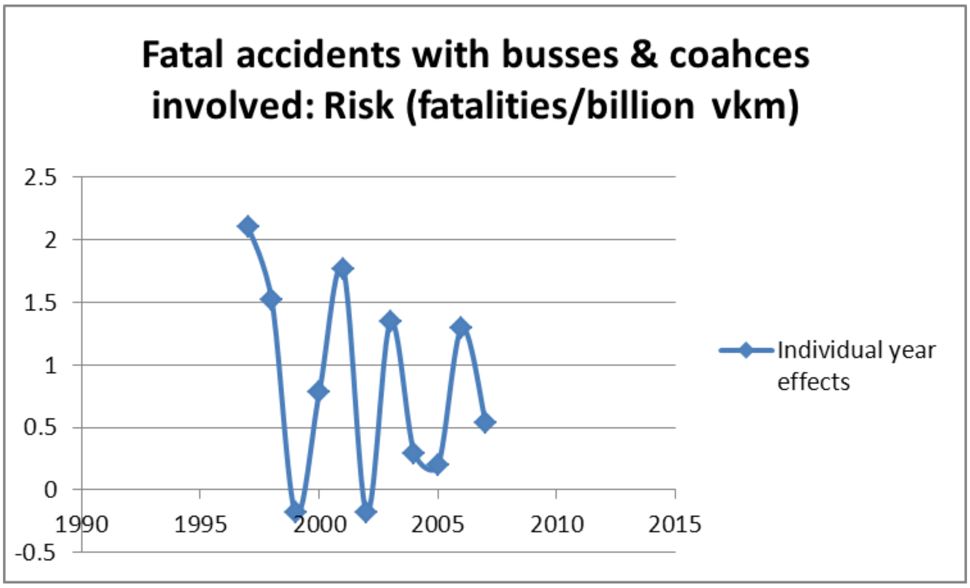


Similar findings can be made when controlling for the number of vehicle kilometers driven. A high R^2 of 0.99 indicates that the majority of the reduction in fatal accident risk can be accounted for by a sole linear parameter (time).

Overall, there is no indication that within the period 2005-2007 one single element attributed to the continuous increase in traffic safety. Hence, purely looking at the accident data no safety effect can be attributed to the implementation of the Speed Limitation Directive.



When looking at the specific difference between the centred moving means and the number of fatal accidents with HGV involved, we notice a singular effect. Positive values can be found for most of the reported years. This indicates that the reported number of fatal accidents is higher than what might have been expected based on the surrounding time period. In itself, this is not a negative element. Together with the decrease of the number of fatal accidents, it indicates that the evolution in the reduction of fatal accidents is in particular stronger than the unique situation presented in that year.

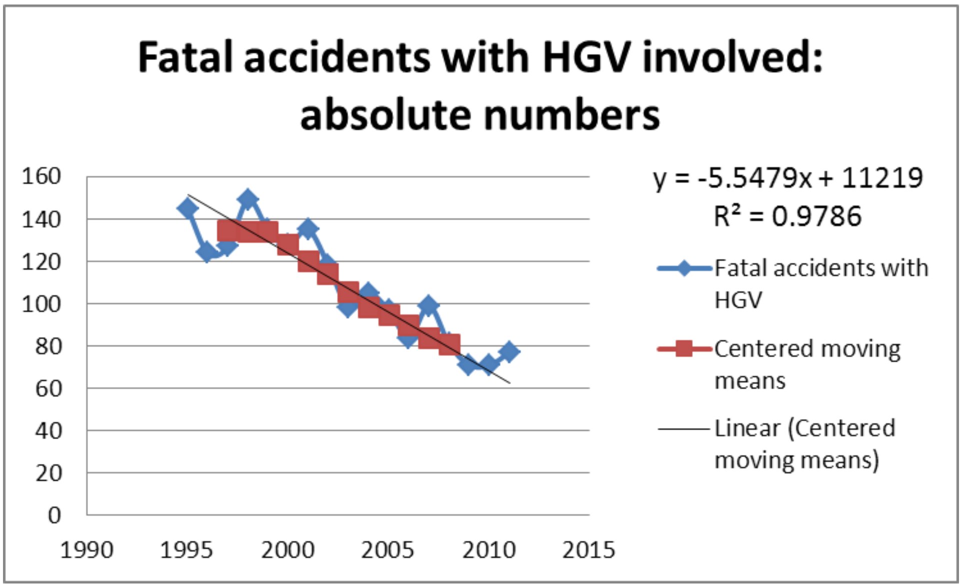


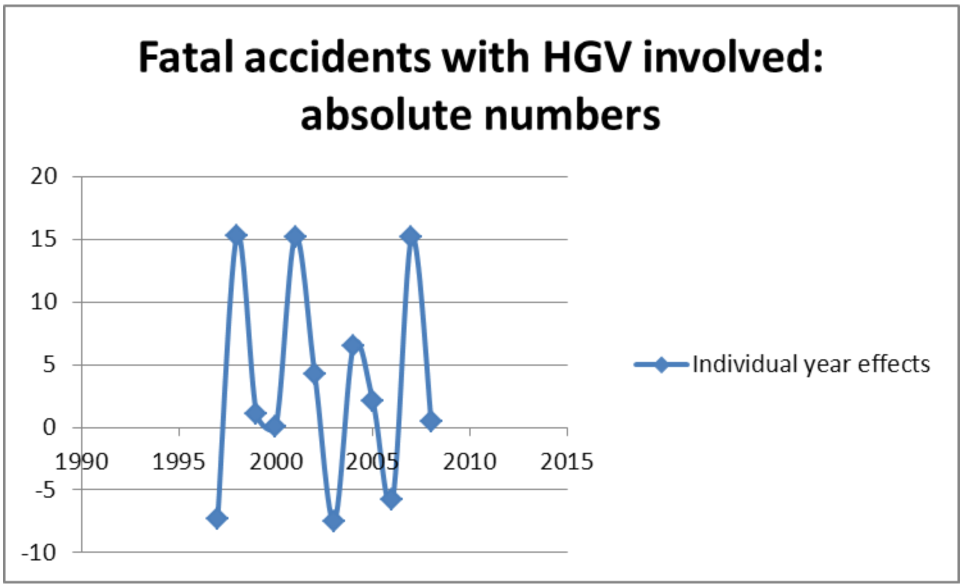
Similar findings can be reported when controlling for the number of vehicle kilometres ran. Slightly positive values are found for most of the reported years. This indicates, together with the recurring decrease in the accident risk, that the reduction in fatal accident risk remains slightly more larger in the surrounding years than in the reported year.

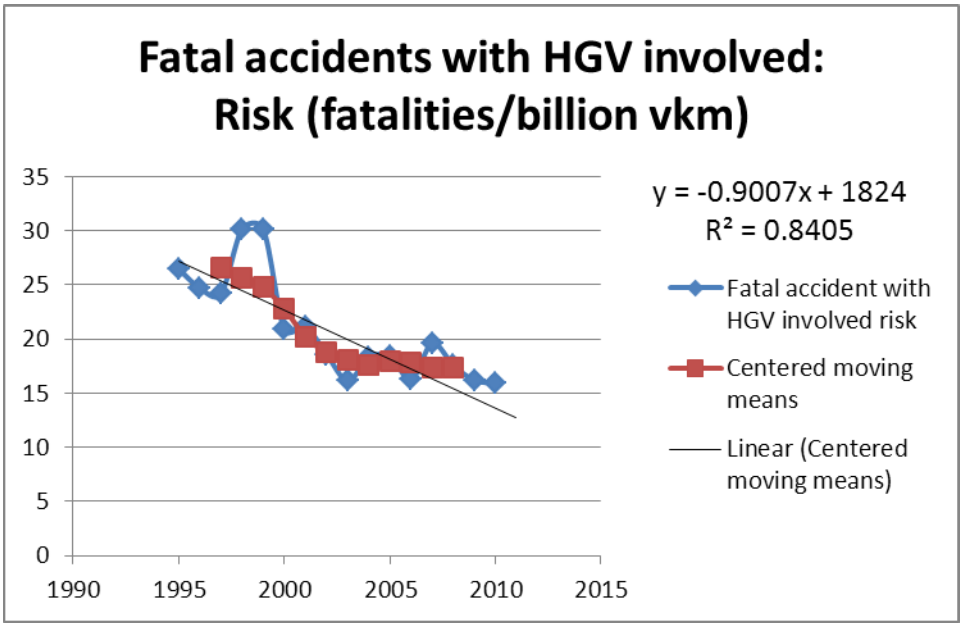
Results for the individual countries

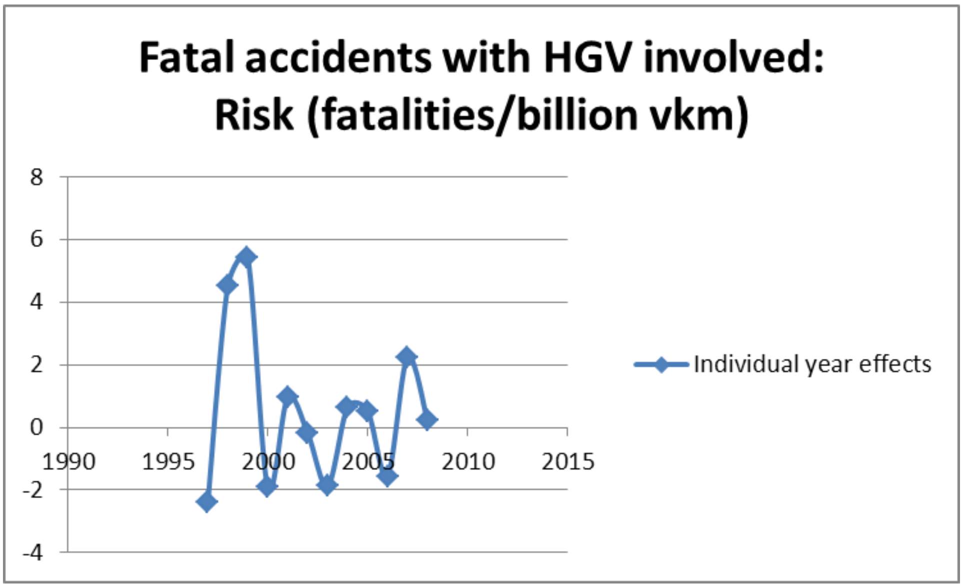
Belgium

Heavy goods vehicles

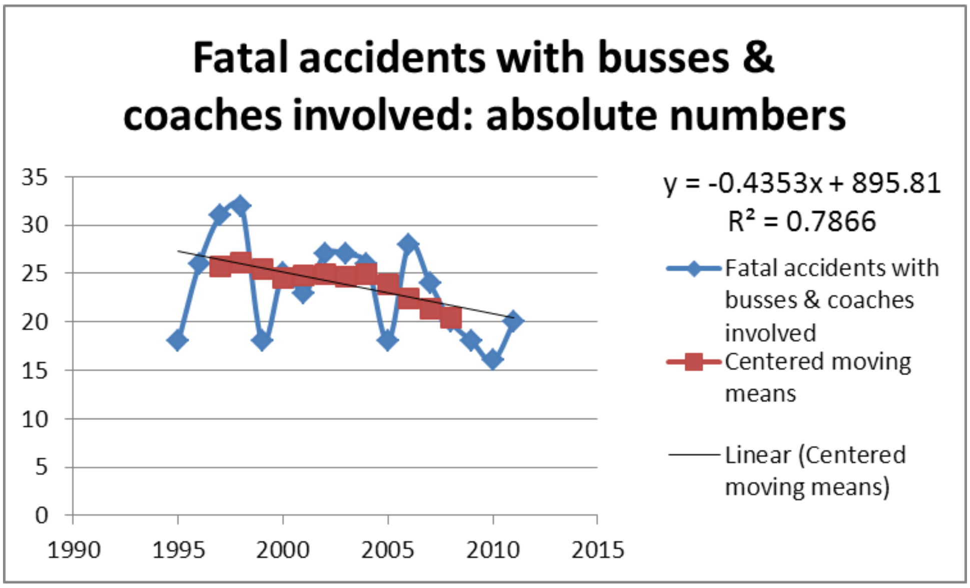


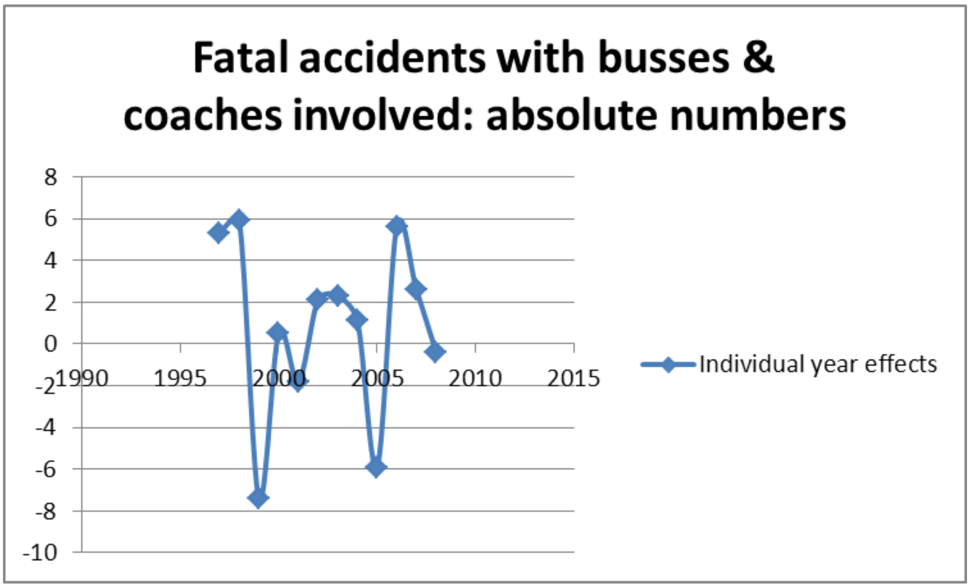


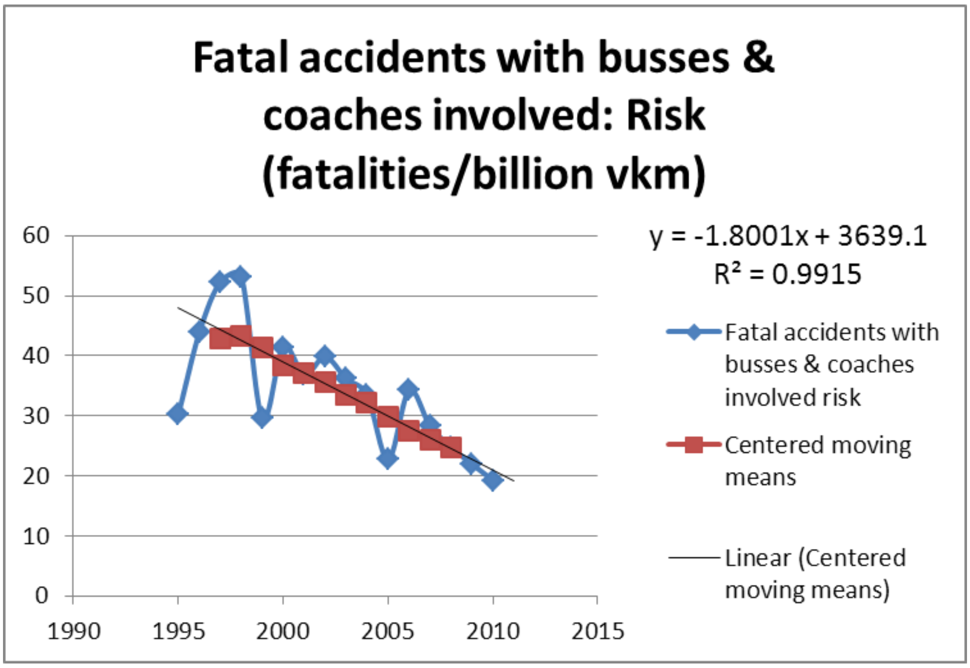

Fatal accidents with HGV involved:
Risk (fatalities/billion vkm)
y = -0.9007x + 1824
R² = 0.8405
Fatal accident with HGV involved risk
Centered moving means
Linear (Centered moving means)
35
30
25
20
15
10
5
0
1990
1995
2000
2005
2010
2015

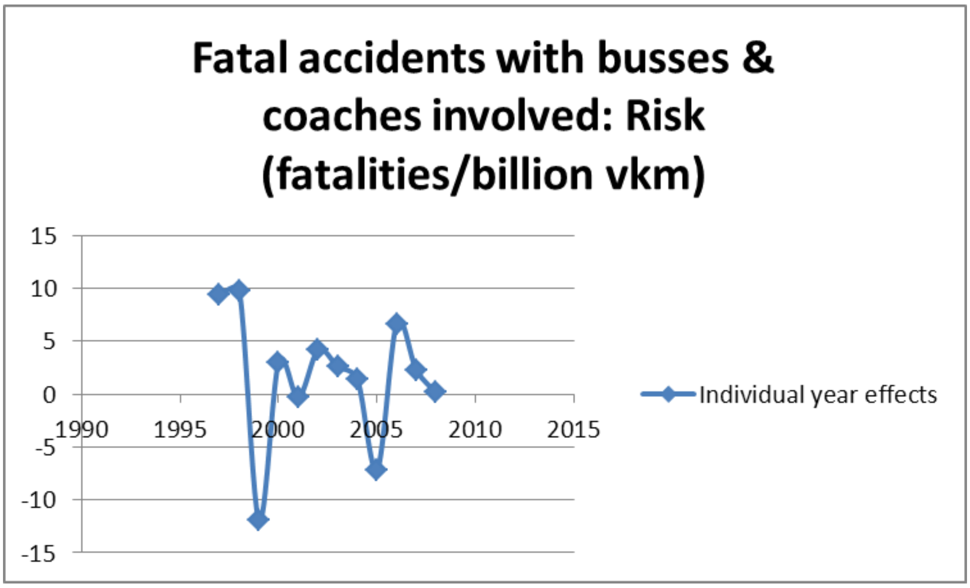

Fatal accidents with HGV involved:
Risk (fatalities/billion vkm)
Individual year effects
8
6
4
2
0
-2
-4
1990
1995
2000
2005
2010
2015

Buses and coaches



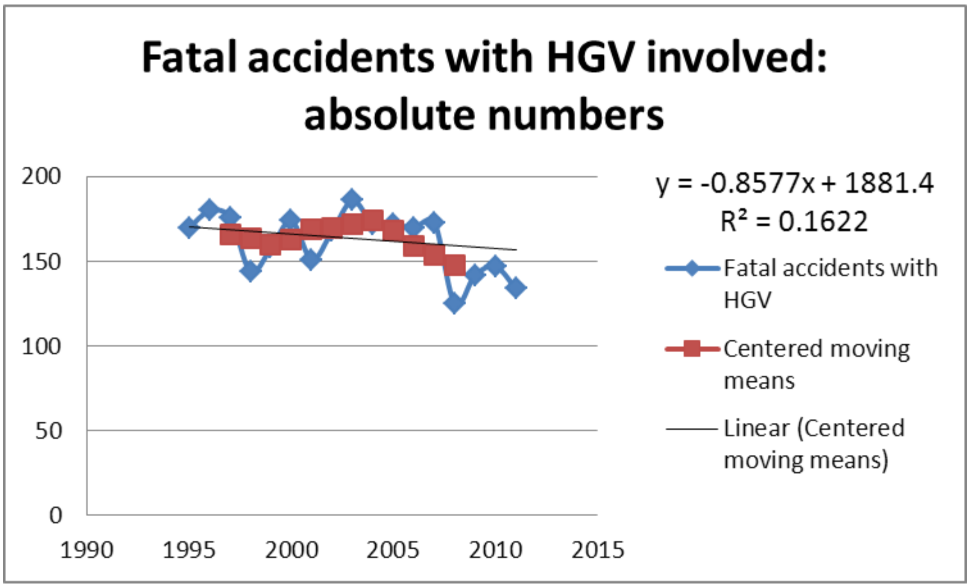


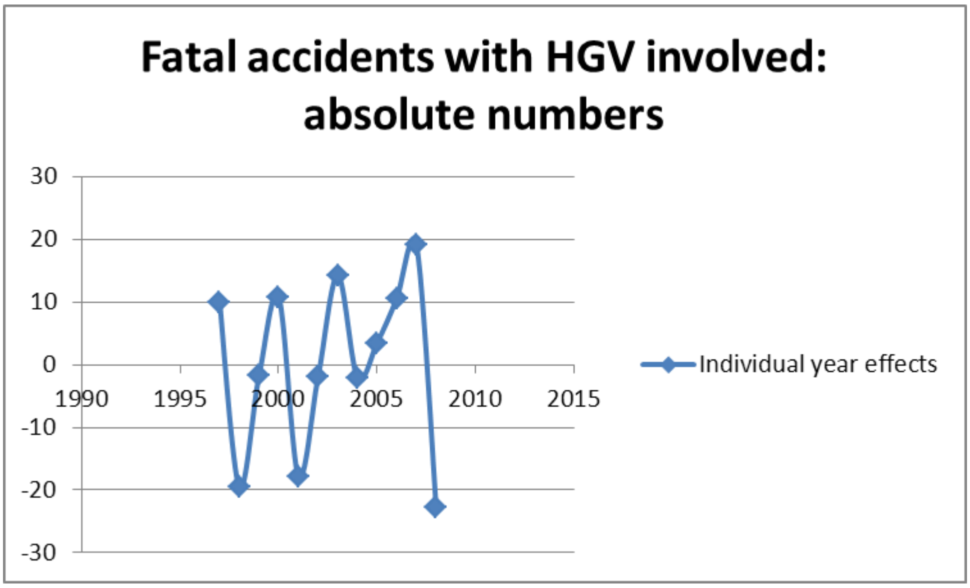

Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
y = -1.8001x + 3639.1
R² = 0.9915
Fatal accidents with busses & coaches involved risk
Centered moving means
Linear (Centered moving means)
60
50
40
30
20
10
0
1990
1995
2000
2005
2010
2015

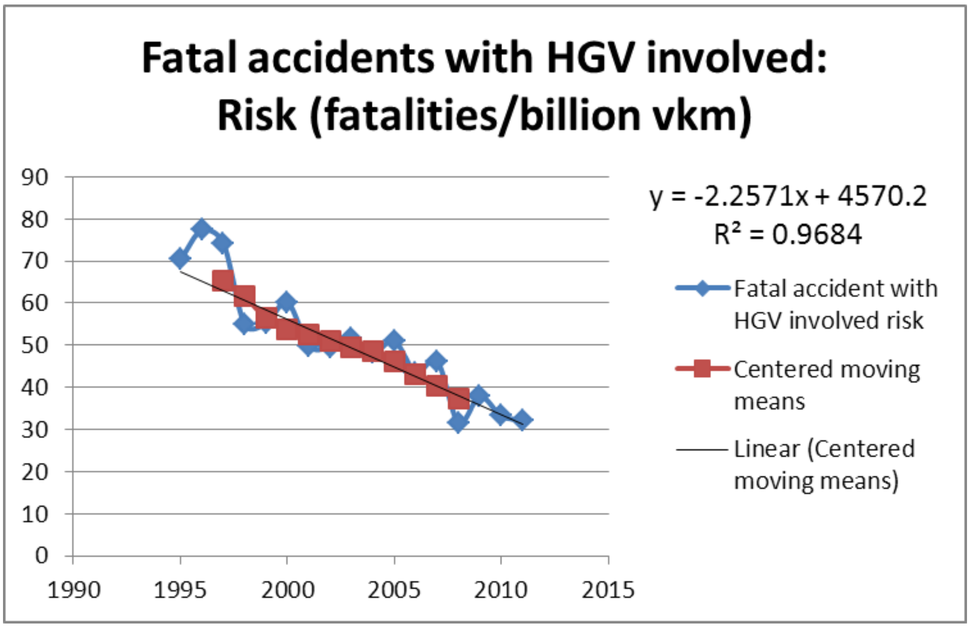

Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
Individual year effects
15
10
5
0
-5
-10
-15
1990
1995
2000
2005
2010
2015

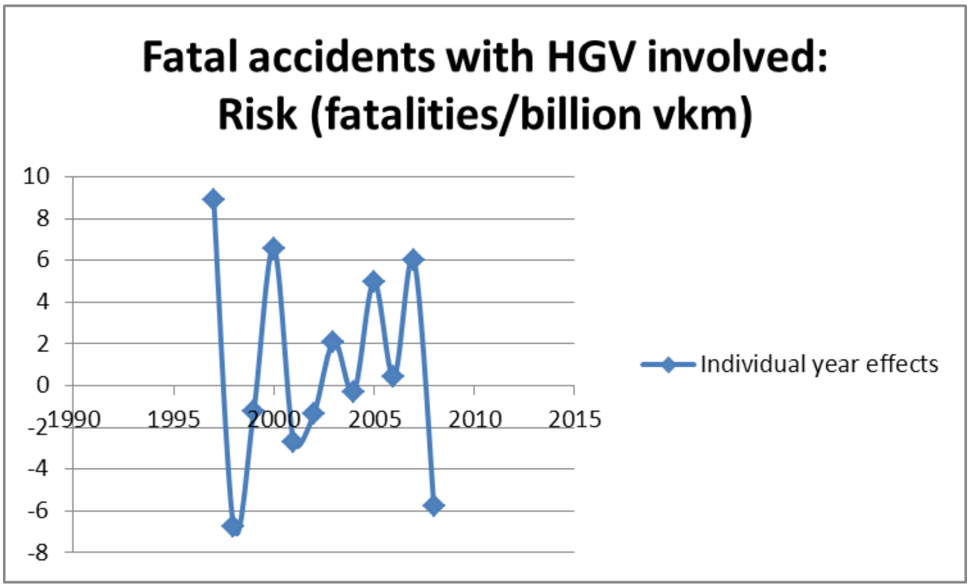
Czech Republic

Heavy goods vehicles

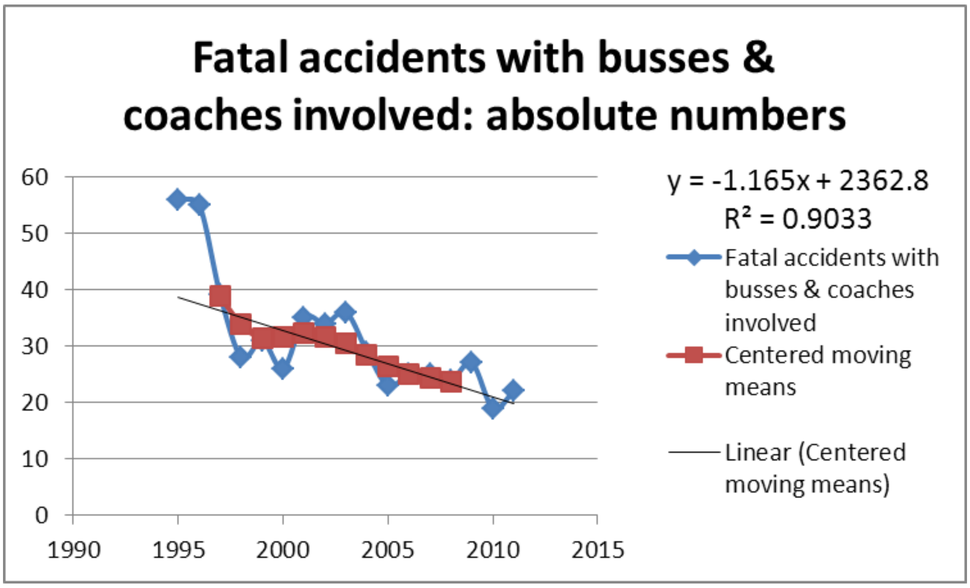


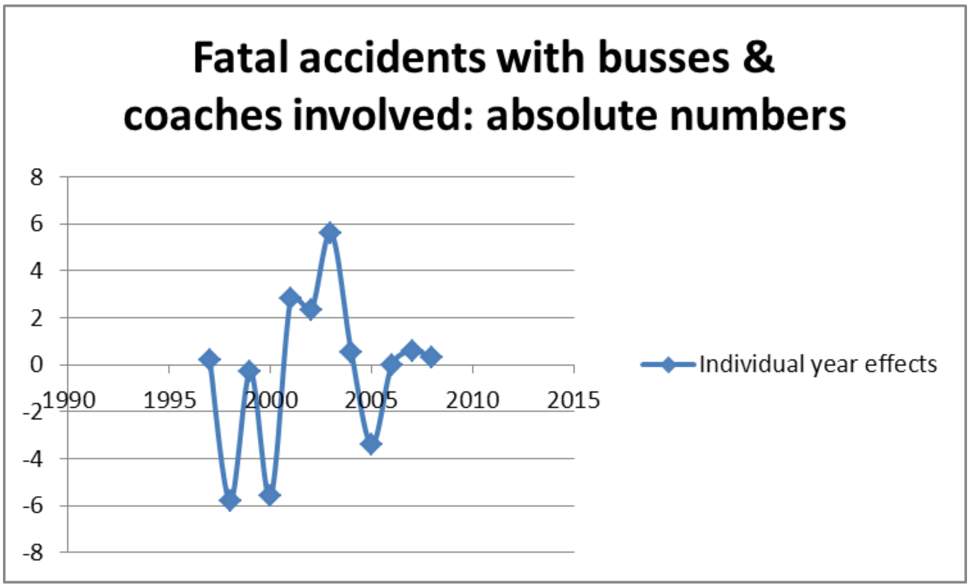


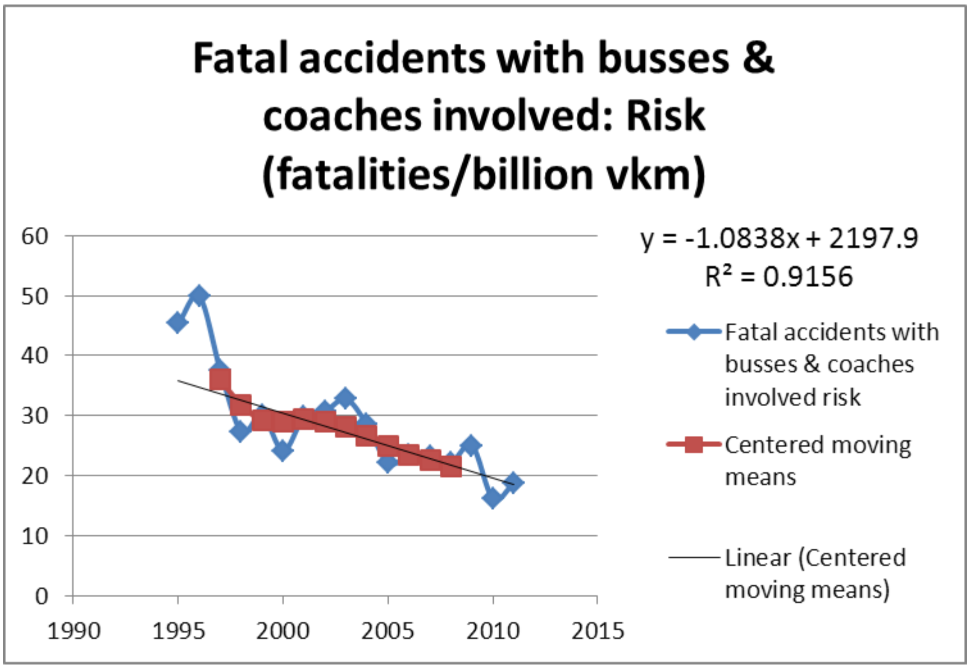

Fatal accidents with HGV involved:
Risk (fatalities/billion vkm)
y = -2.2571x + 4570.2
R² = 0.9684
Fatal accident with HGV involved risk
Centered moving means
Linear (Centered moving means)
90
80
70
60
50
40
30
20
10
0
1990
1995
2000
2005
2010
2015

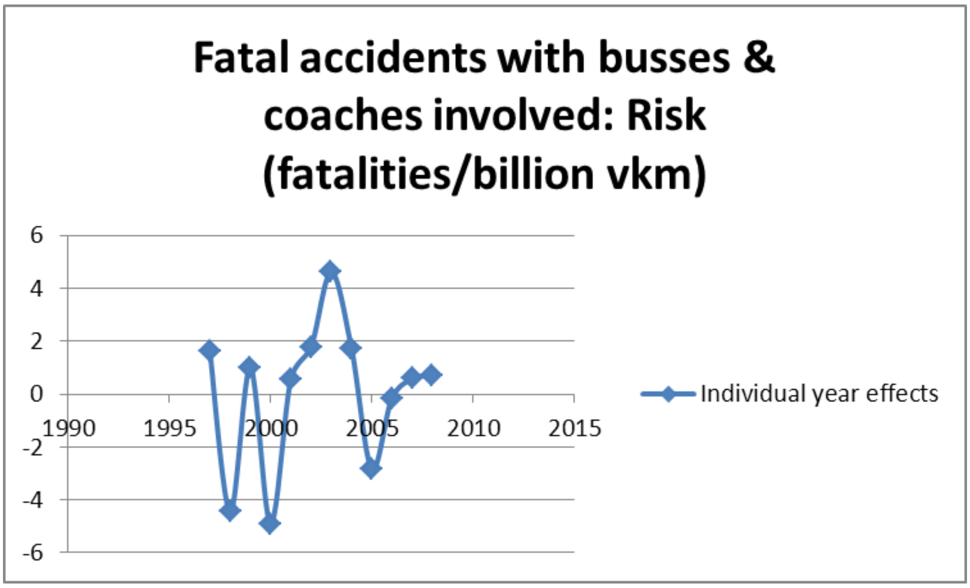

Fatal accidents with HGV involved:
Risk (fatalities/billion vkm)
Individual year effects
10
8
6
4
2
0
-2
-4
-6
-8
1990
1995
2000
2005
2010
2015

Buses and coaches



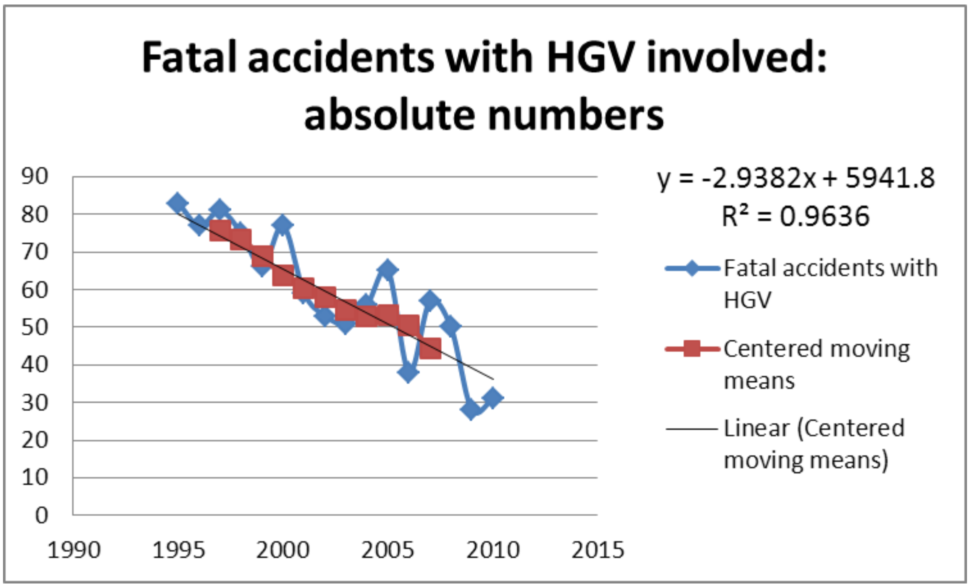


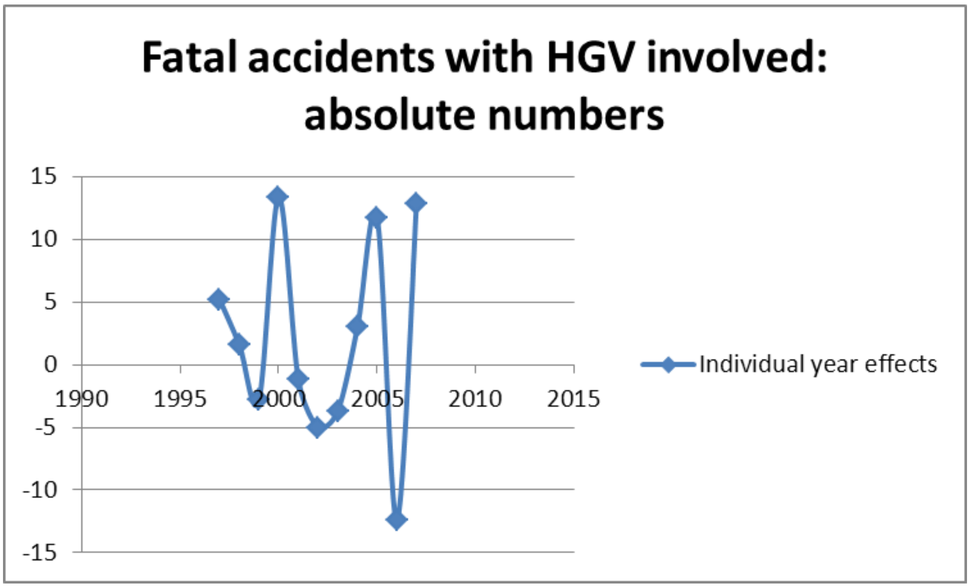

Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
y = -1.0838x + 2197.9
R² = 0.9156
60
50
40
30
20
10
0
1990
1995
2000
2005
2010
2015
Fatal accidents with busses & coaches involved risk
Centered moving means
Linear (Centered moving means)

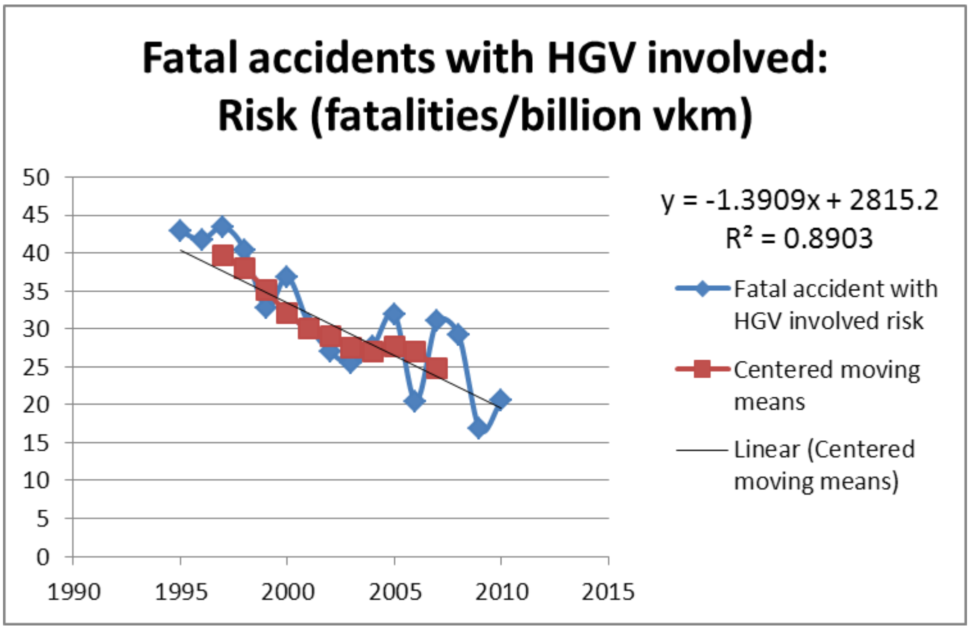

Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
6
4
2
0
-2
-4
-6
1990
1995
2000
2005
2010
2015
Individual year effects

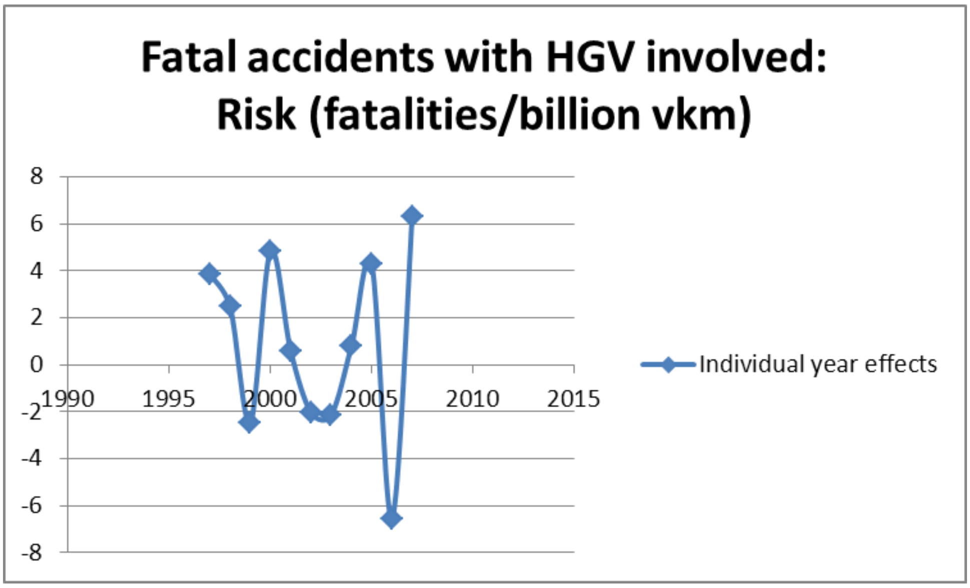
Denmark

Heavy goods vehicles

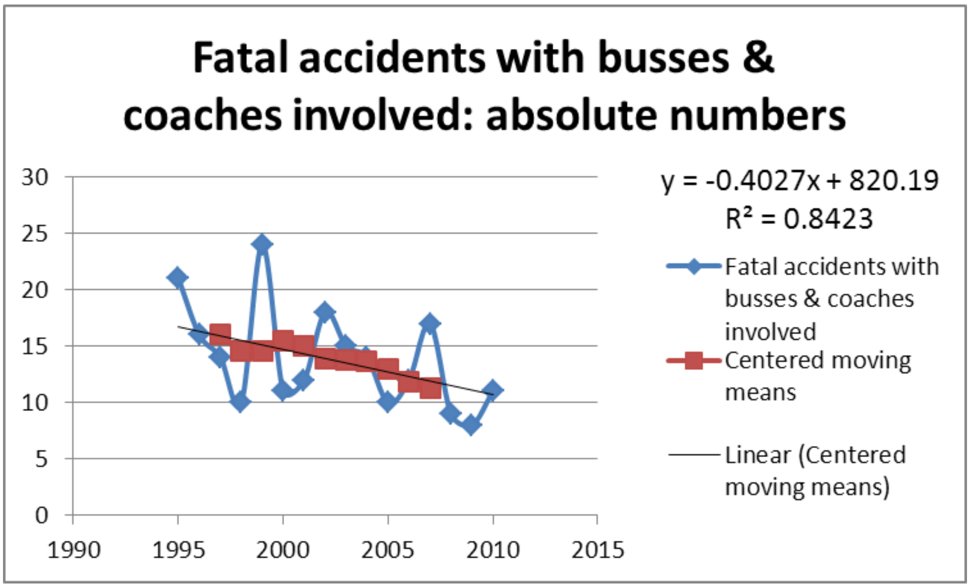


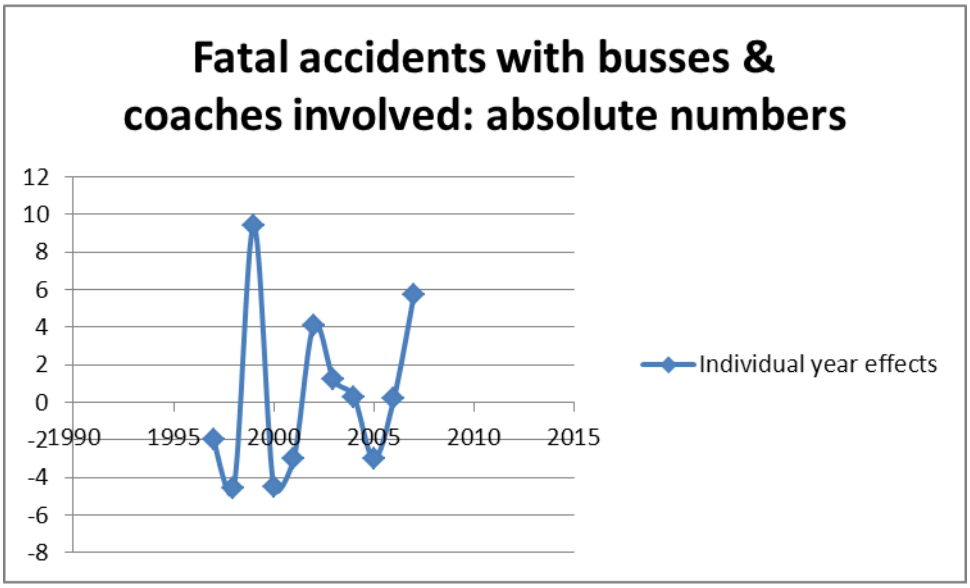


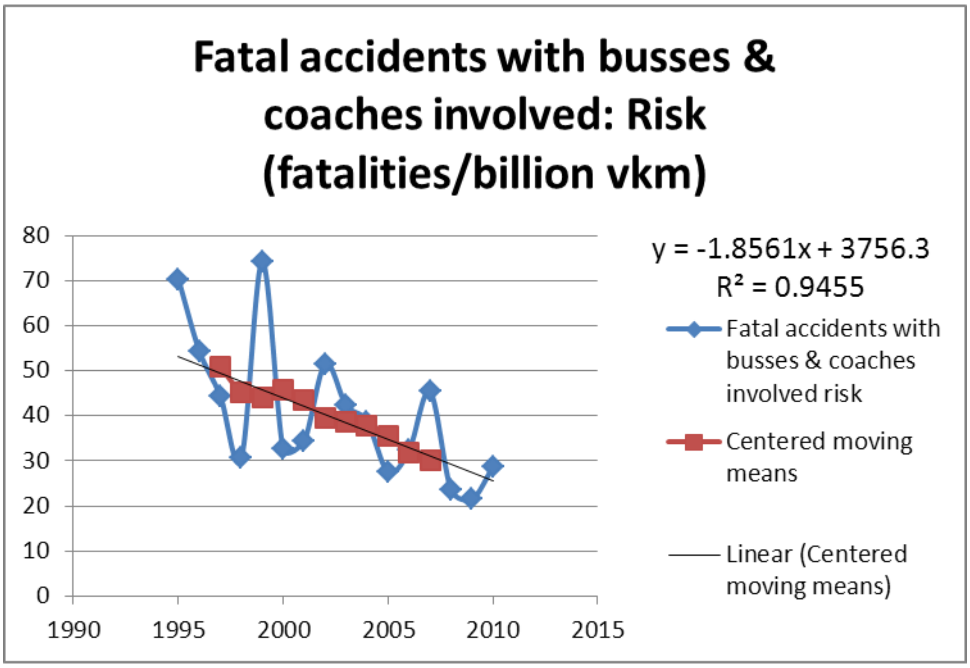

Fatal accidents with HGV involved: Risk (fatalities/billion vkm)
50
45
40
35
30
25
20
15
10
5
0
1990
1995
2000
2005
2010
2015
y = -1.3909x + 2815.2
R² = 0.8903
Fatal accident with HGV involved risk
Centered moving means
Linear (Centered moving means)

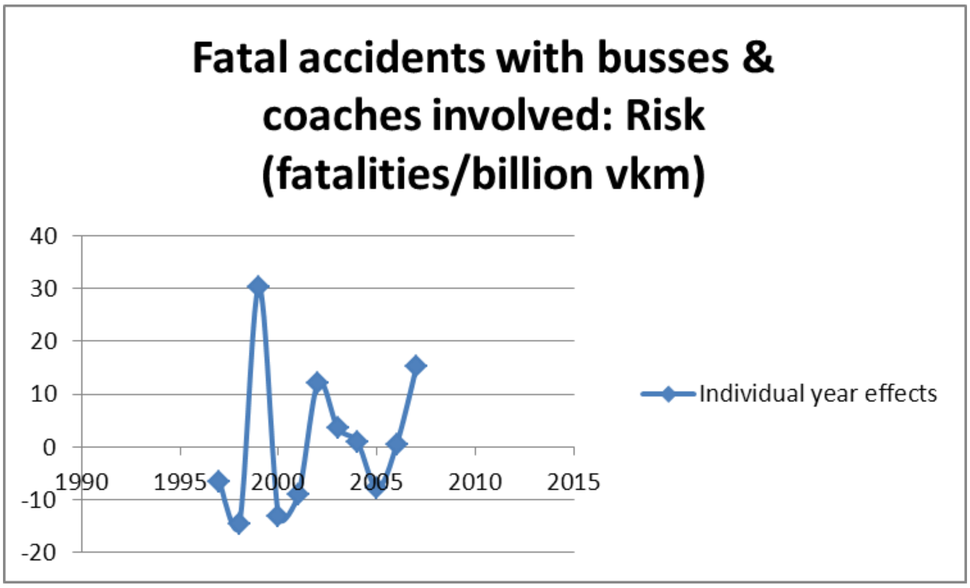

Fatal accidents with HGV involved: Risk (fatalities/billion vkm)
8
6
4
2
0
-2
-4
-6
-8
1990
1995
2000
2005
2010
2015
Individual year effects

Buses and coaches



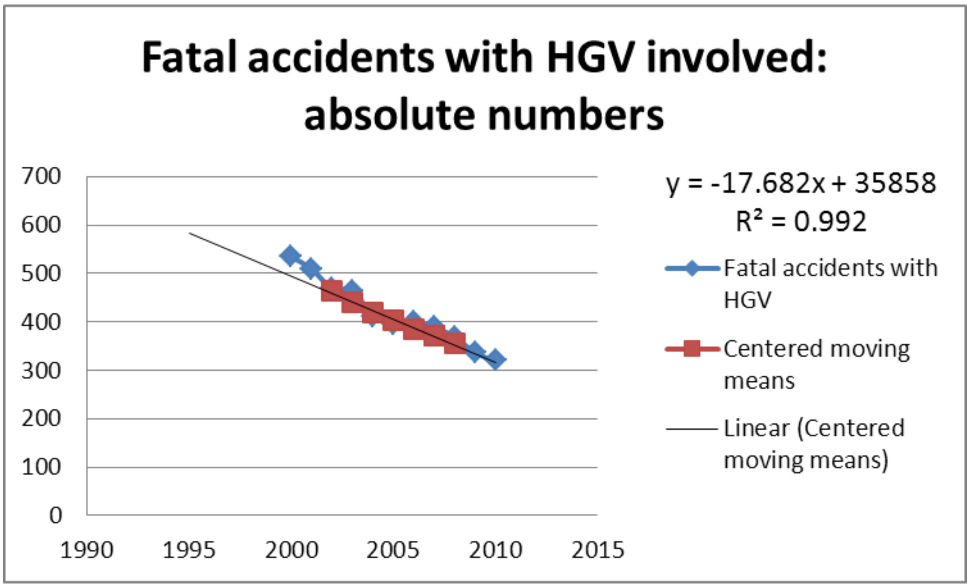


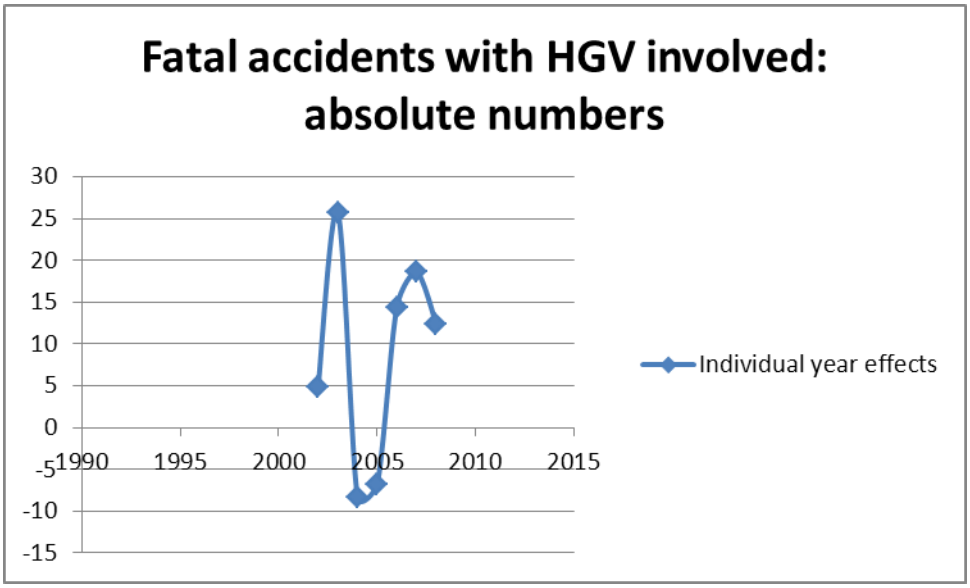

Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
80
70
60
50
40
30
20
10
0
1990
1995
2000
2005
2010
2015
y = -1.8561x + 3756.3
R² = 0.9455
Fatal accidents with busses & coaches involved risk
Centered moving means
Linear (Centered moving means)

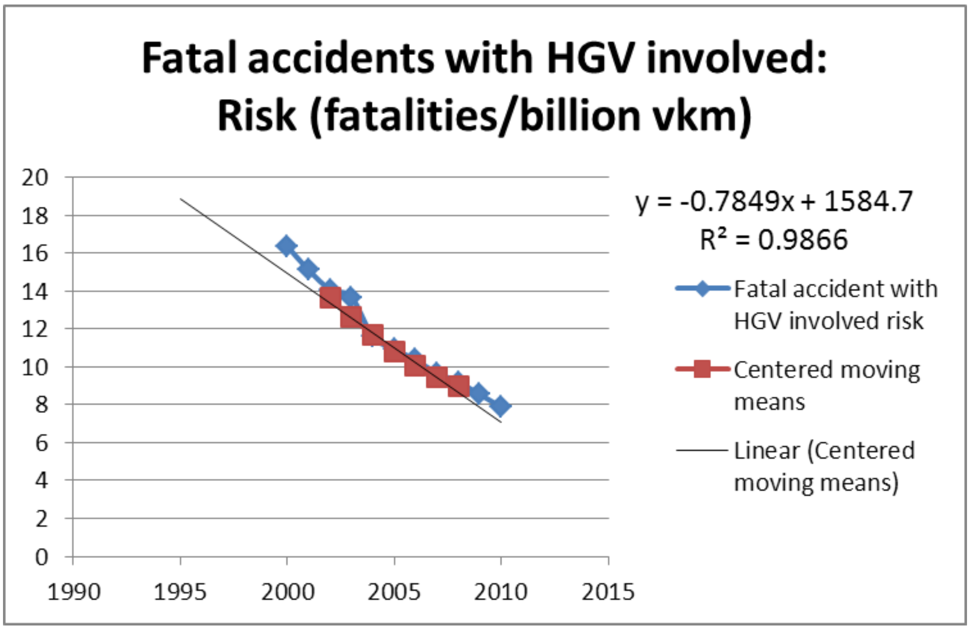

Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
40
30
20
10
0
-10
-20
1990
1995
2000
2005
2010
2015
Individual year effects

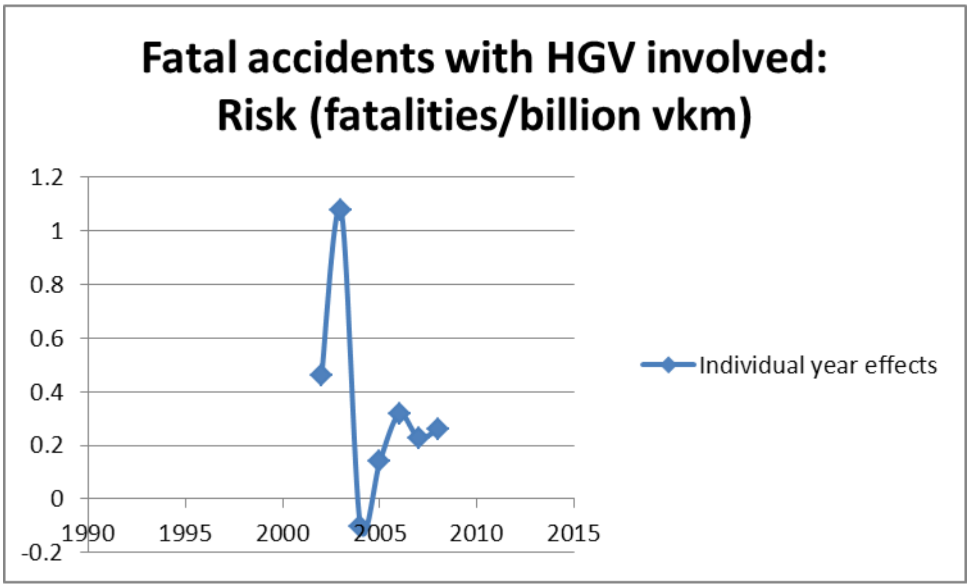
Germany

Heavy goods vehicles

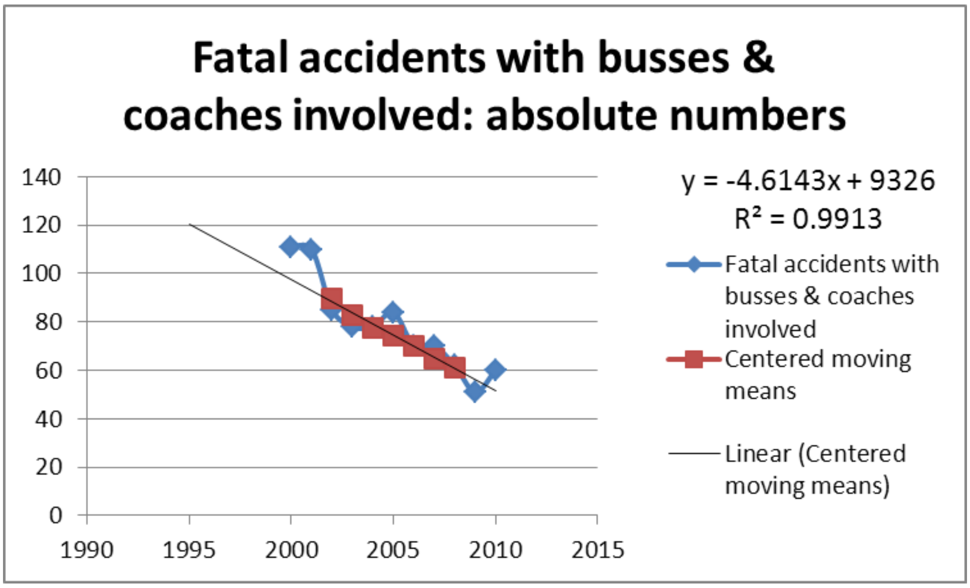


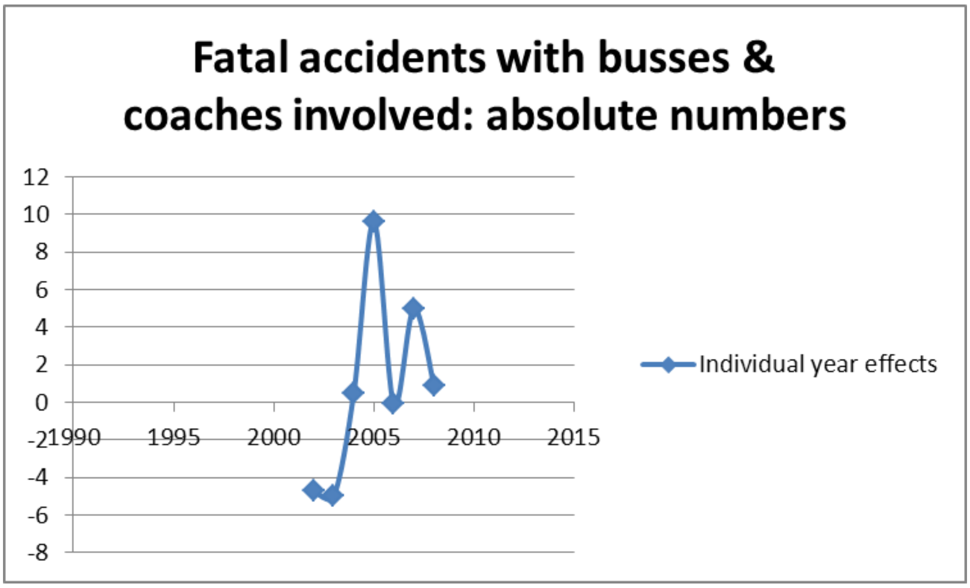


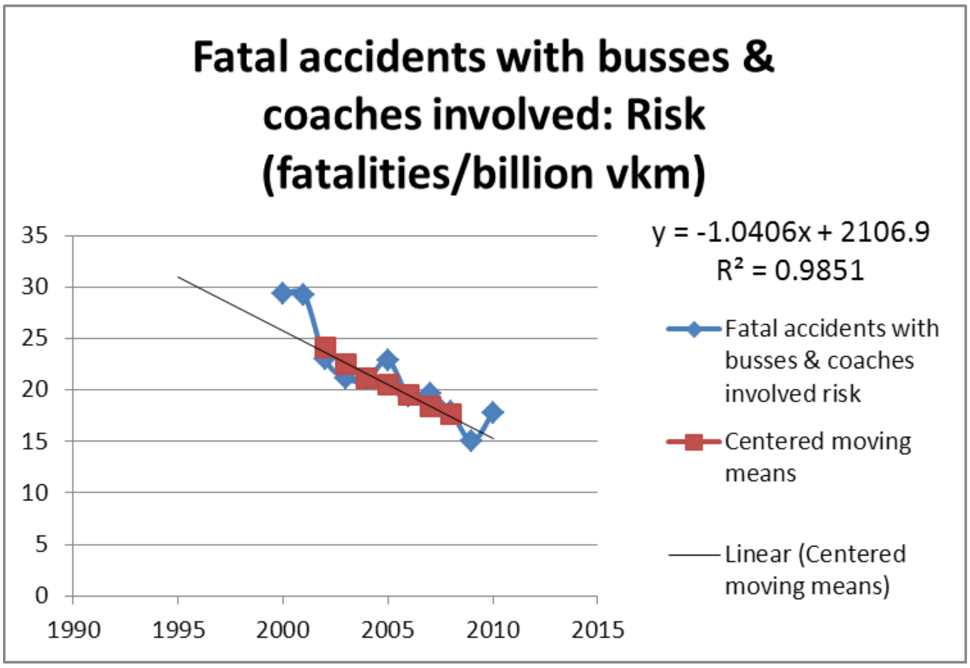

Fatal accidents with HGV involved:
Risk (fatalities/billion vkm)
y = -0.7849x + 1584.7
R² = 0.9866
Fatal accident with HGV involved risk
Centered moving means
Linear (Centered moving means)
20
18
16
14
12
10
8
6
4
2
0
1990
1995
2000
2005
2010
2015

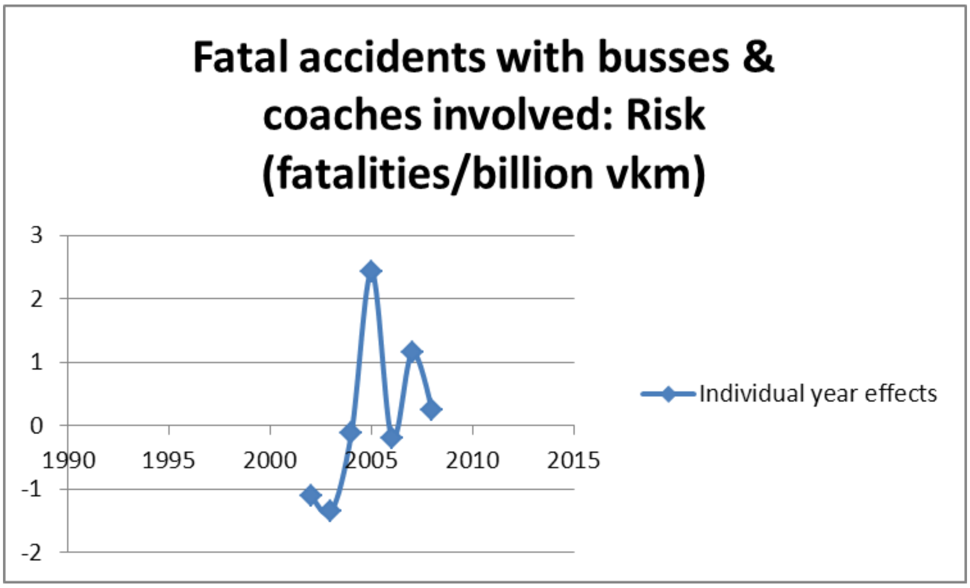

Fatal accidents with HGV involved:
Risk (fatalities/billion vkm)
Individual year effects
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
1990
1995
2000
2005
2010
2015

Buses and coaches



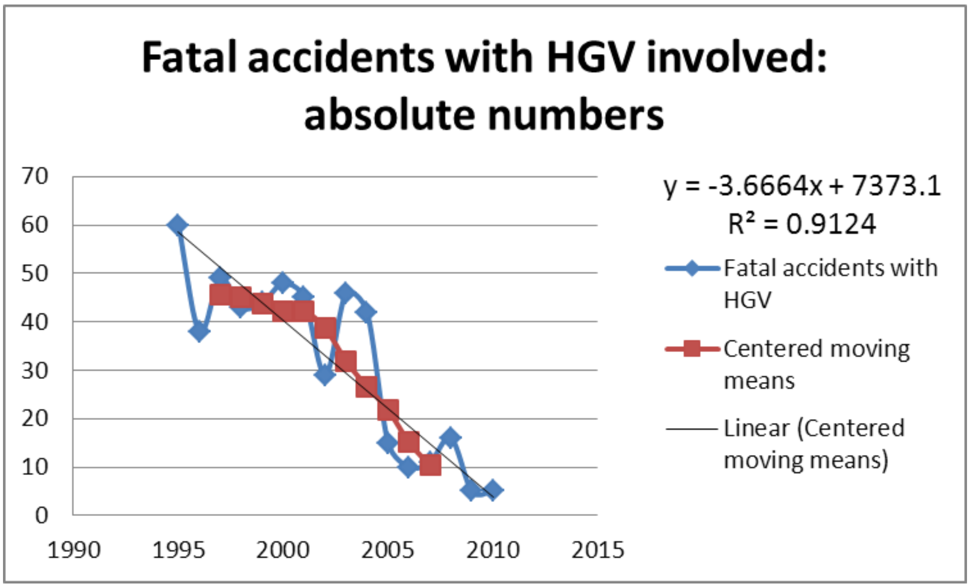


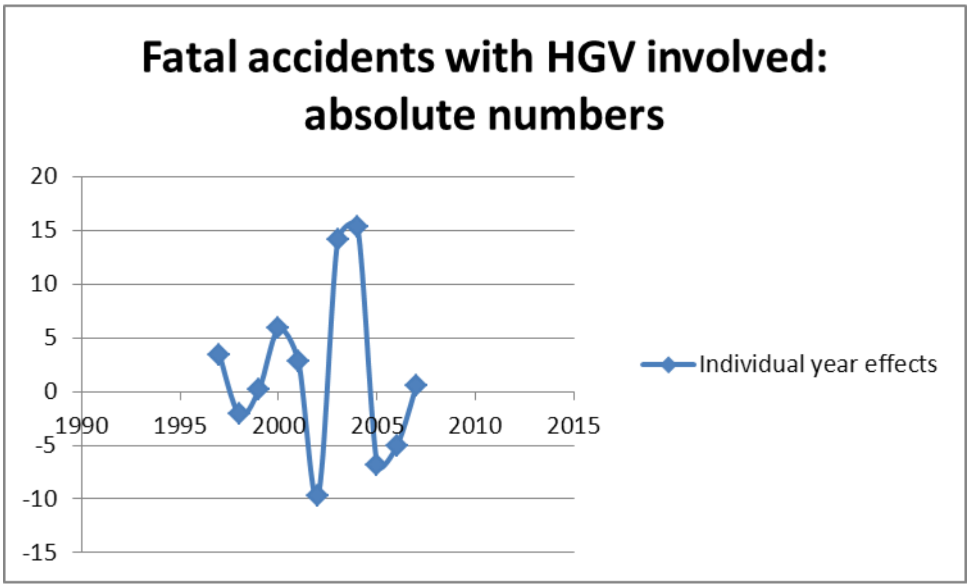

Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
y = -1.0406x + 2106.9
R² = 0.9851
35
30
25
20
15
10
5
0
1990
1995
2000
2005
2010
2015
Fatal accidents with busses & coaches involved risk
Centered moving means
Linear (Centered moving means)

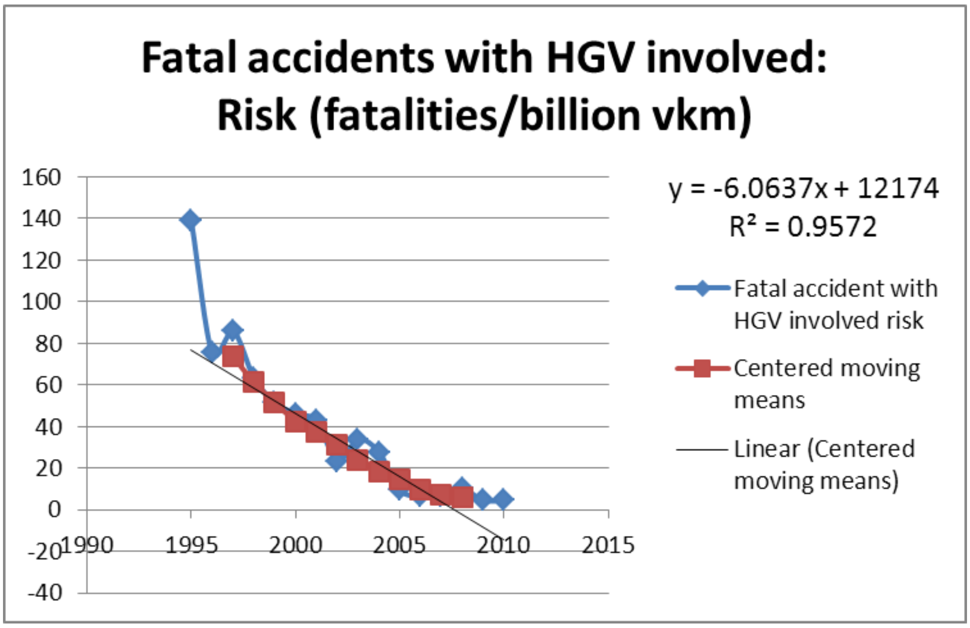

Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
3
2
1
0
-1
-2
1990
1995
2000
2005
2010
2015
Individual year effects

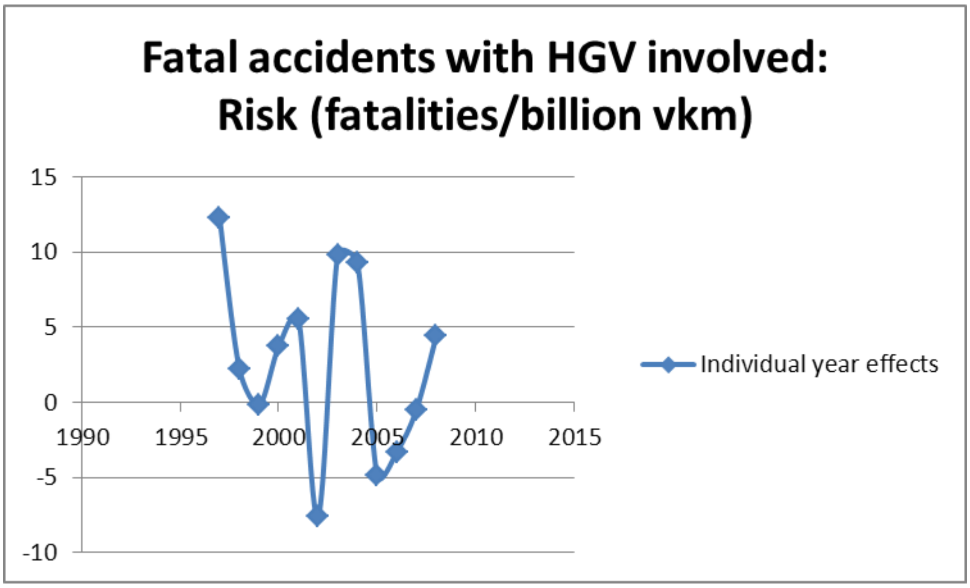
Ireland

Heavy goods vehicles

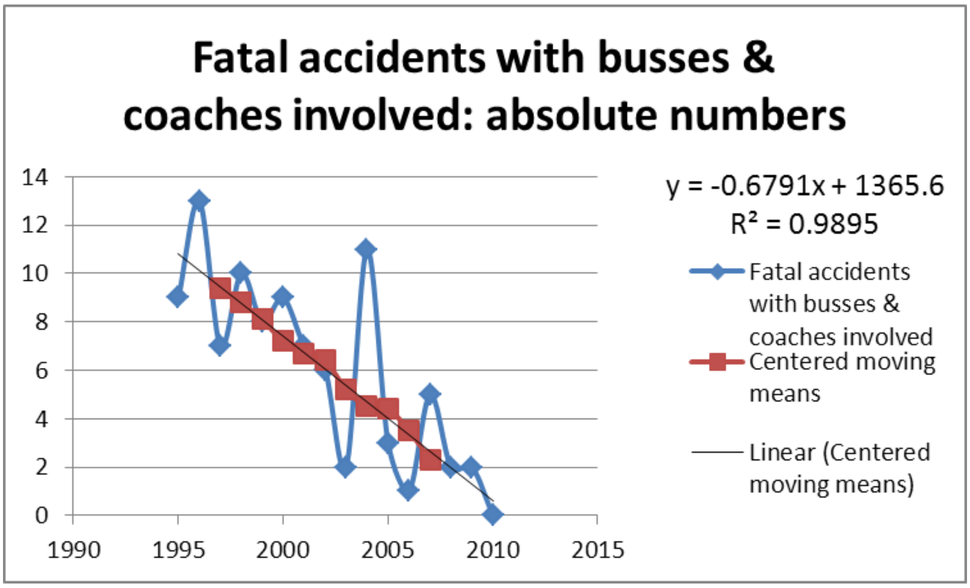


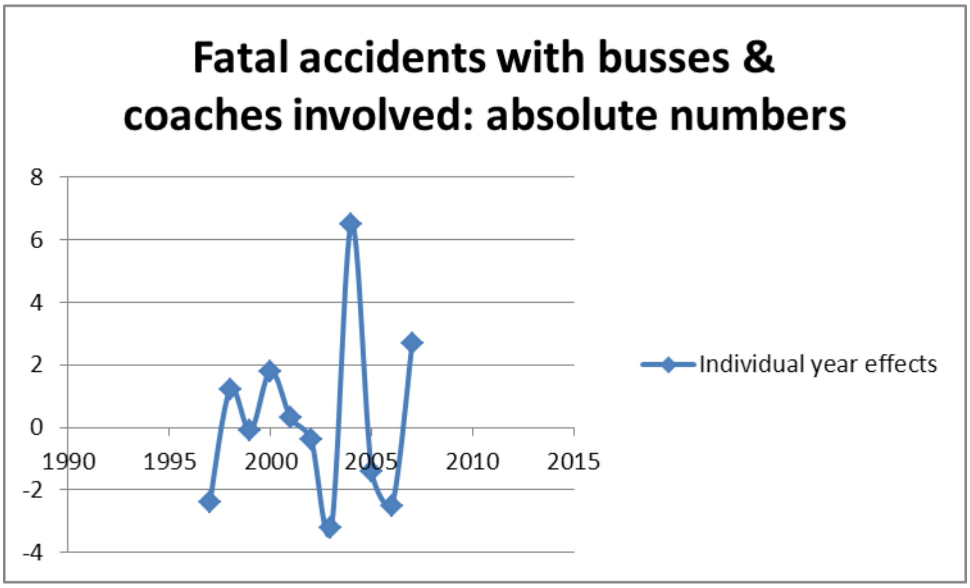


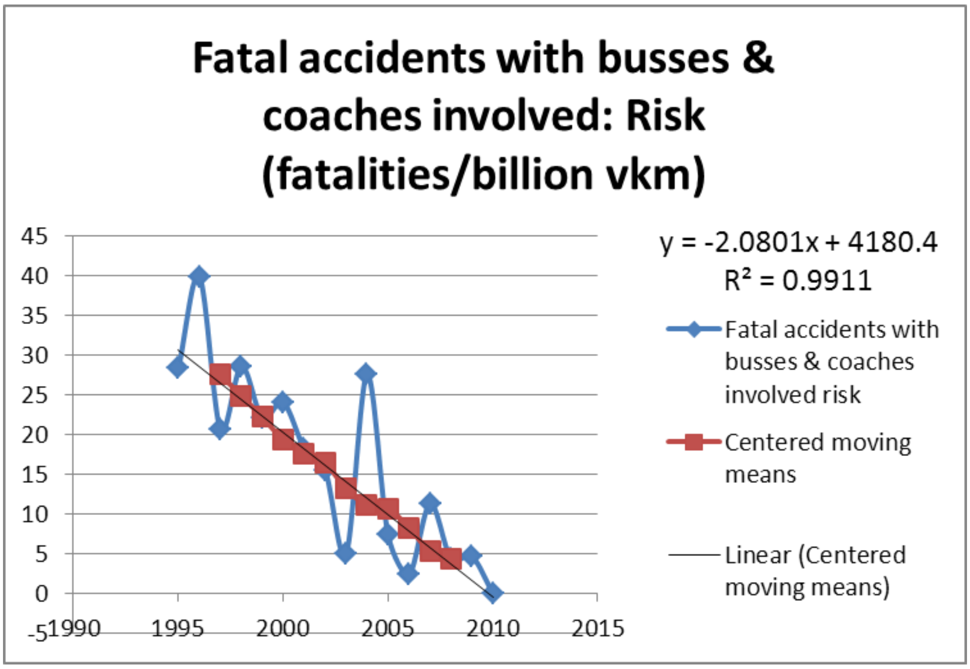

Fatal accidents with HGV involved:
Risk (fatalities/billion vkm)
160
140
120
100
80
60
40
20
0
-20
-40
1990
1995
2000
2005
2010
2015
y = -6.0637x + 12174
R² = 0.9572
Fatal accident with HGV involved risk
Centered moving means
Linear (Centered moving means)

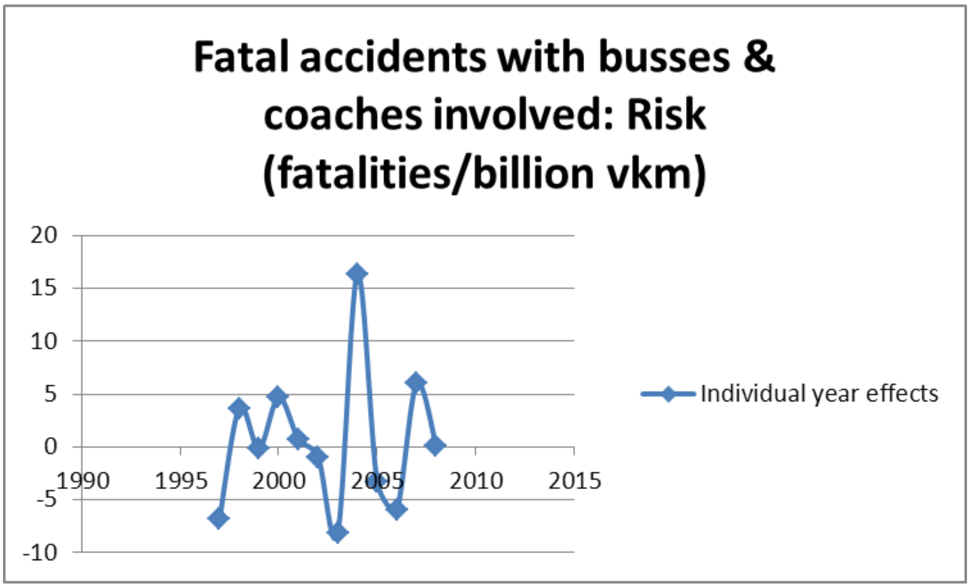

Fatal accidents with HGV involved:
Risk (fatalities/billion vkm)
15
10
5
0
-5
-10
1990
1995
2000
2005
2010
2015
Individual year effects

Buses and coaches



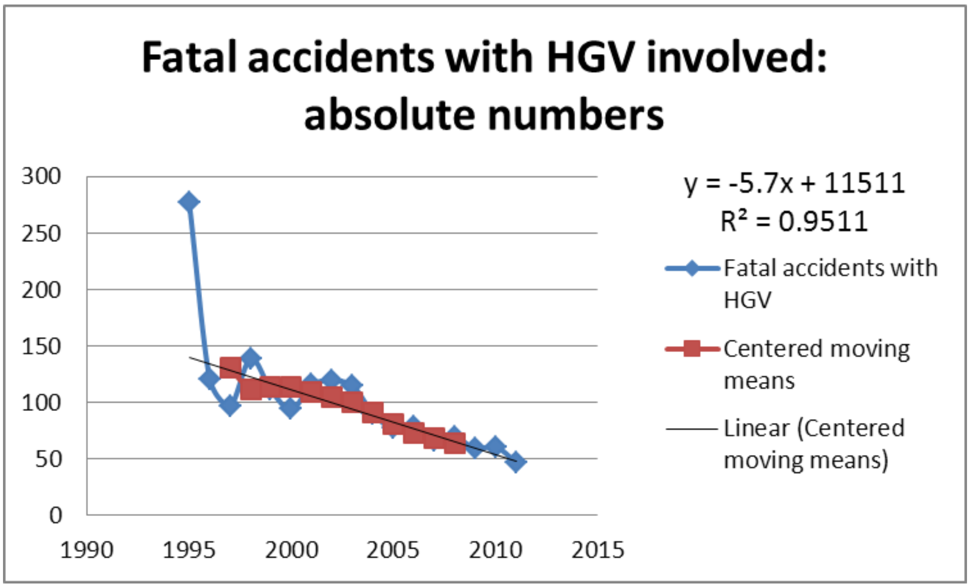


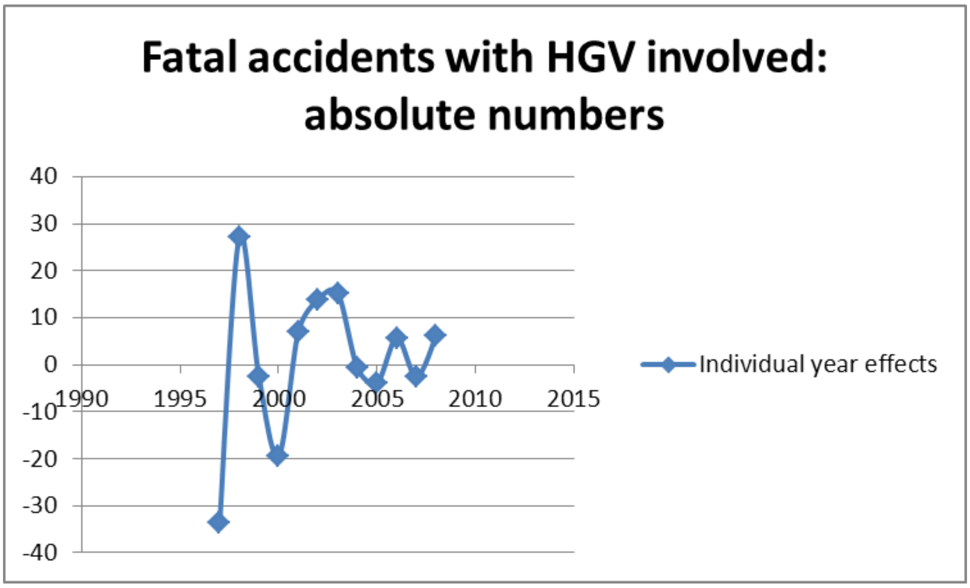

Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
y = -2.0801x + 4180.4
R² = 0.9911
Fatal accidents with busses & coaches involved risk
Centered moving means
Linear (Centered moving means)
45
40
35
30
25
20
15
10
5
0
-5
1990
1995
2000
2005
2010
2015

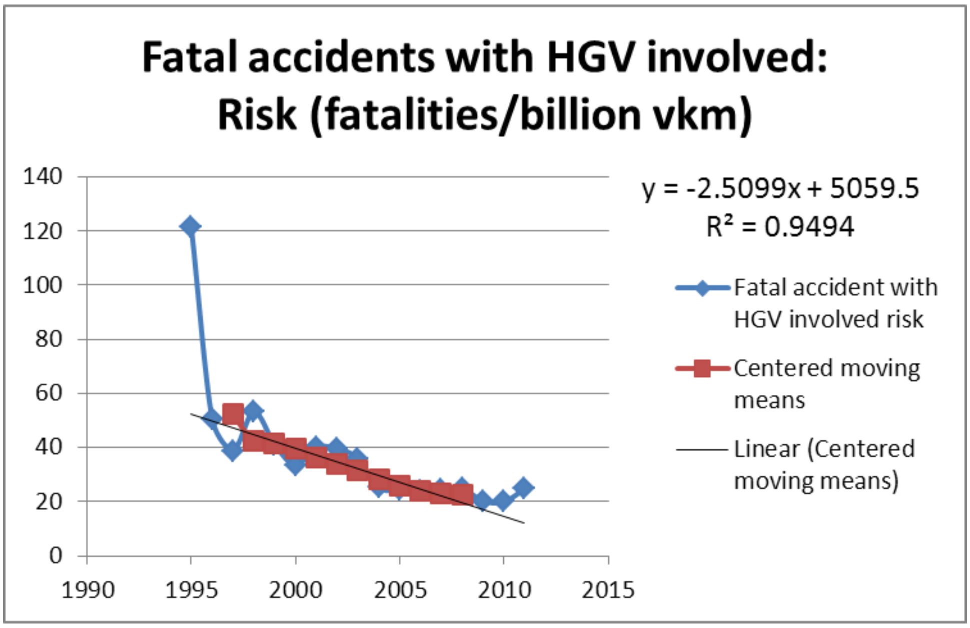

Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
Individual year effects
20
15
10
5
0
-5
-10
1990
1995
2000
2005
2010
2015

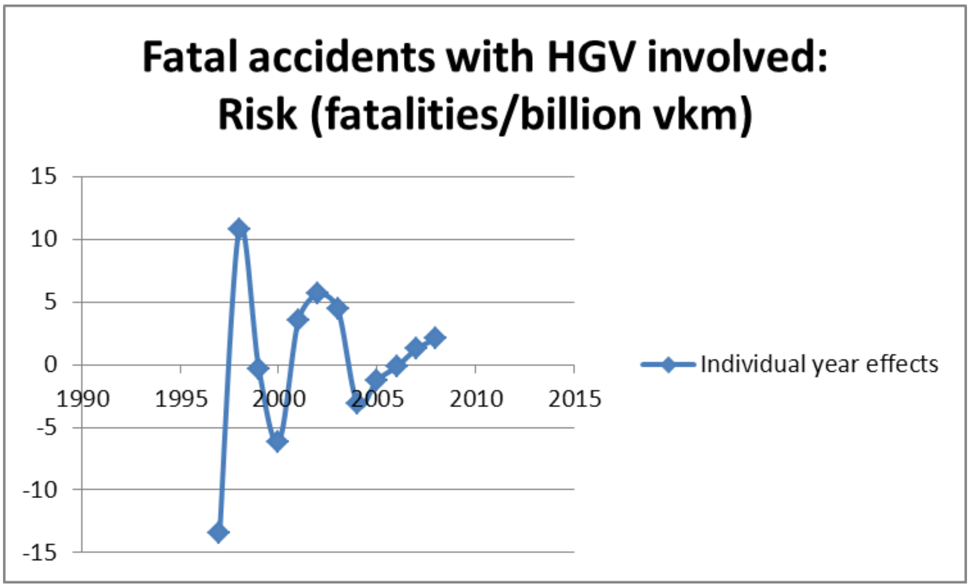
Greece

Heavy goods vehicles

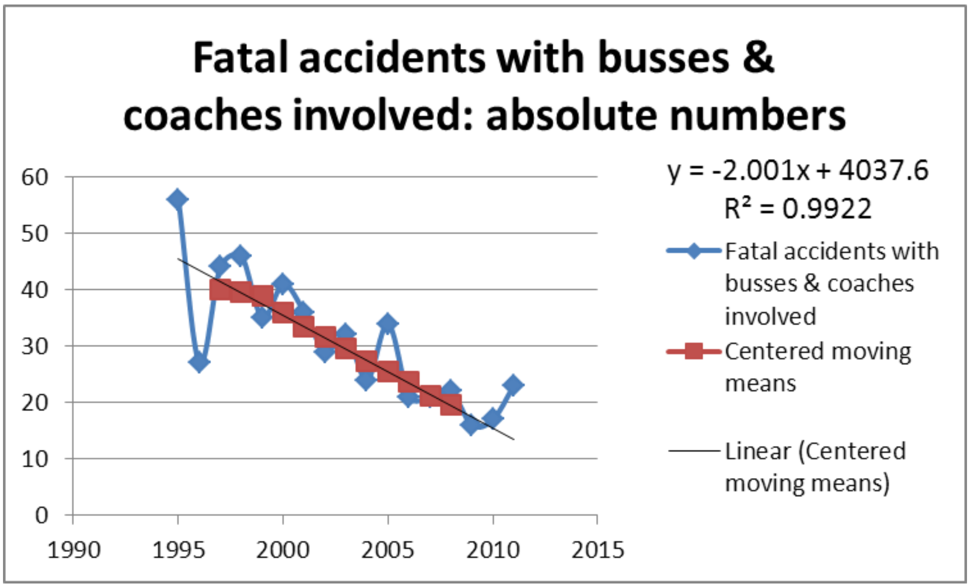


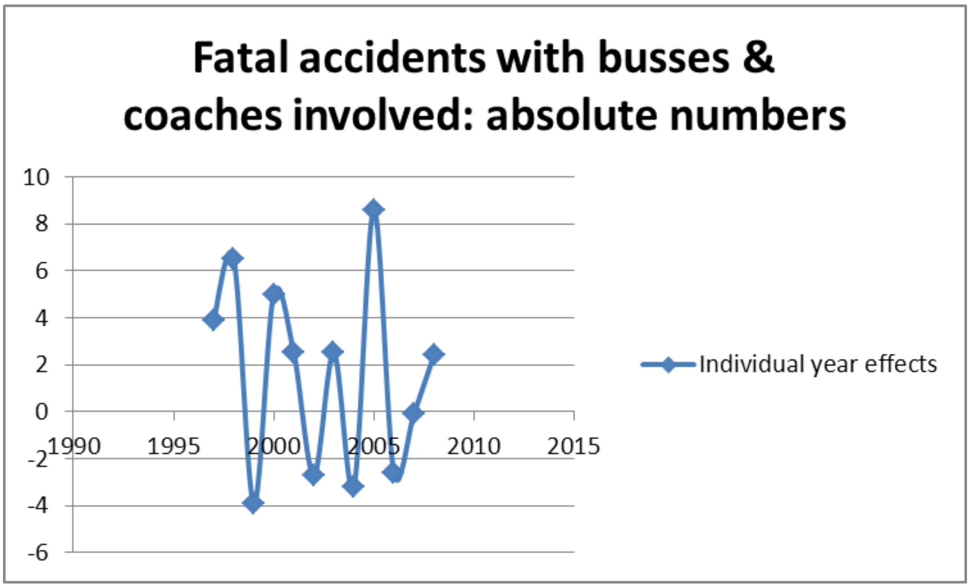


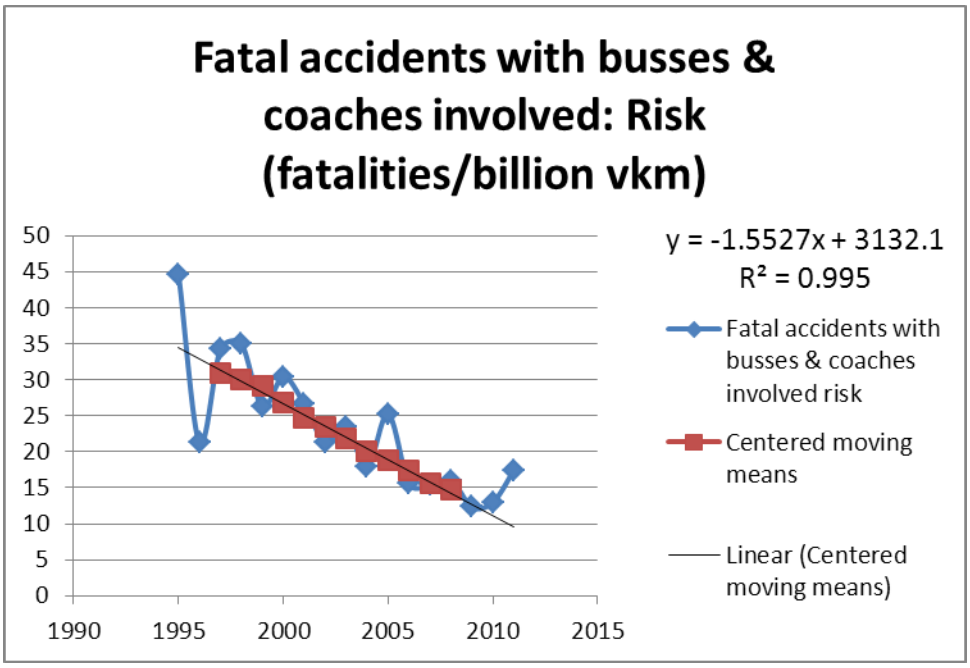

Fatal accidents with HGV involved:
Risk (fatalities/billion vkm)
y = -2.5099x + 5059.5
R² = 0.9494
Fatal accident with HGV involved risk
Centered moving means
Linear (Centered moving means)
140
120
100
80
60
40
20
0
1990
1995
2000
2005
2010
2015

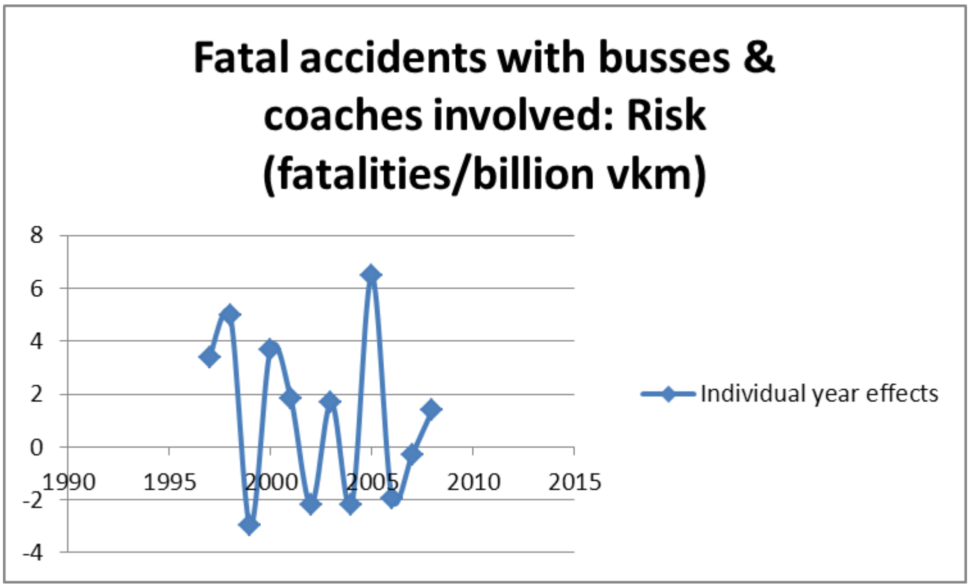

Fatal accidents with HGV involved:
Risk (fatalities/billion vkm)
Individual year effects
15
10
5
0
-5
-10
-15
1990
1995
2000
2005
2010
2015

Buses and coaches



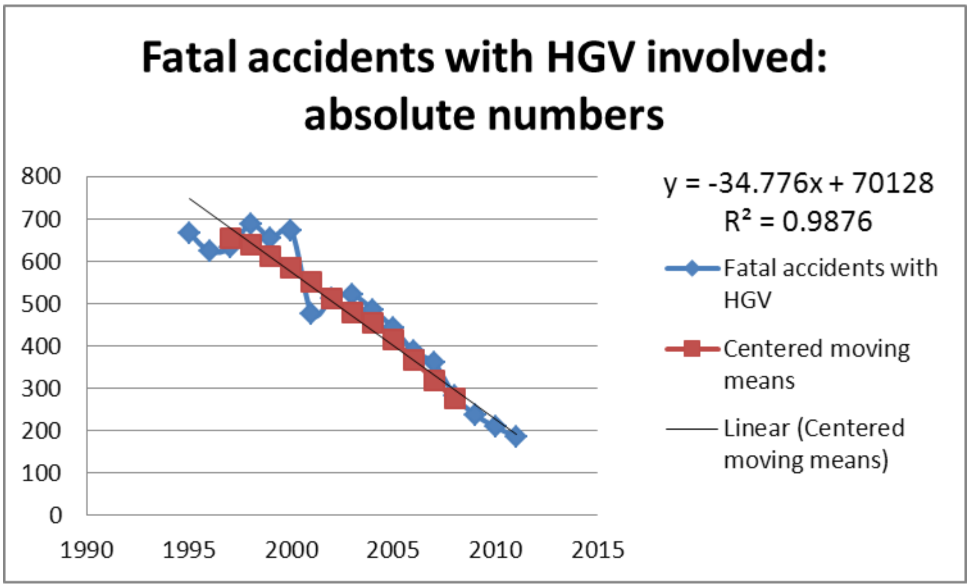


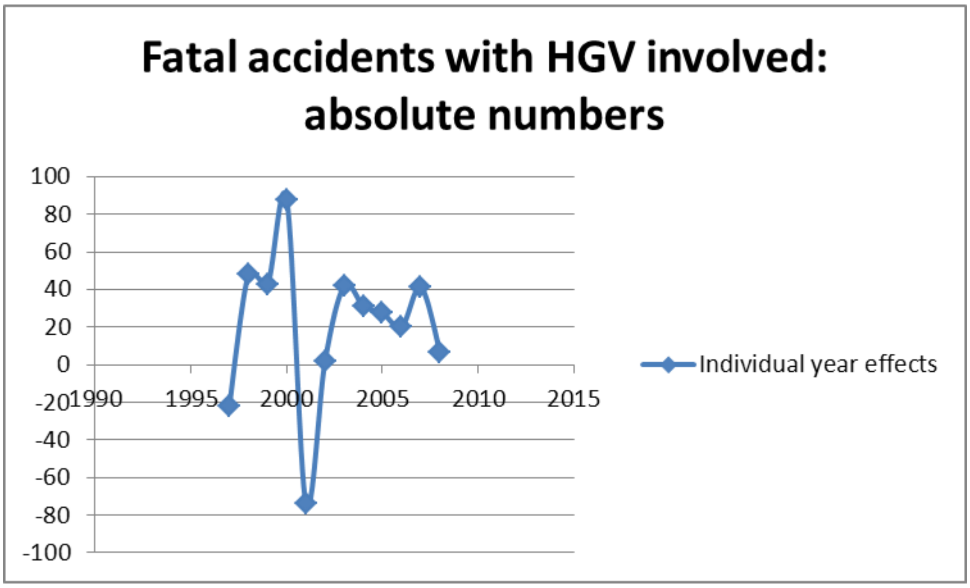

Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
y = -1.5527x + 3132.1
R² = 0.995
Fatal accidents with busses & coaches involved risk
Centered moving means
Linear (Centered moving means)
50
45
40
35
30
25
20
15
10
5
0
1990
1995
2000
2005
2010
2015

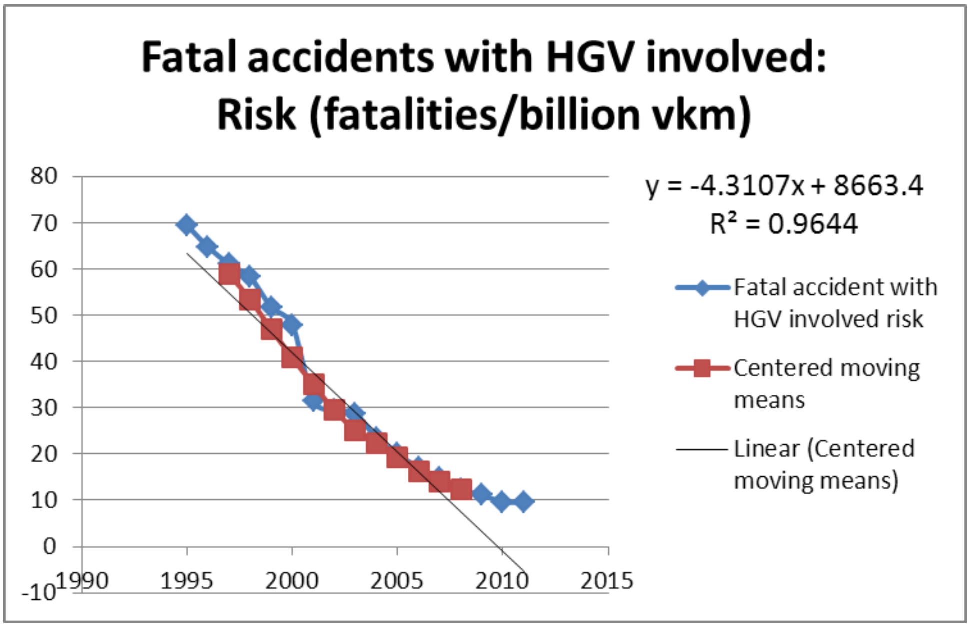

Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
Individual year effects
8
6
4
2
0
-2
-4
1990
1995
2000
2005
2010
2015

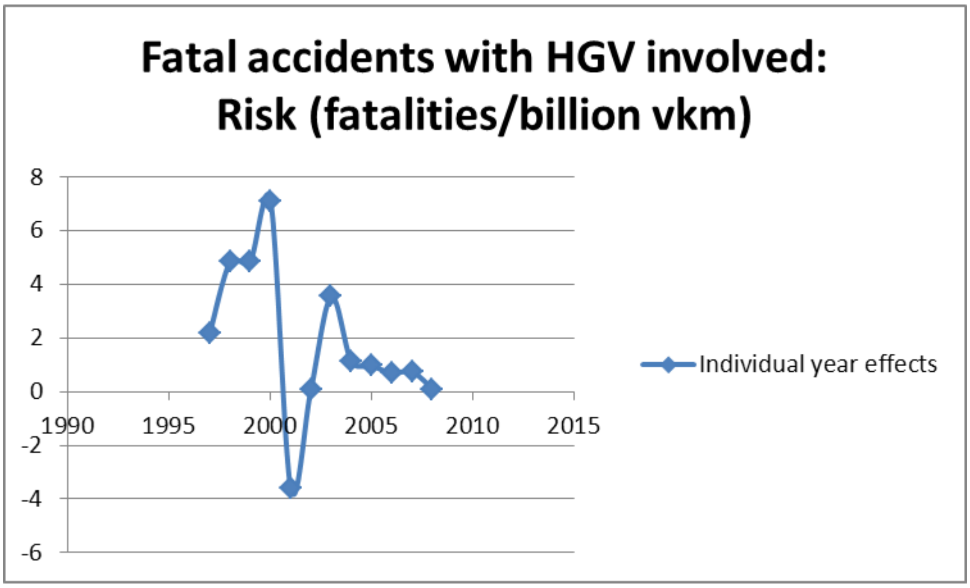
Spain

Heavy goods vehicles

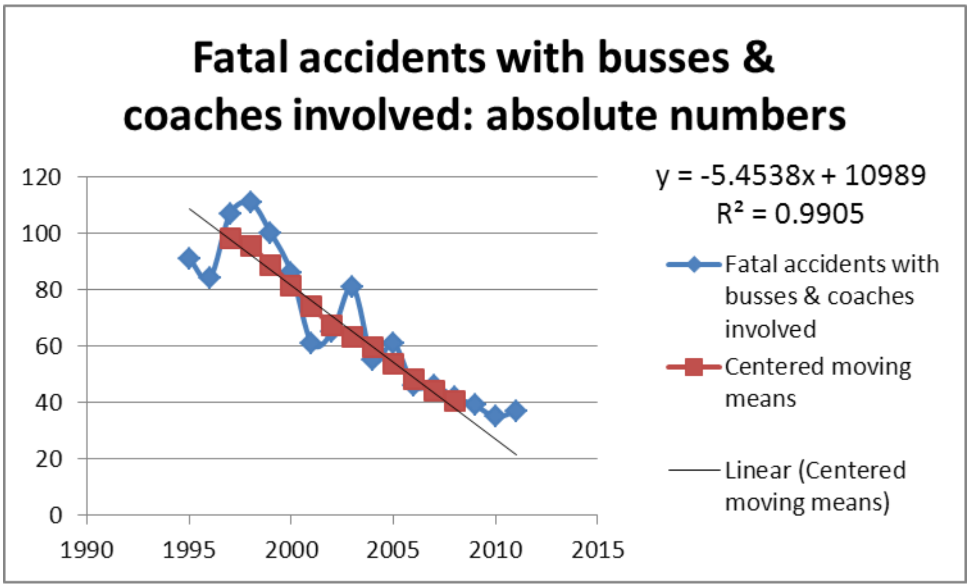


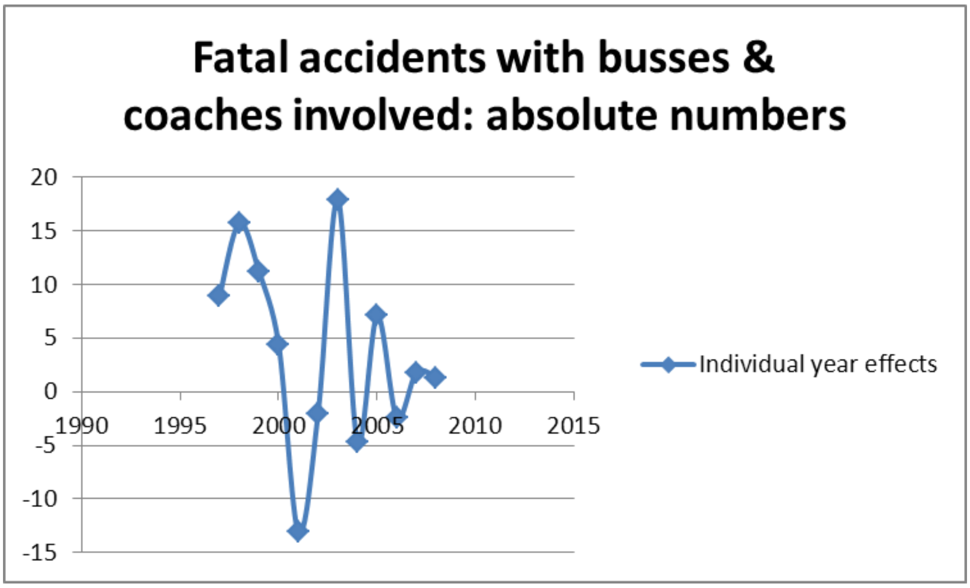


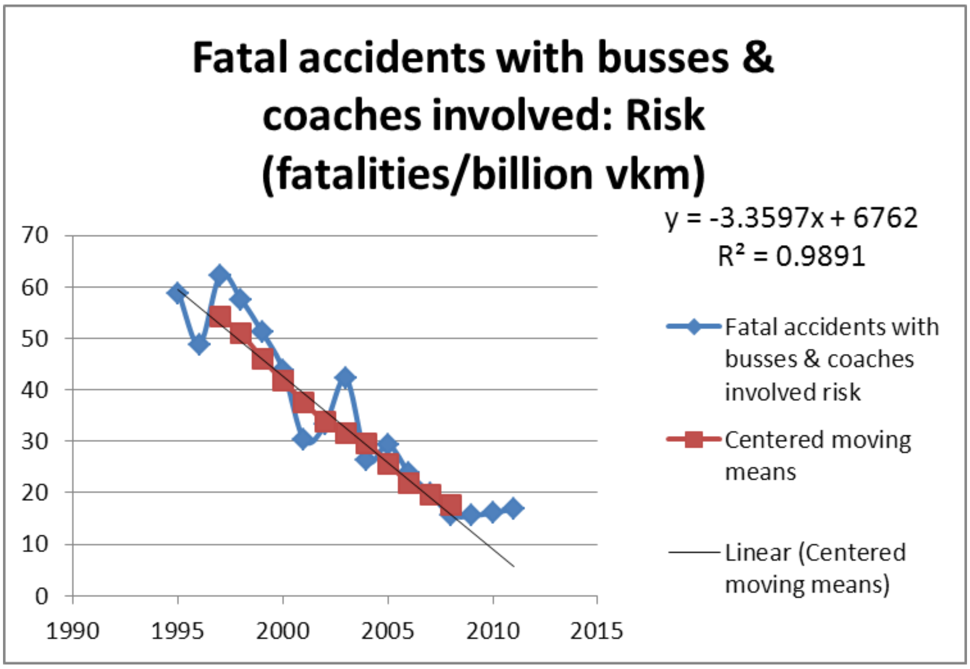

Fatal accidents with HGV involved:
Risk (fatalities/billion vkm)
80
70
60
50
40
30
20
10
0
-10
1990
1995
2000
2005
2010
2015
y = -4.3107x + 8663.4
R² = 0.9644
Fatal accident with HGV involved risk
Centered moving means
Linear (Centered moving means)

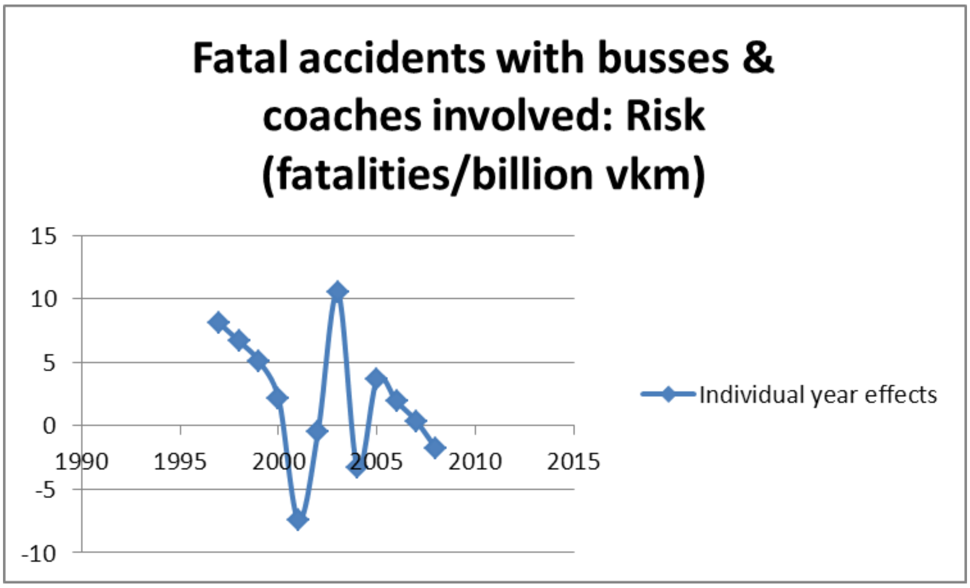

Fatal accidents with HGV involved:
Risk (fatalities/billion vkm)
8
6
4
2
0
-2
-4
-6
1990
1995
2000
2005
2010
2015
Individual year effects

Buses and coaches



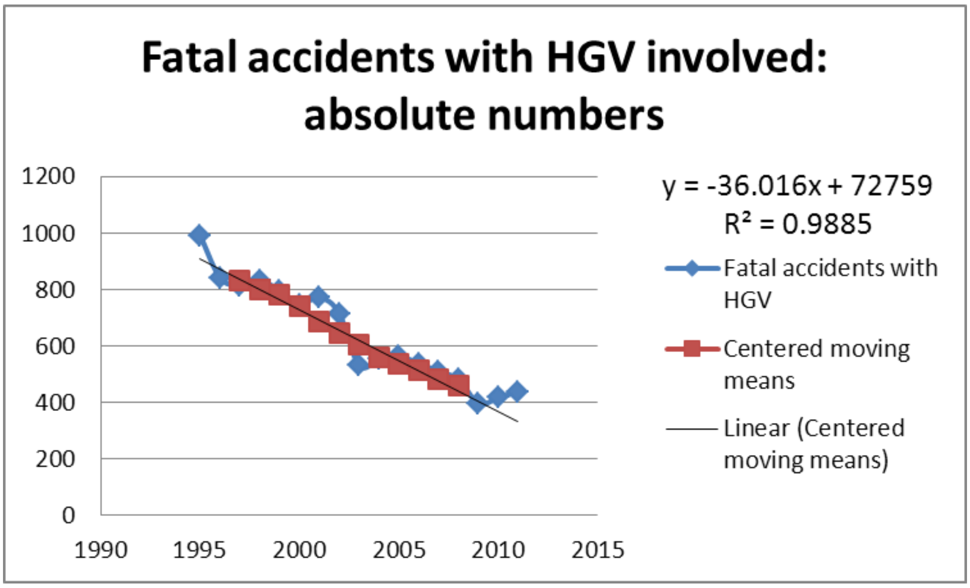


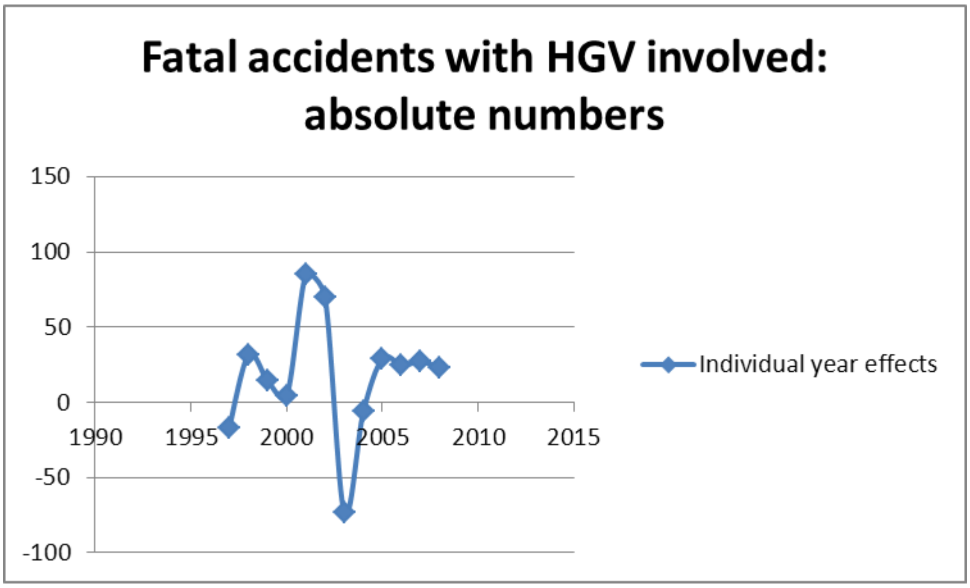

Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
y = -3.3597x + 6762
R² = 0.9891
70
60
50
40
30
20
10
0
1990
1995
2000
2005
2010
2015
Fatal accidents with busses & coaches involved risk
Centered moving means
Linear (Centered moving means)

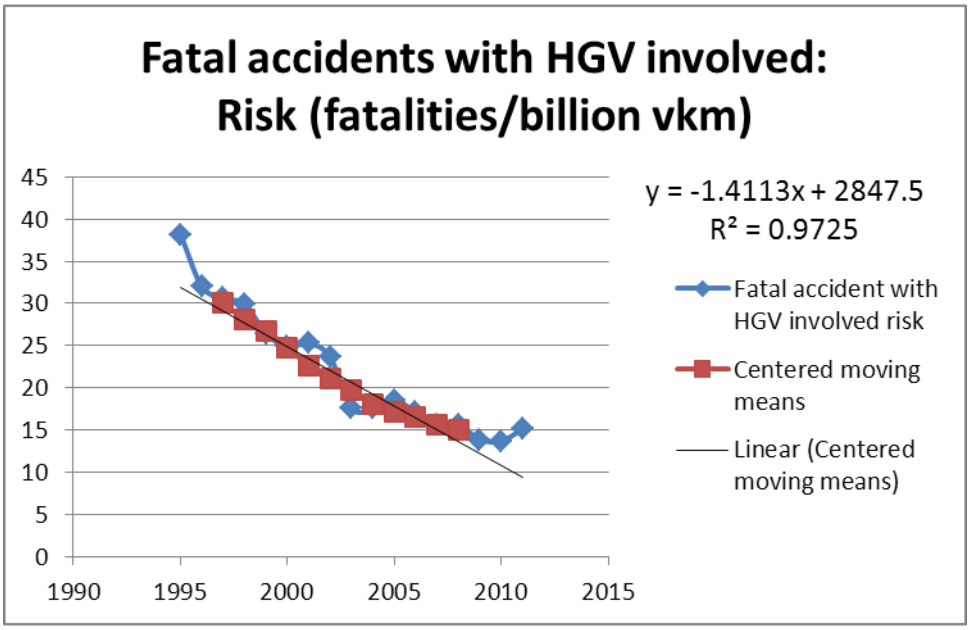

Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
15
10
5
0
-5
-10
1990
1995
2000
2005
2010
2015
Individual year effects

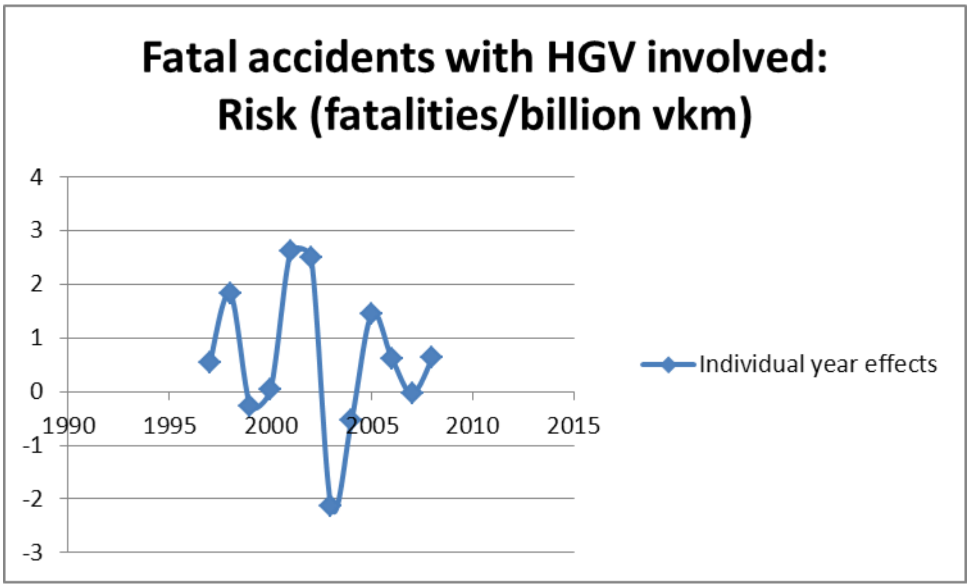
France

Heavy goods vehicles

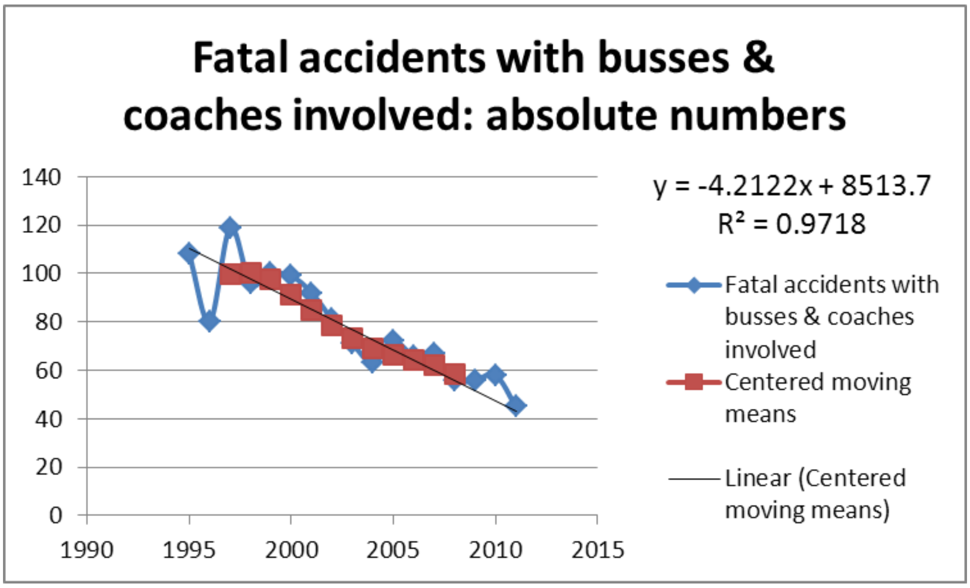


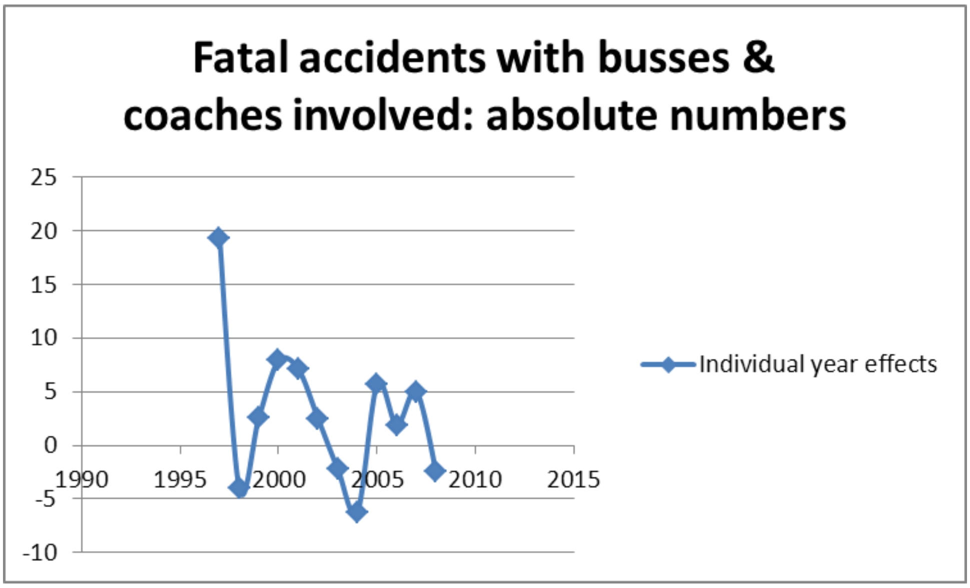


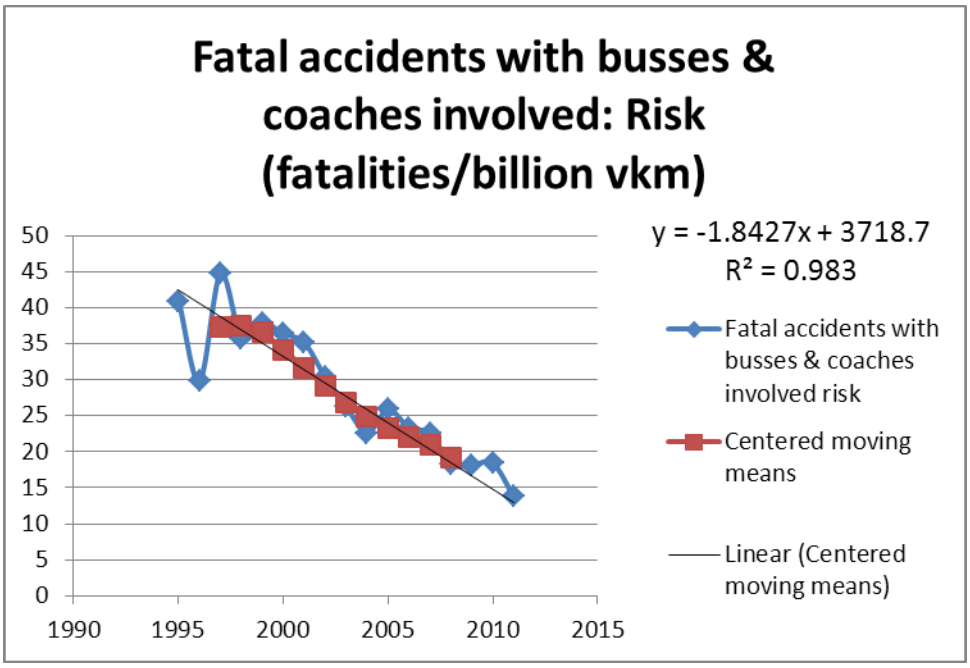

Fatal accidents with HGV involved:
Risk (fatalities/billion vkm)
y = -1.4113x + 2847.5
R² = 0.9725
Fatal accident with HGV involved risk
Centered moving means
Linear (Centered moving means)
45
40
35
30
25
20
15
10
5
0
1990
1995
2000
2005
2010
2015

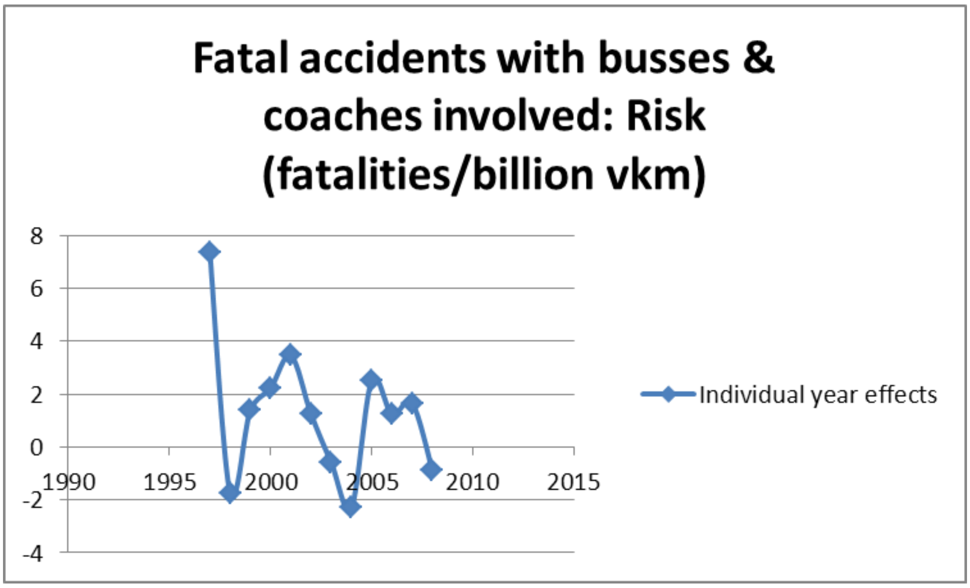

Fatal accidents with HGV involved:
Risk (fatalities/billion vkm)
Individual year effects
4
3
2
1
0
-1
-2
-3
1990
1995
2000
2005
2010
2015

Buses and coaches



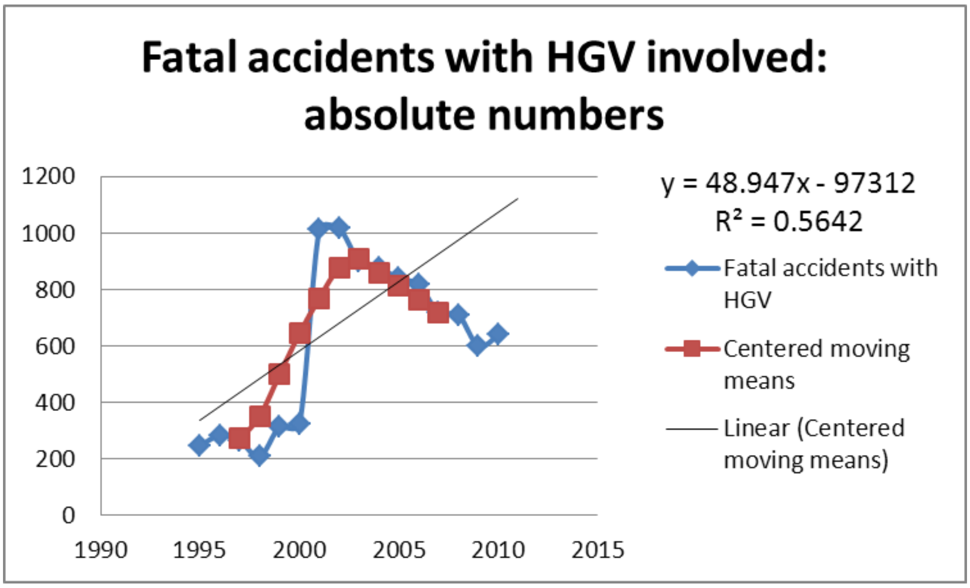


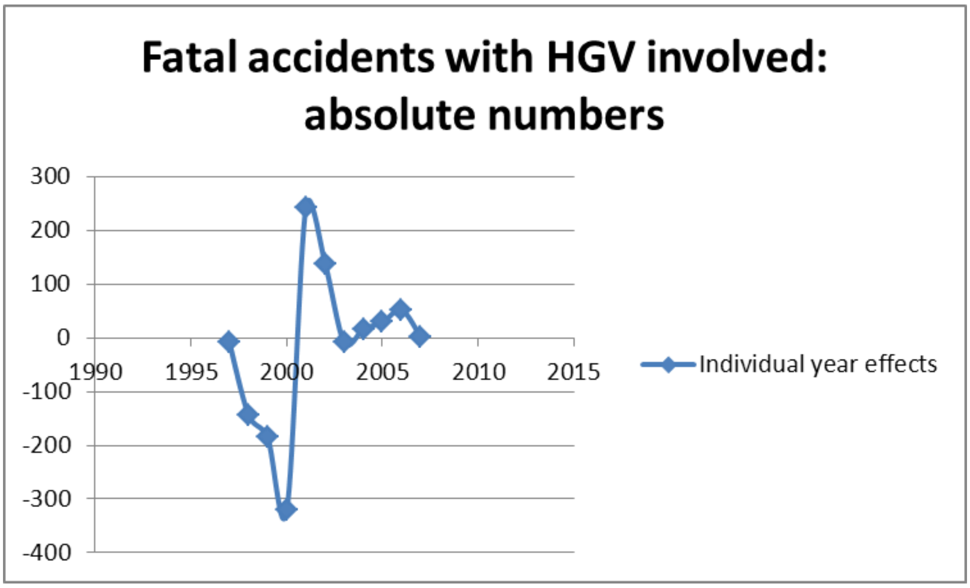

Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
y = -1.8427x + 3718.7
R² = 0.983
50
45
40
35
30
25
20
15
10
5
0
1990
1995
2000
2005
2010
2015
Fatal accidents with busses & coaches involved risk
Centered moving means
Linear (Centered moving means)

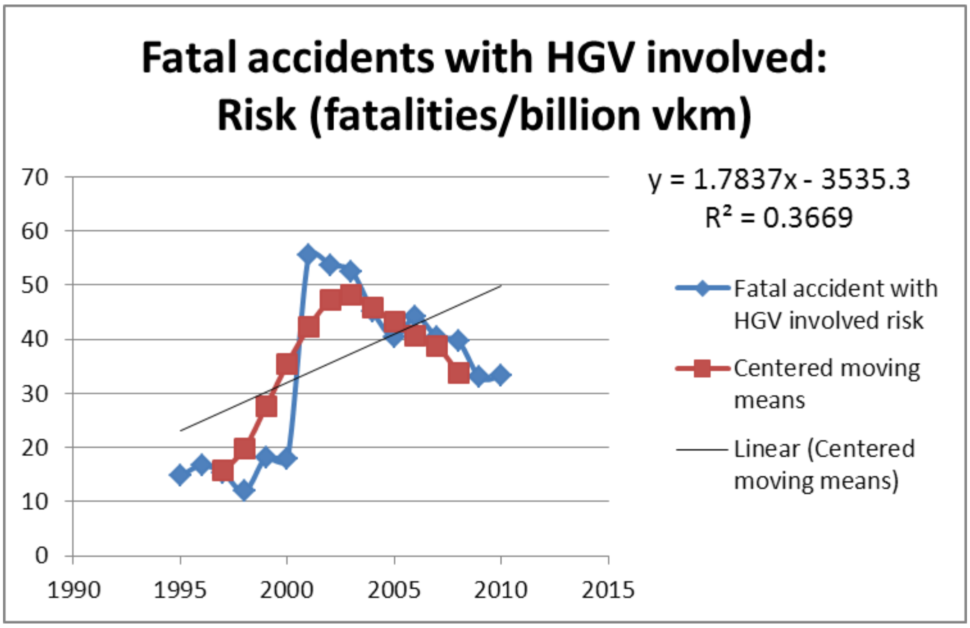

Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
8
6
4
2
0
-2
-4
1990
1995
2000
2005
2010
2015
Individual year effects

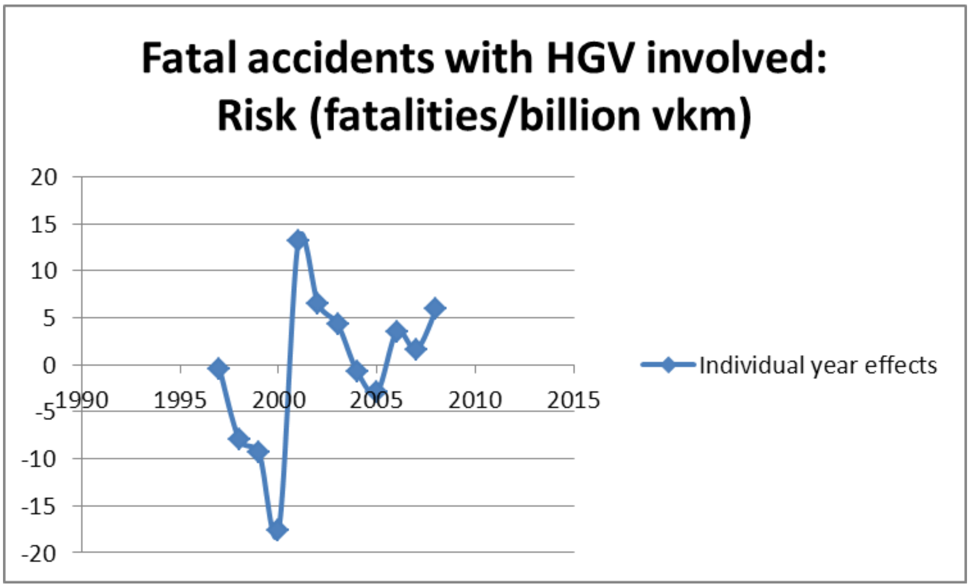
Italy

Heavy goods vehicles

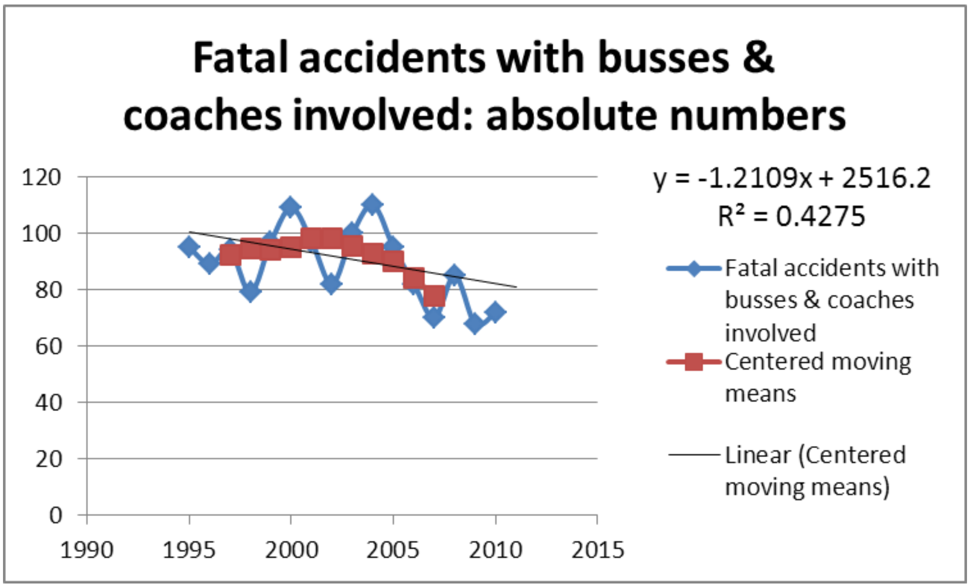


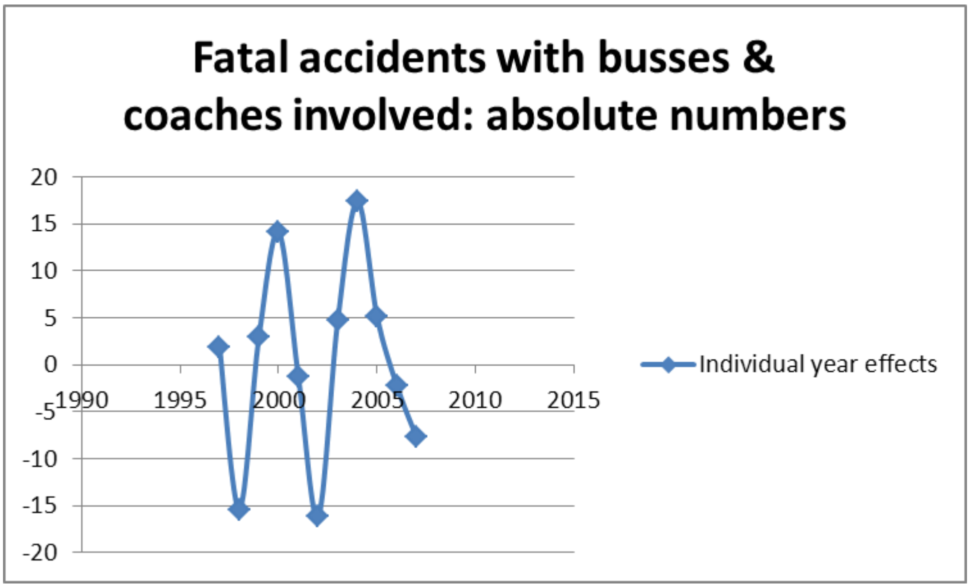


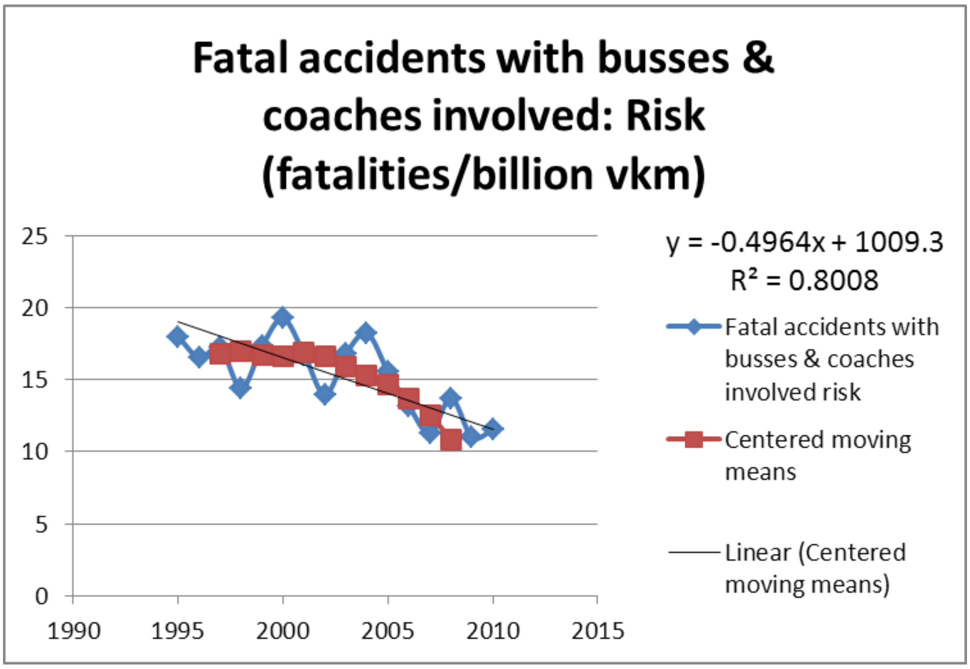

Fatal accidents with HGV involved:
Risk (fatalities/billion vkm)
y = 1.7837x - 3535.3
R² = 0.3669
Fatal accident with HGV involved risk
Centered moving means
Linear (Centered moving means)
70
60
50
40
30
20
10
0
1990
1995
2000
2005
2010
2015

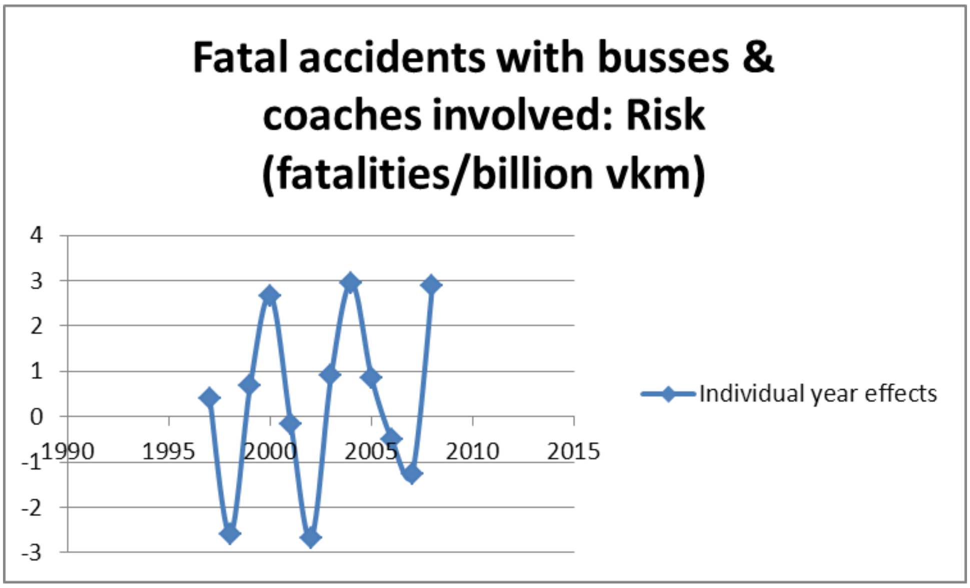

Fatal accidents with HGV involved:
Risk (fatalities/billion vkm)
Individual year effects
20
15
10
5
0
-5
-10
-15
-20
1990
1995
2000
2005
2010
2015

Buses and coaches



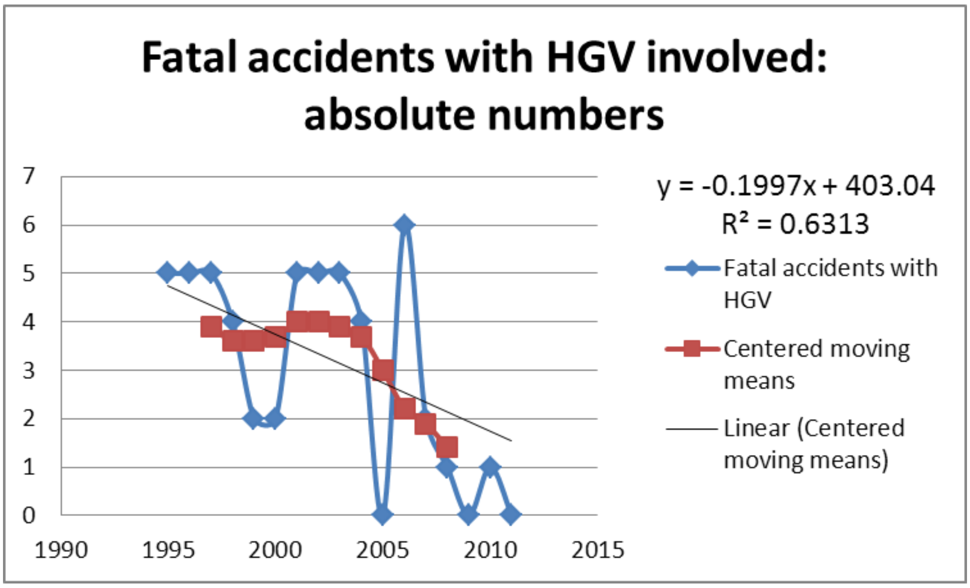


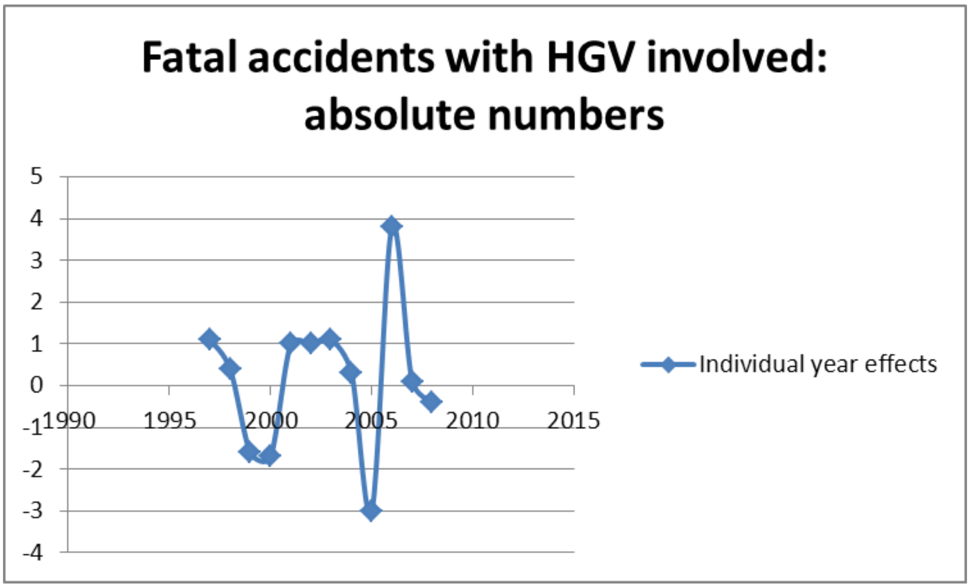

Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
y = -0.4964x + 1009.3
R² = 0.8008
Fatal accidents with busses & coaches involved risk
Centered moving means
Linear (Centered moving means)
25
20
15
10
5
0
1990
1995
2000
2005
2010
2015

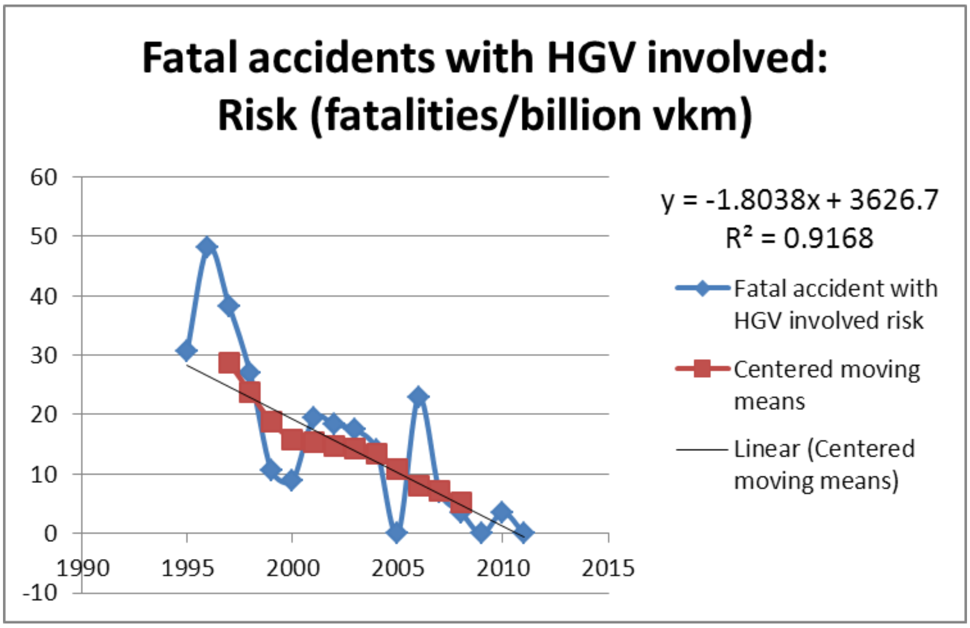

Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
Individual year effects
4
3
2
1
0
-1
-2
-3
1990
1995
2000
2005
2010
2015

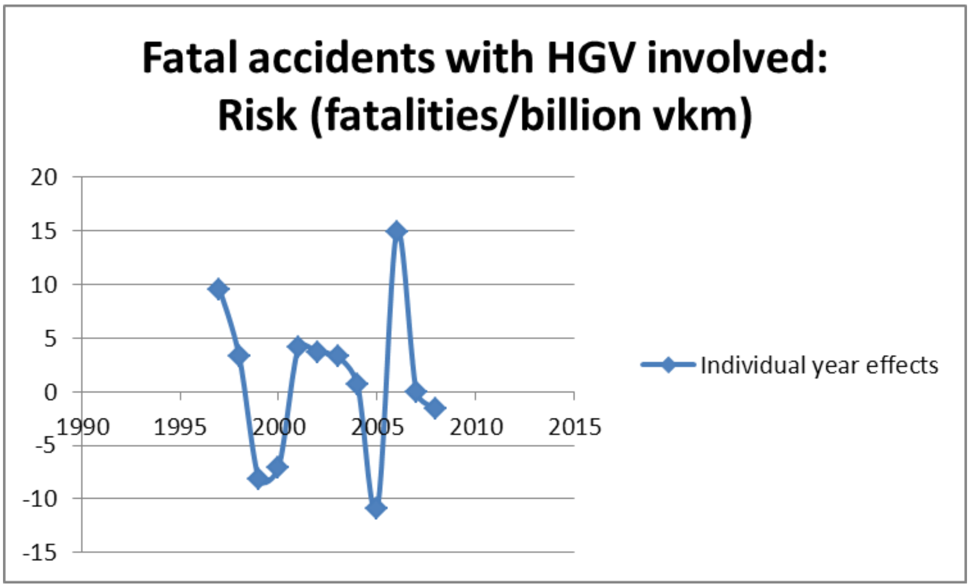
Luxemburg

Heavy goods vehicles

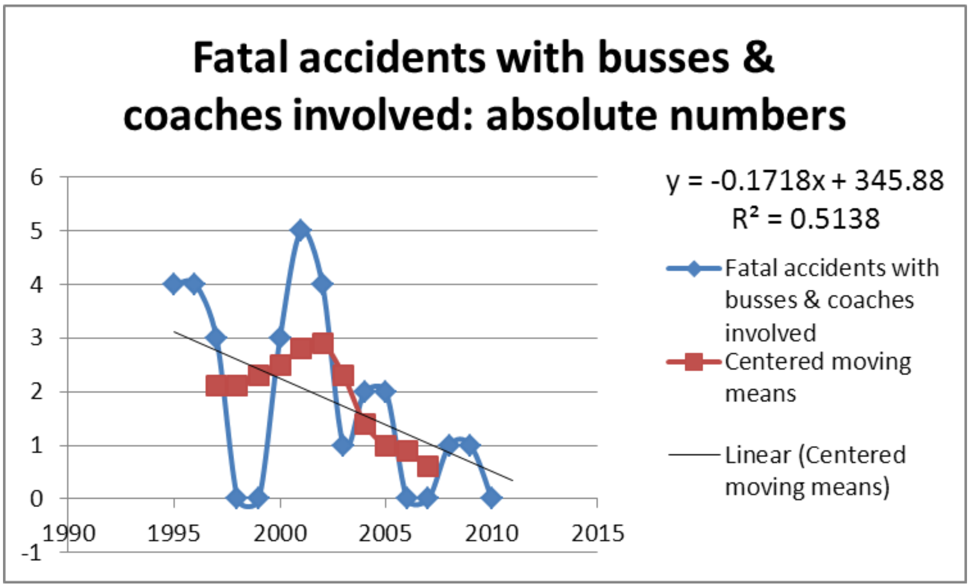


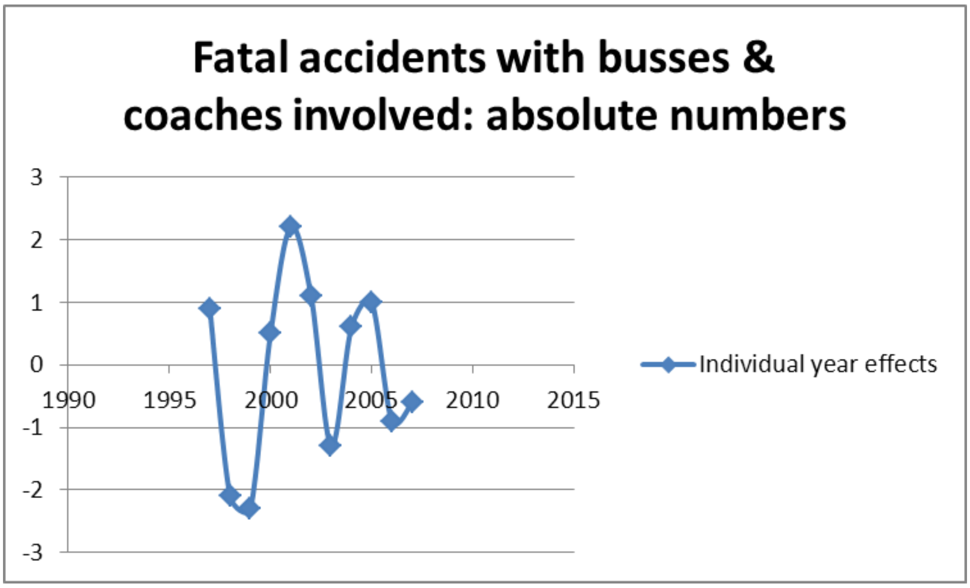


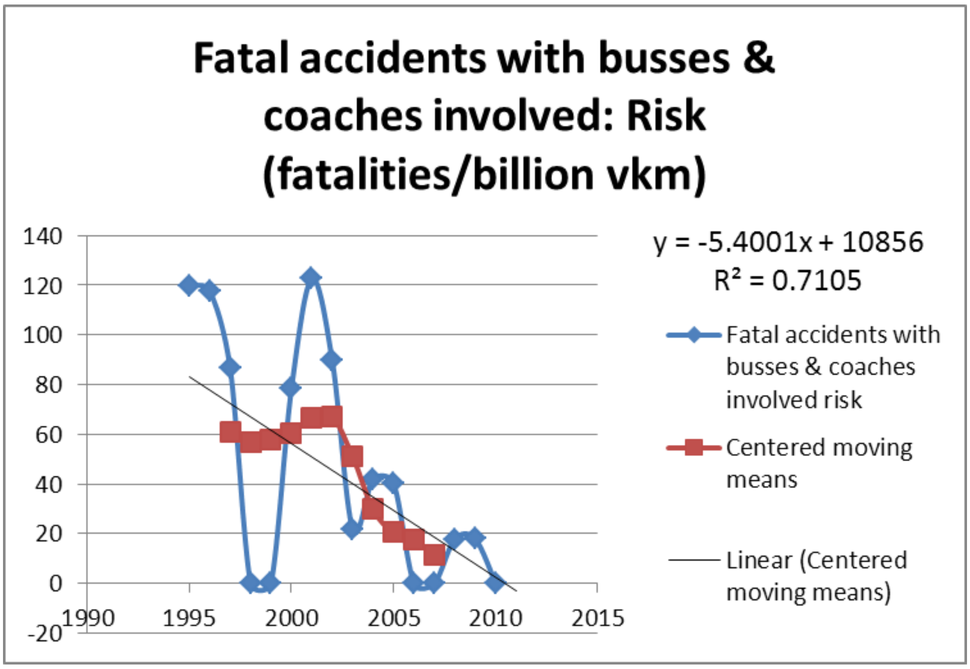

Fatal accidents with HGV involved:
Risk (fatalities/billion vkm)
y = -1.8038x + 3626.7
R² = 0.9168
Fatal accident with HGV involved risk
Centered moving means
Linear (Centered moving means)
60
50
40
30
20
10
0
-10
1990
1995
2000
2005
2010
2015

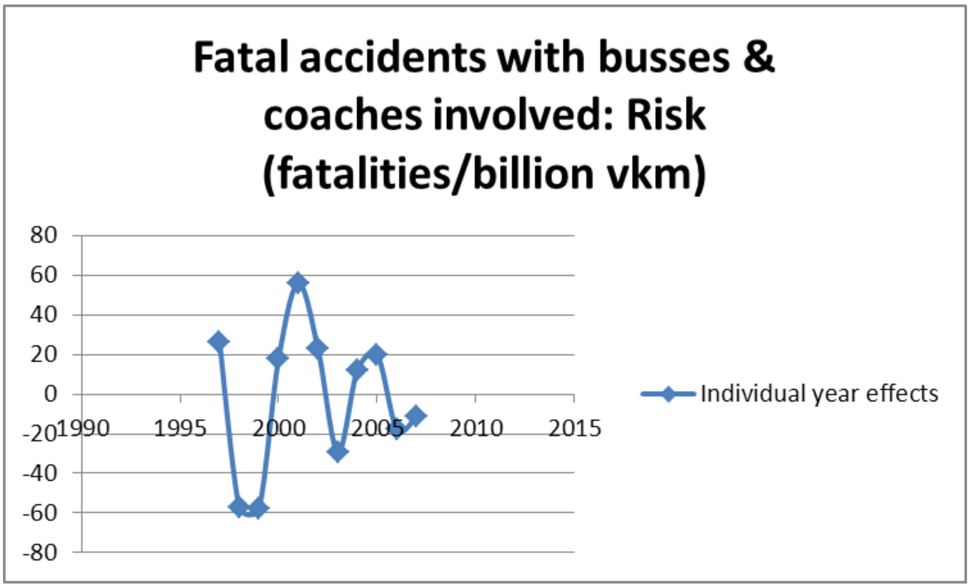

Fatal accidents with HGV involved:
Risk (fatalities/billion vkm)
Individual year effects
20
15
10
5
0
-5
-10
-15
1990
1995
2000
2005
2010
2015

Buses and coaches



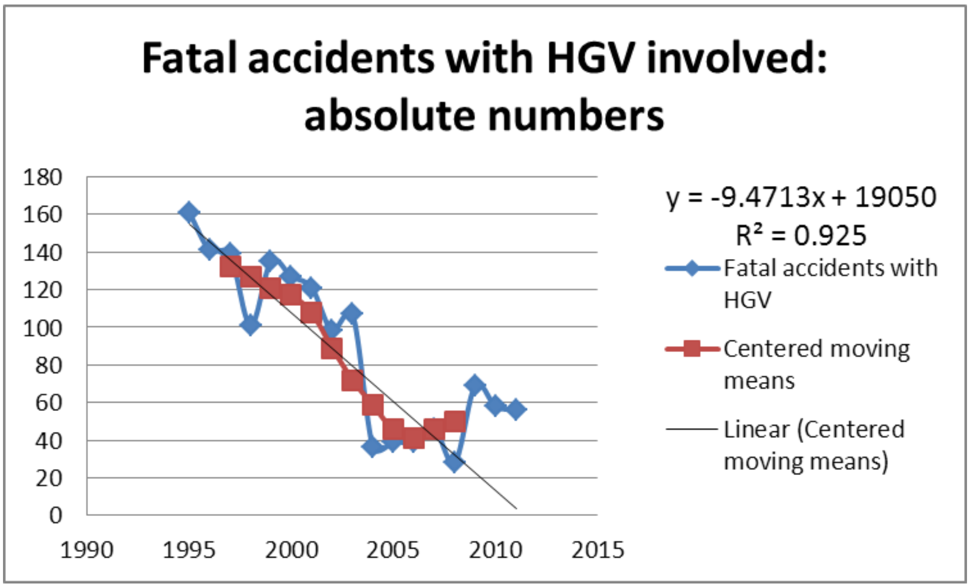


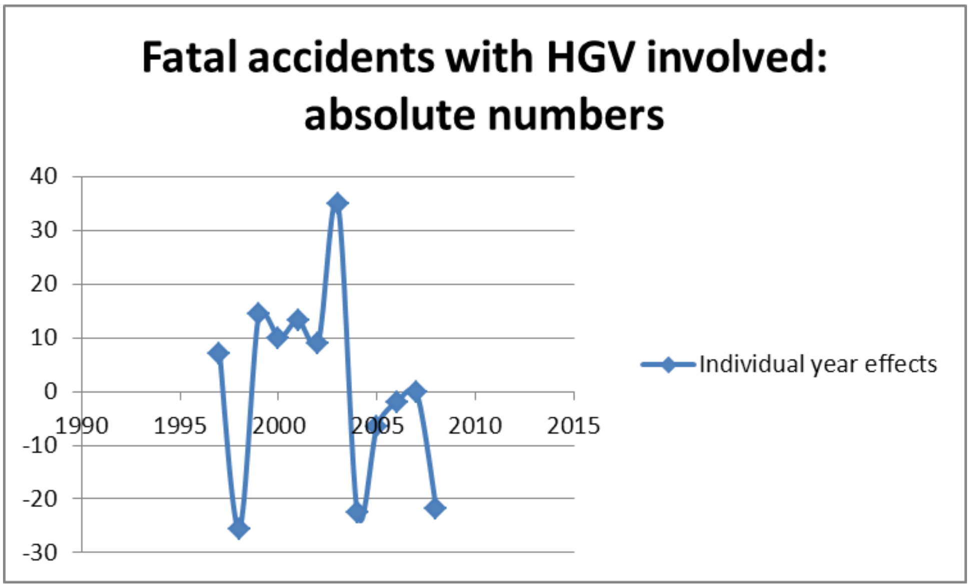

Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
140
120
100
80
60
40
20
0
-20
1990
1995
2000
2005
2010
2015
y = -5.4001x + 10856
R² = 0.7105
Fatal accidents with busses & coaches involved risk
Centered moving means
Linear (Centered moving means)

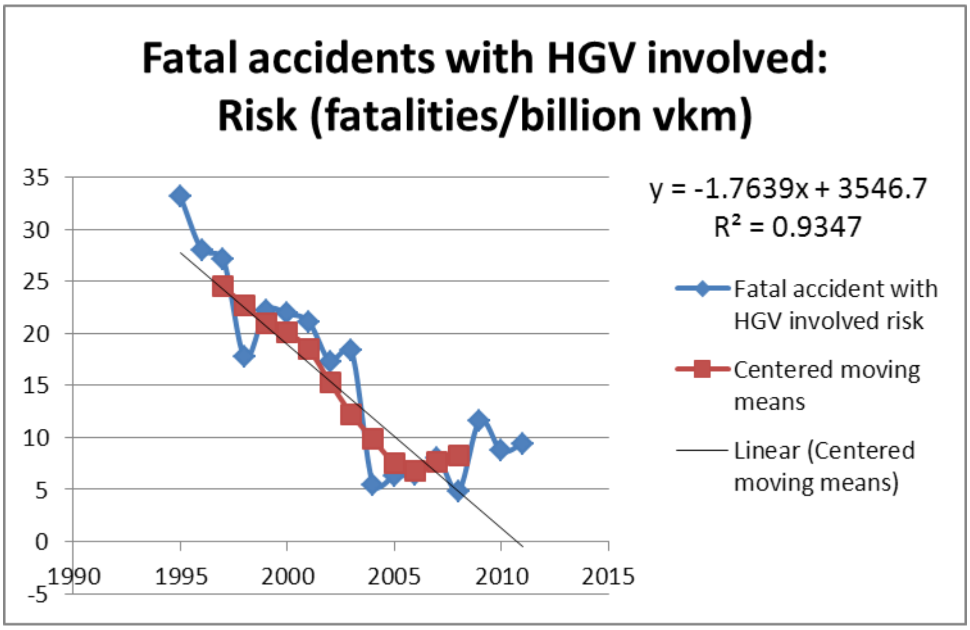

Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
80
60
40
20
0
-20
-40
-60
-80
1990
1995
2000
2005
2010
2015
Individual year effects

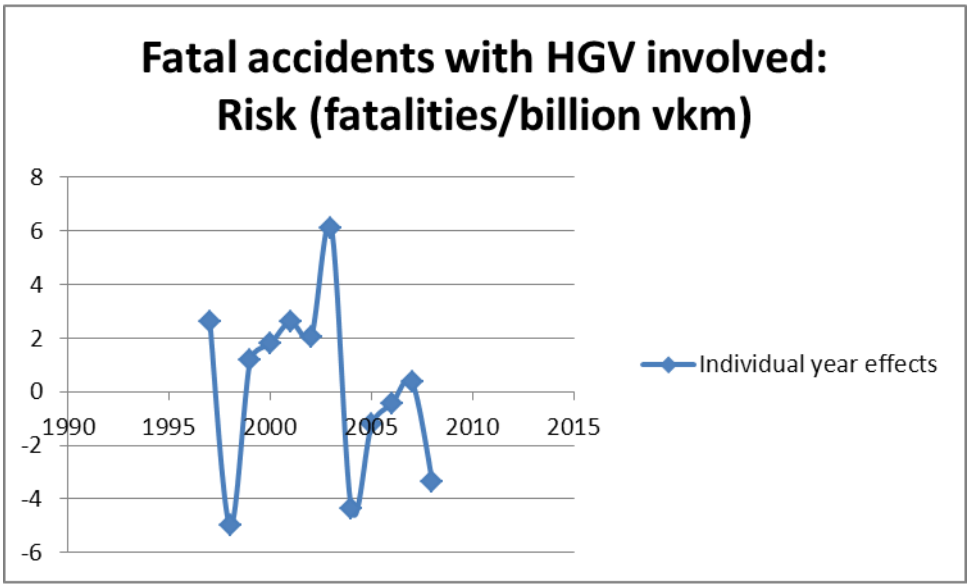
The Netherlands

Heavy goods vehicles

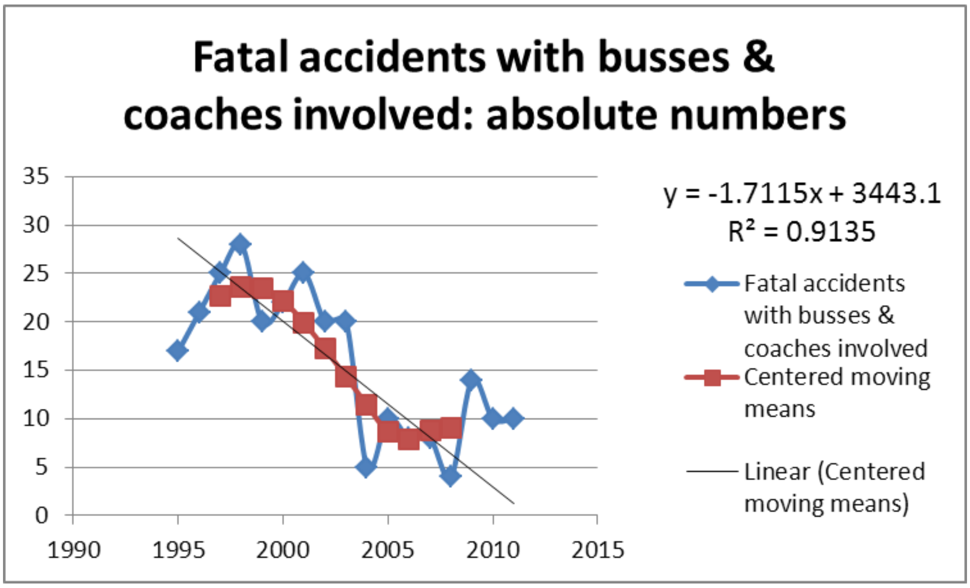


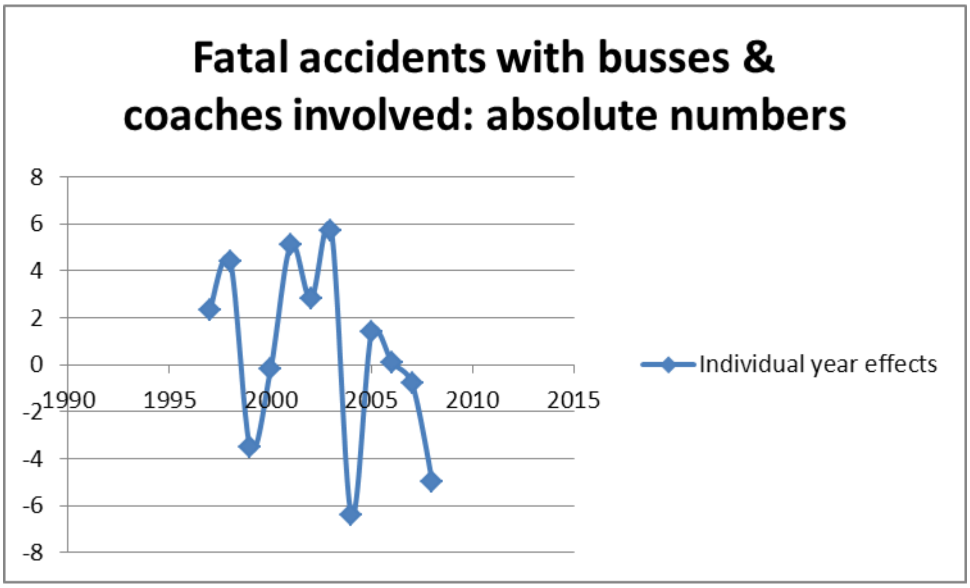


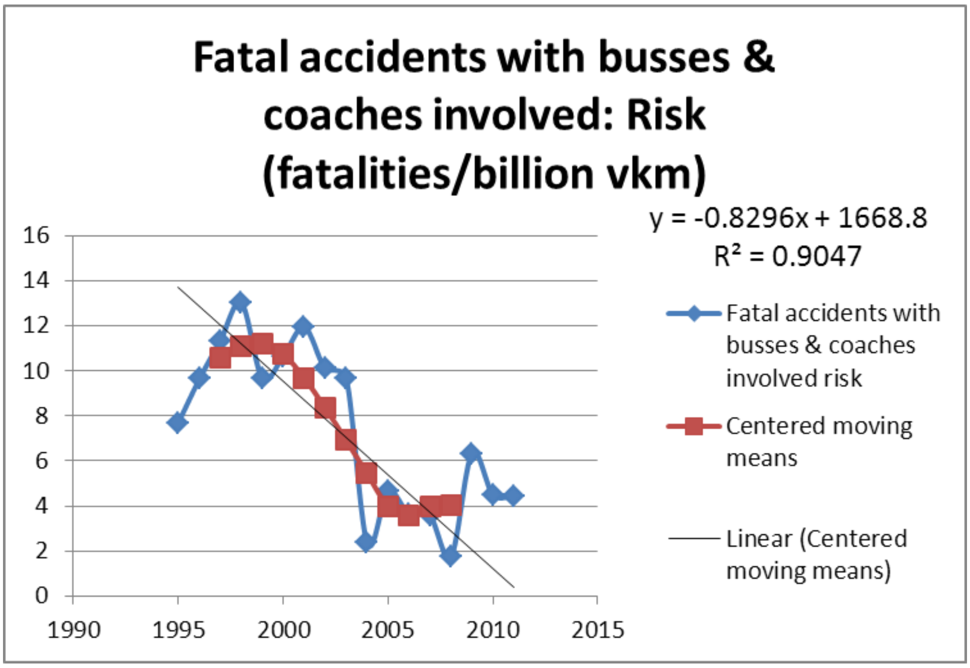

Fatal accidents with HGV involved:
Risk (fatalities/billion vkm)
35
30
25
20
15
10
5
0
-5
1990
1995
2000
2005
2010
2015
y = -1.7639x + 3546.7
R² = 0.9347
Fatal accident with HGV involved risk
Centered moving means
Linear (Centered moving means)

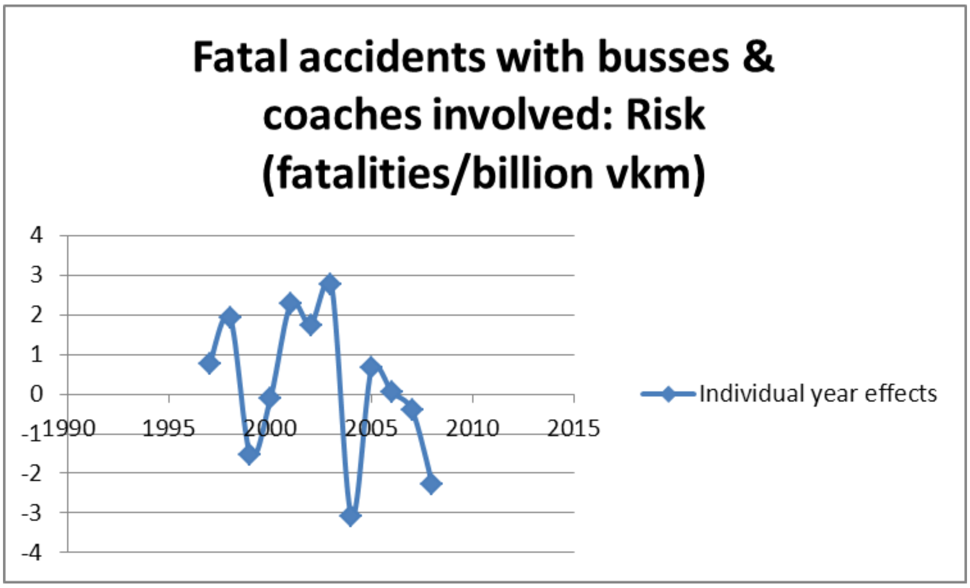

Fatal accidents with HGV involved:
Risk (fatalities/billion vkm)
8
6
4
2
0
-2
-4
-6
1990
1995
2000
2005
2010
2015
Individual year effects

Buses and coaches



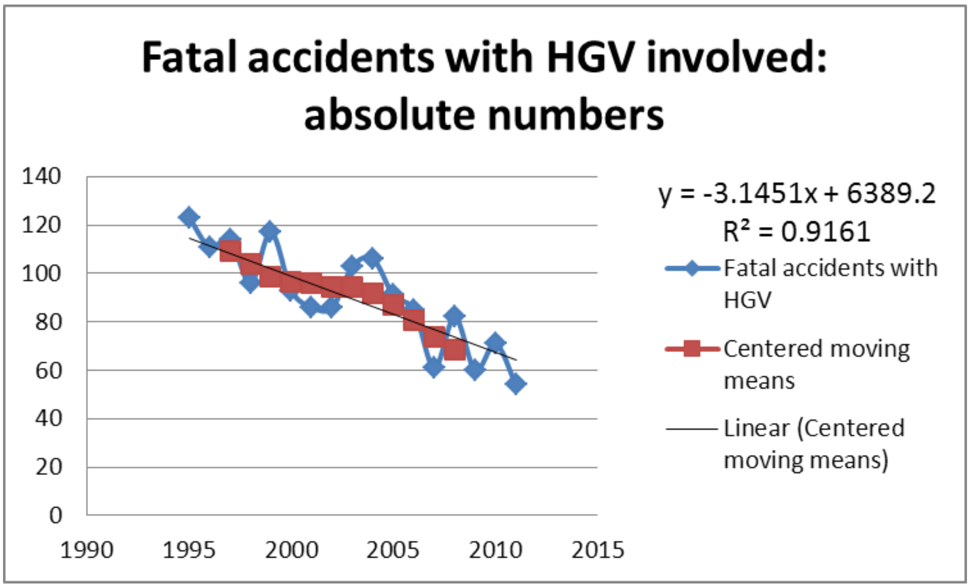


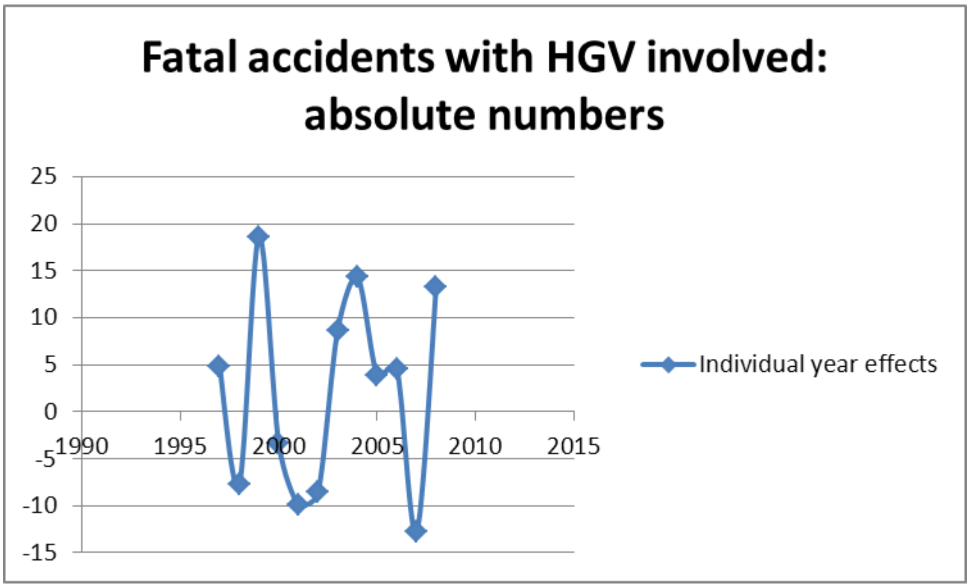

Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
y = -0.8296x + 1668.8
R² = 0.9047
16
14
12
10
8
6
4
2
0
1990
1995
2000
2005
2010
2015
Fatal accidents with busses & coaches involved risk
Centered moving means
Linear (Centered moving means)

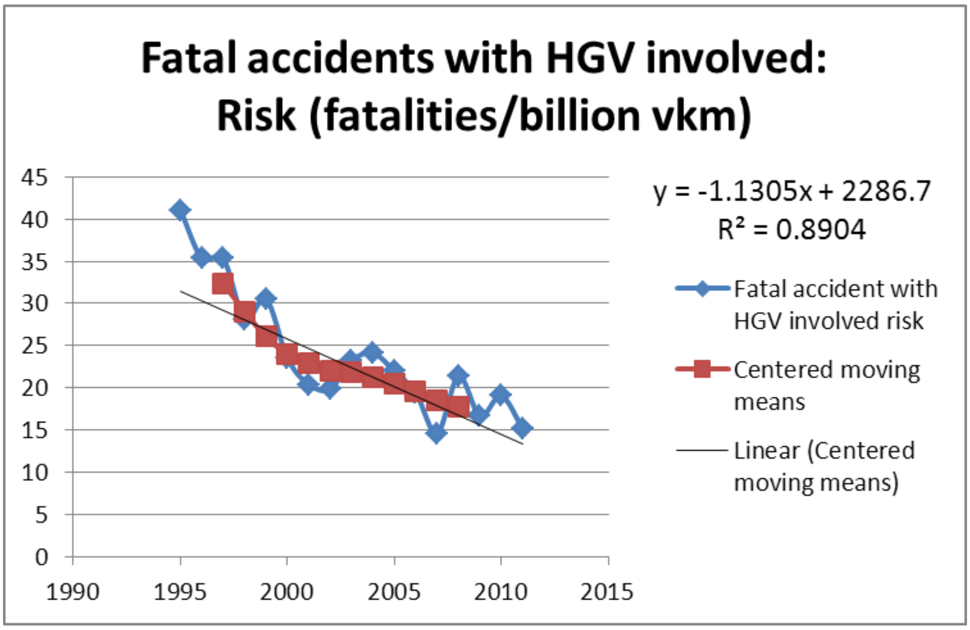

Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
4
3
2
1
0
-1
-2
-3
-4
1990
1995
2000
2005
2010
2015
Individual year effects

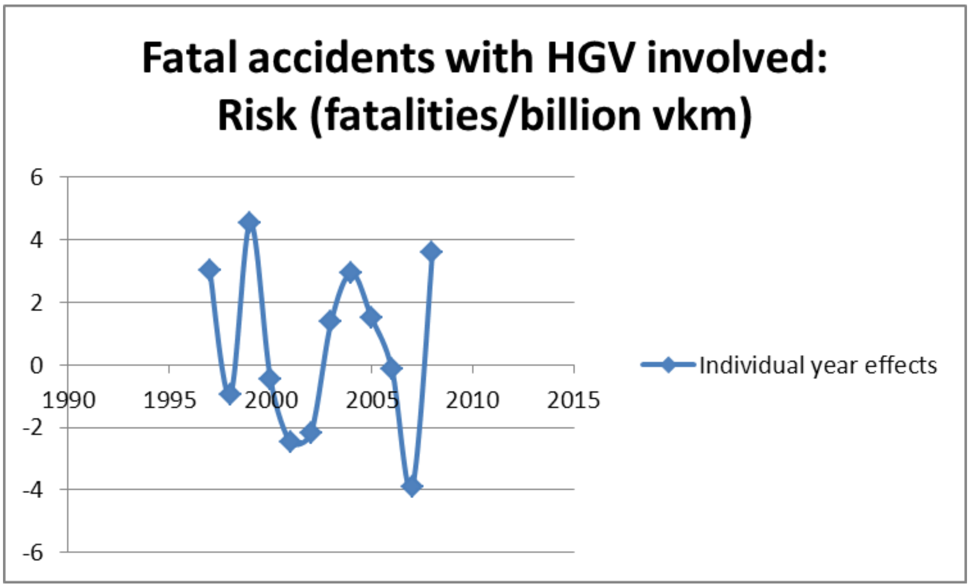
Austria

Heavy goods vehicles

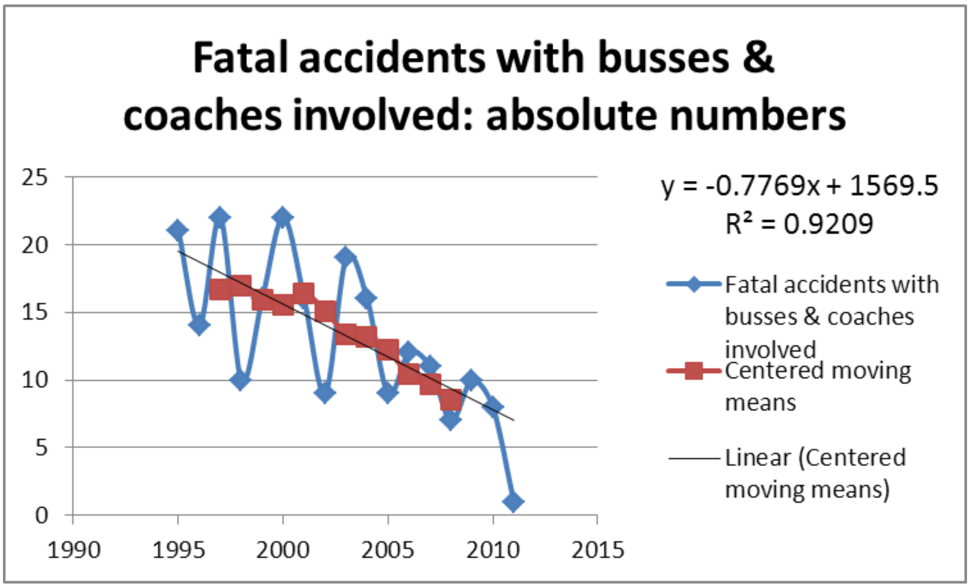


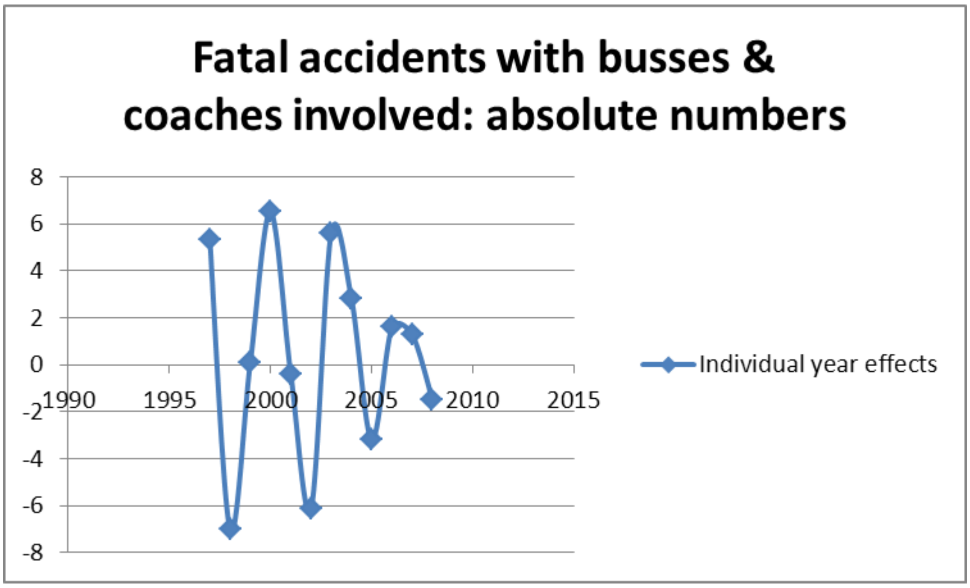


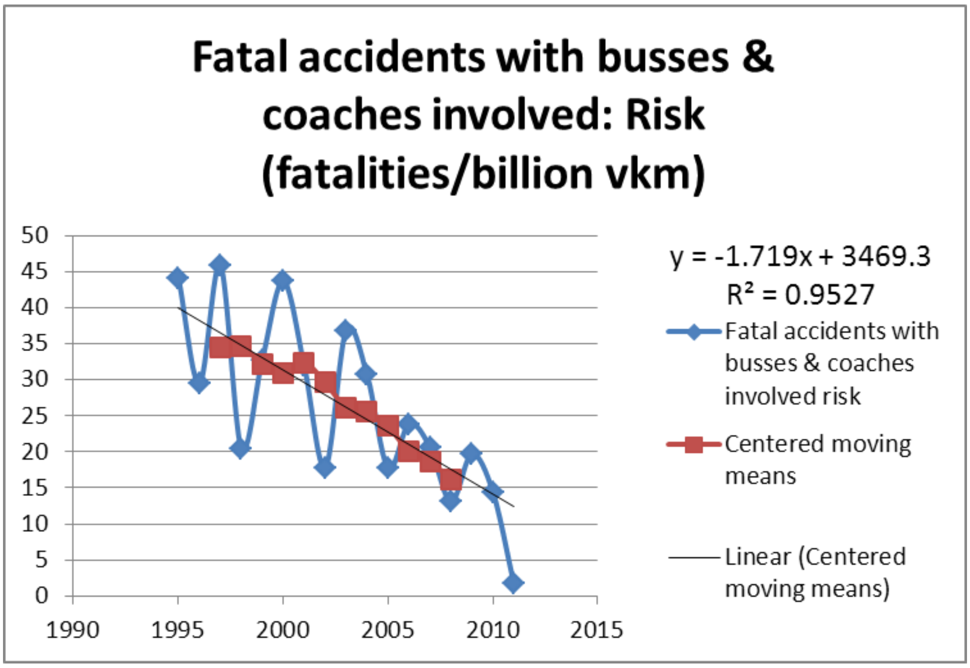

Fatal accidents with HGV involved: Risk (fatalities/billion vkm)
y = -1.1305x + 2286.7
R² = 0.8904
Fatal accident with HGV involved risk
Centered moving means
Linear (Centered moving means)
45
40
35
30
25
20
15
10
5
0
1990
1995
2000
2005
2010
2015

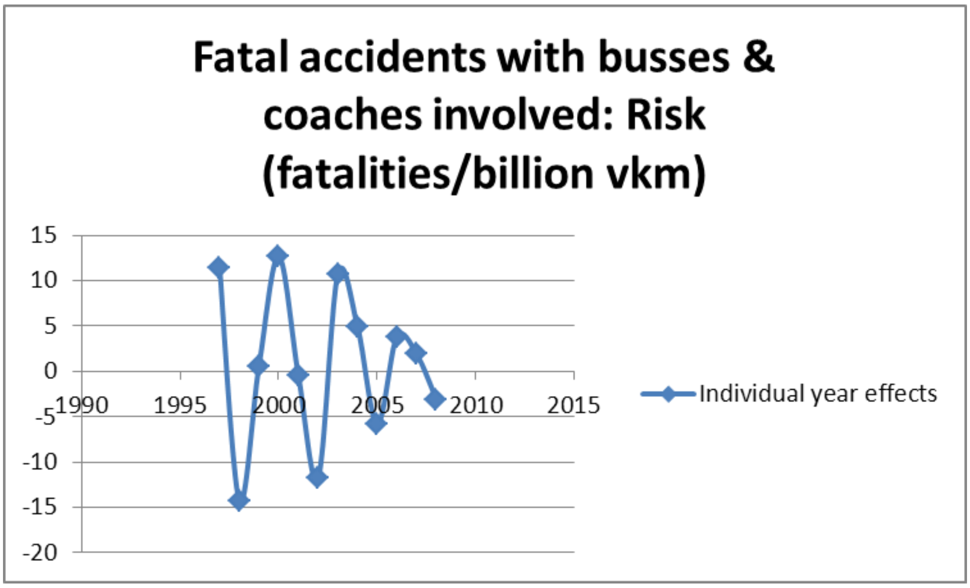

Fatal accidents with HGV involved: Risk (fatalities/billion vkm)
Individual year effects
6
4
2
0
-2
-4
-6
1990
1995
2000
2005
2010
2015

Buses and coaches



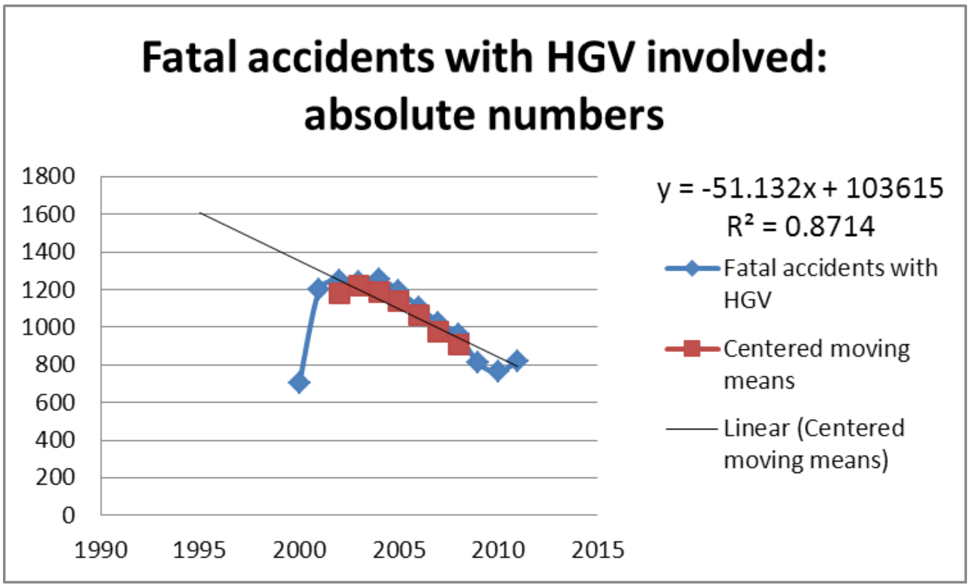


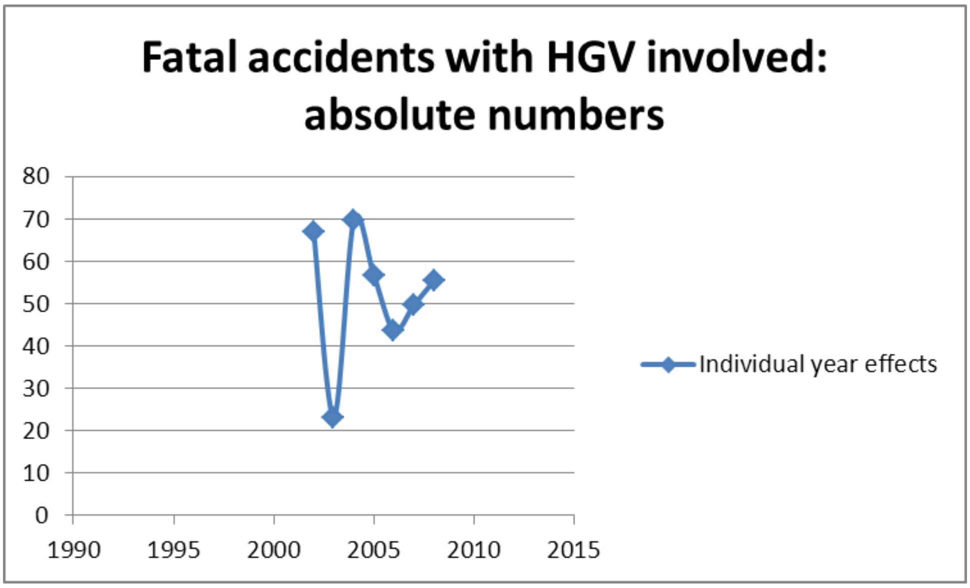

Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
y = -1.719x + 3469.3
R² = 0.9527
Fatal accidents with busses & coaches involved risk
Centered moving means
Linear (Centered moving means)
50
45
40
35
30
25
20
15
10
5
0
1990
1995
2000
2005
2010
2015

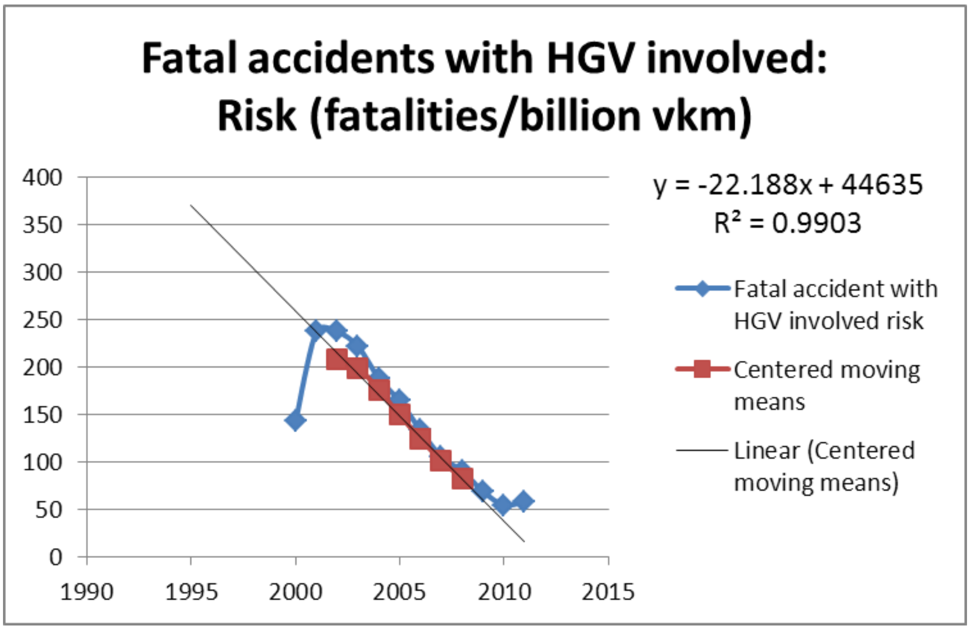

Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
Individual year effects
15
10
5
0
-5
-10
-15
-20
1990
1995
2000
2005
2010
2015

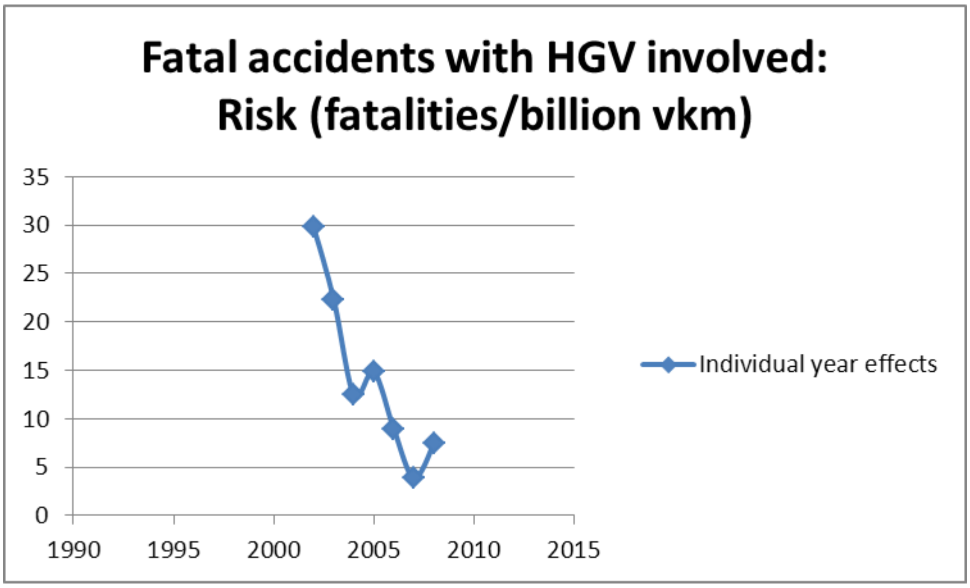
Poland

Heavy goods vehicles

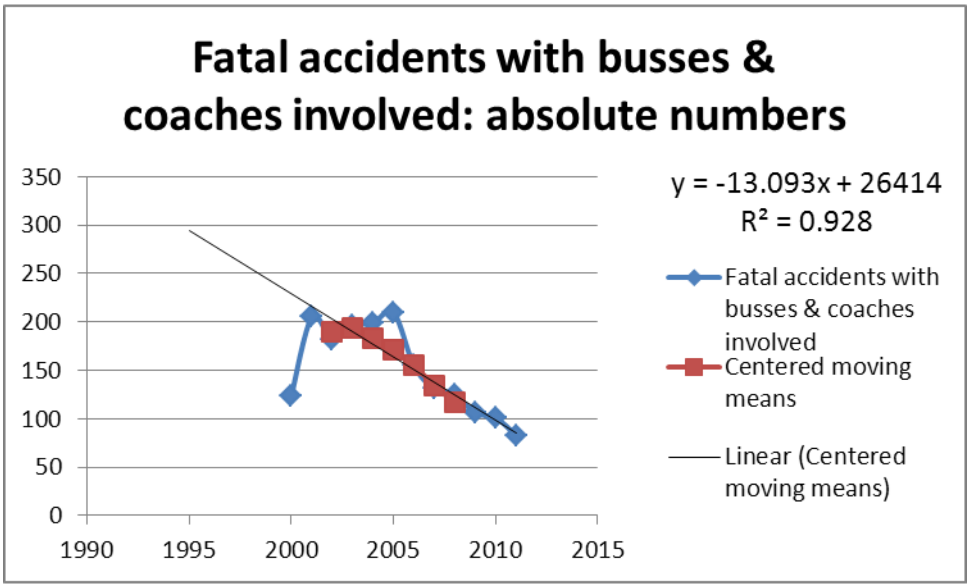


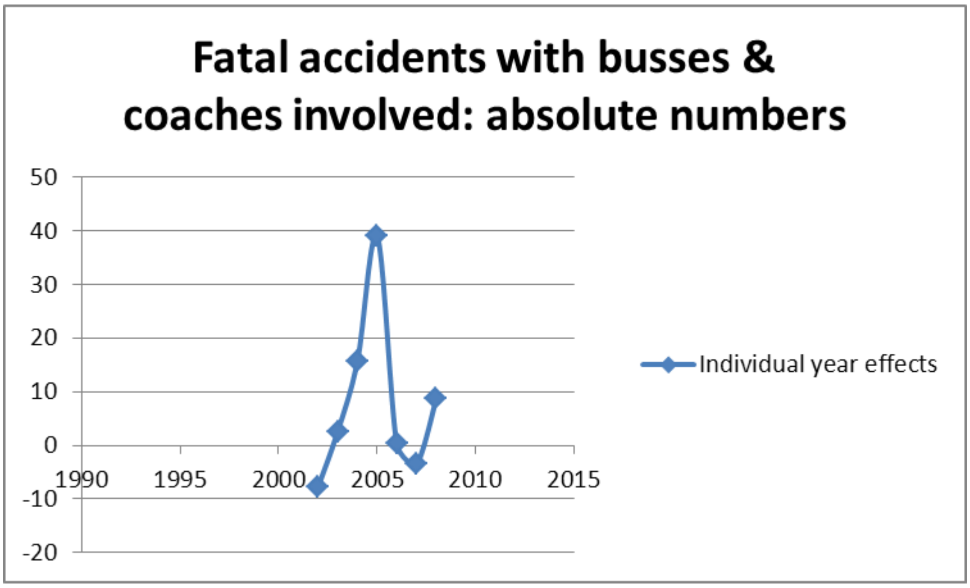


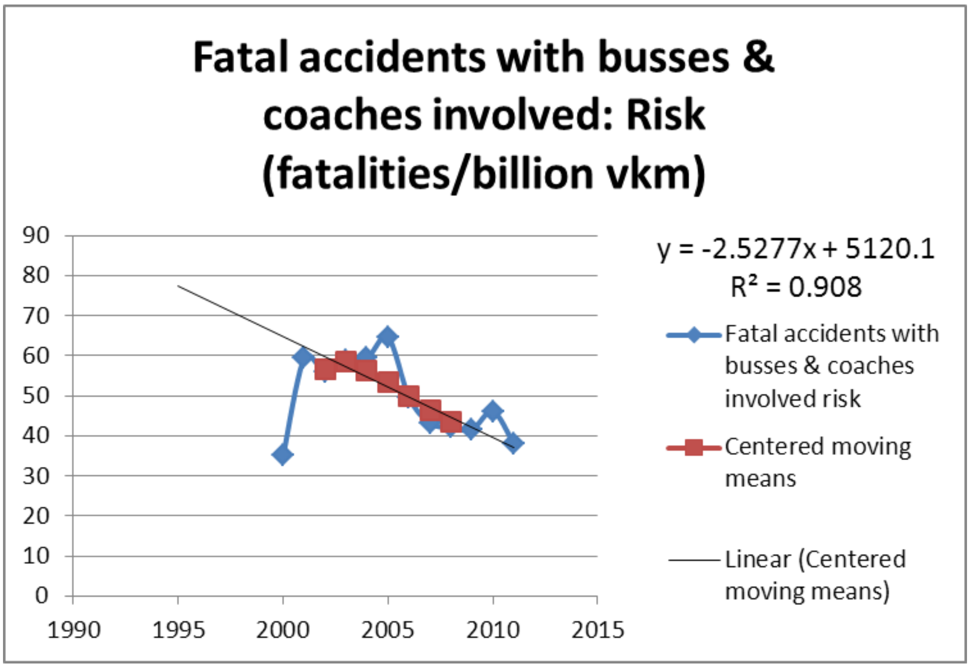

Fatal accidents with HGV involved:
Risk (fatalities/billion vkm)
y = -22.188x + 44635
R² = 0.9903
Fatal accident with HGV involved risk
Centered moving means
Linear (Centered moving means)
400
350
300
250
200
150
100
50
0
1990
1995
2000
2005
2010
2015


Fatal accidents with HGV involved:
Risk (fatalities/billion vkm)
Individual year effects
35
30
25
20
15
10
5
0
1990
1995
2000
2005
2010
2015

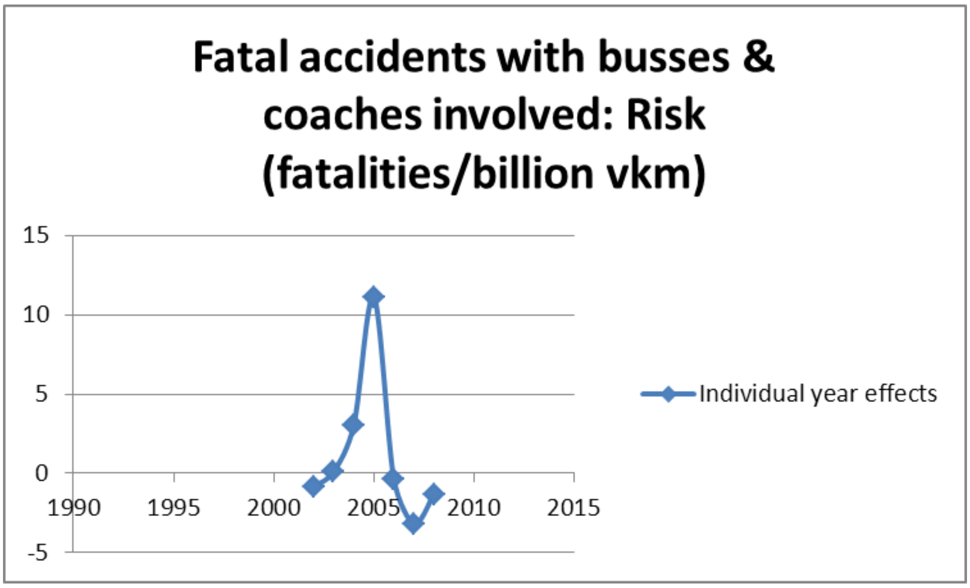
Buses and coaches







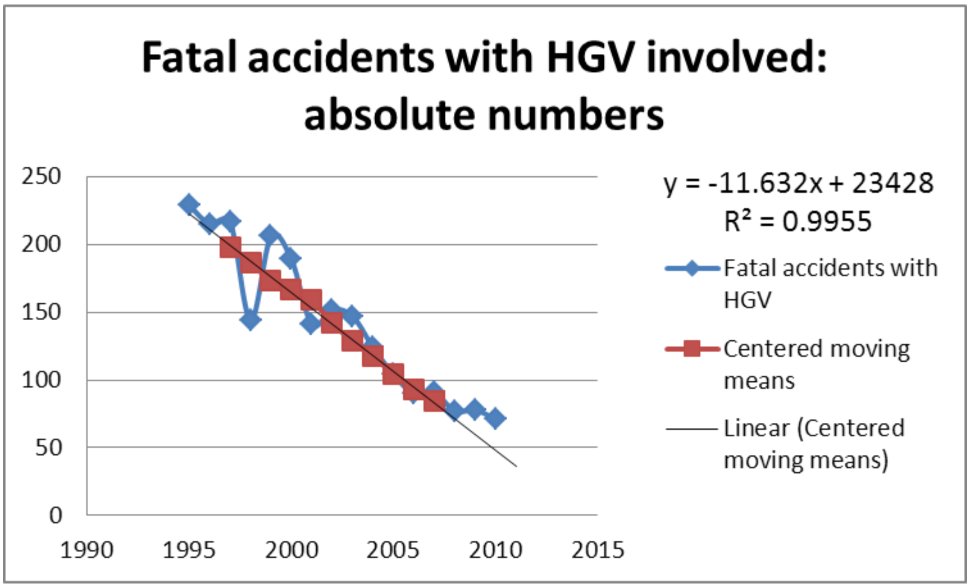
Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
y = -2.5277x + 5120.1
R² = 0.908
Fatal accidents with busses & coaches involved risk
Centered moving means
Linear (Centered moving means)
90
80
70
60
50
40
30
20
10
0
1990
1995
2000
2005
2010
2015

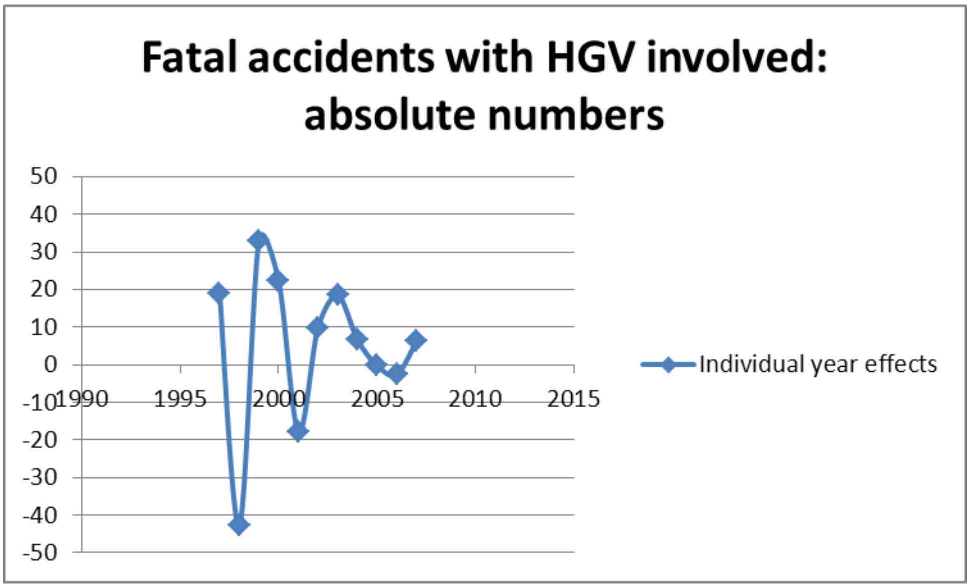


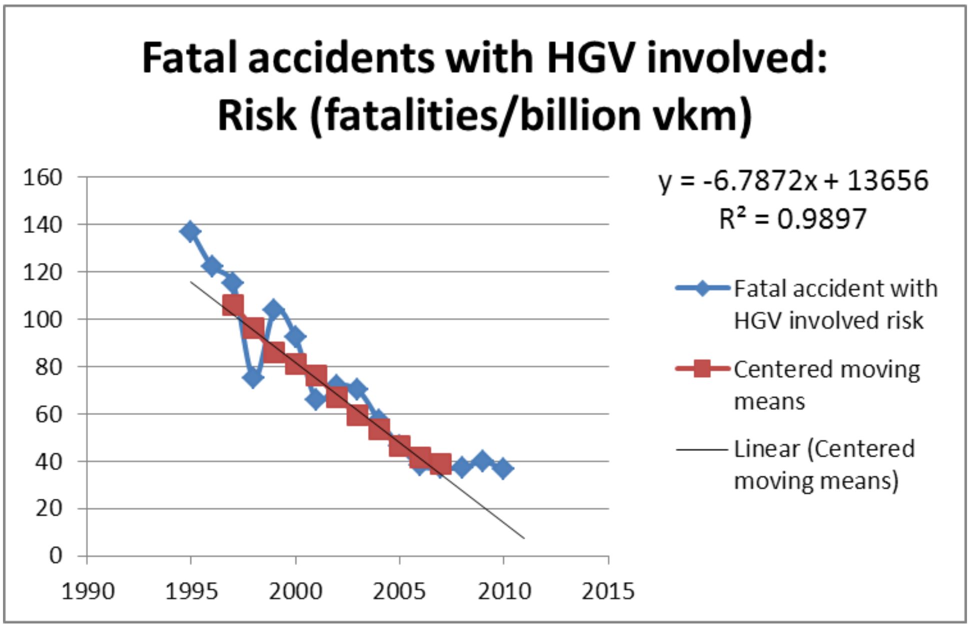
Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
Individual year effects
15
10
5
0
-5
1990
1995
2000
2005
2010
2015

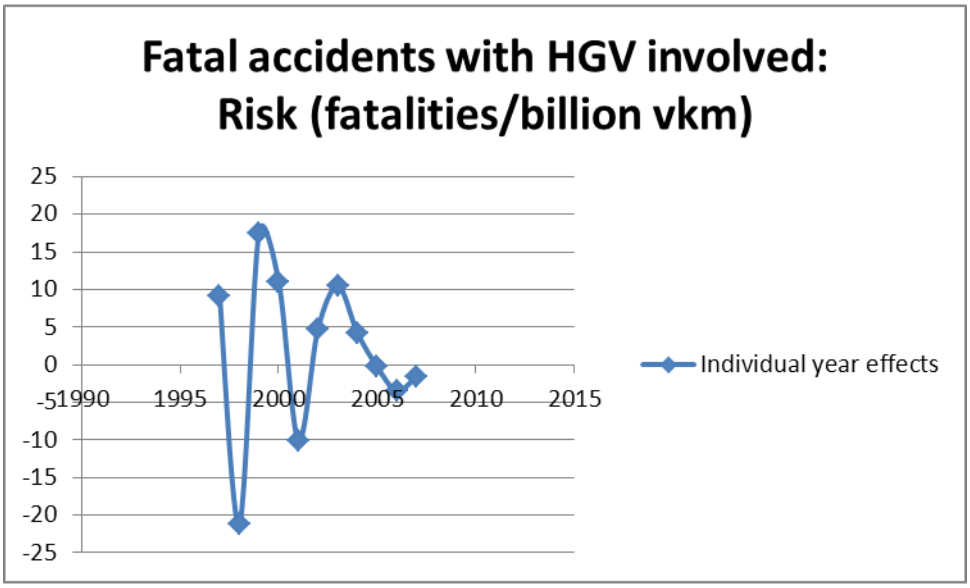
Portugal

Heavy goods vehicles

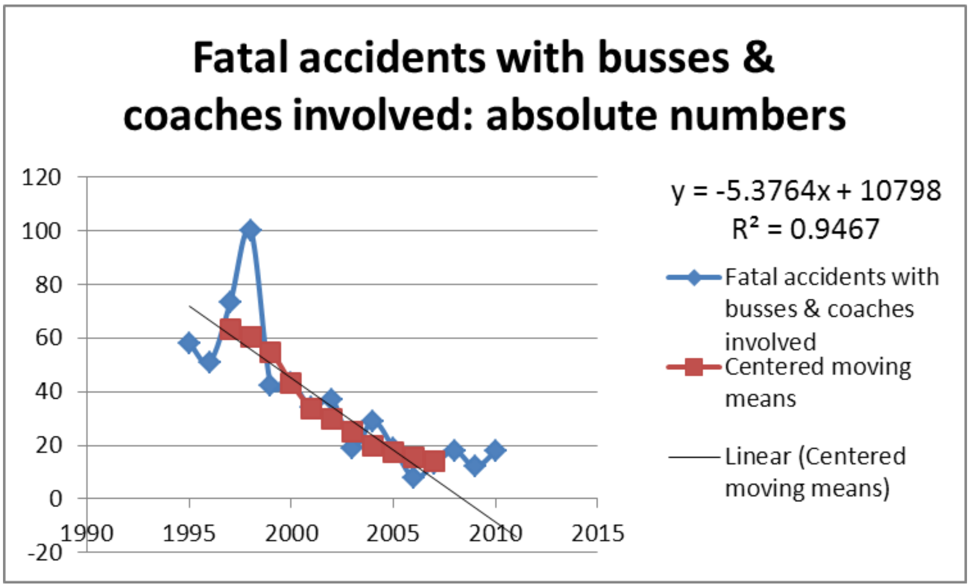


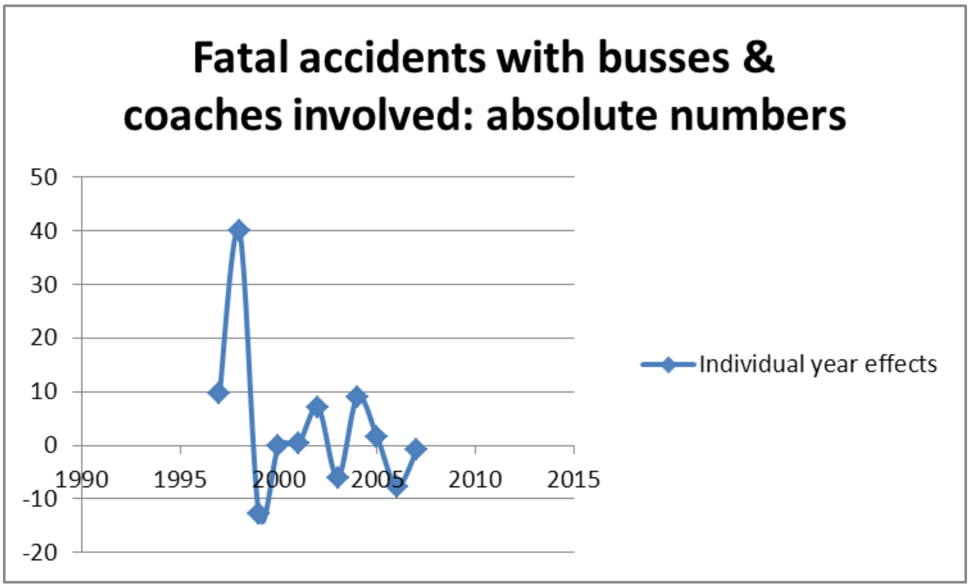


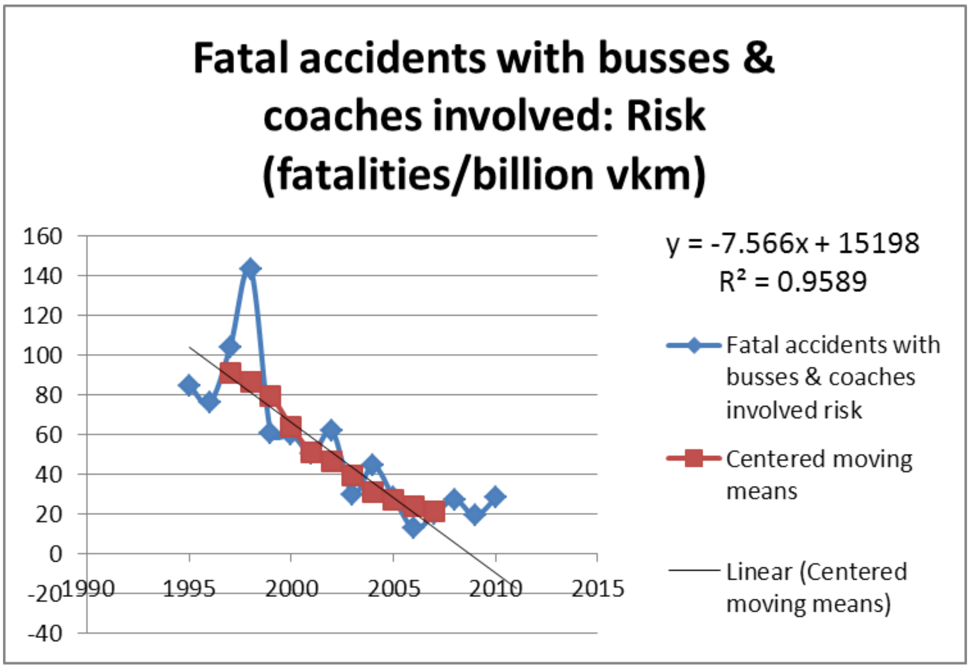

Fatal accidents with HGV involved:
Risk (fatalities/billion vkm)
y = -6.7872x + 13656
R² = 0.9897
Fatal accident with HGV involved risk
Centered moving means
Linear (Centered moving means)
160
140
120
100
80
60
40
20
0
1990
1995
2000
2005
2010
2015

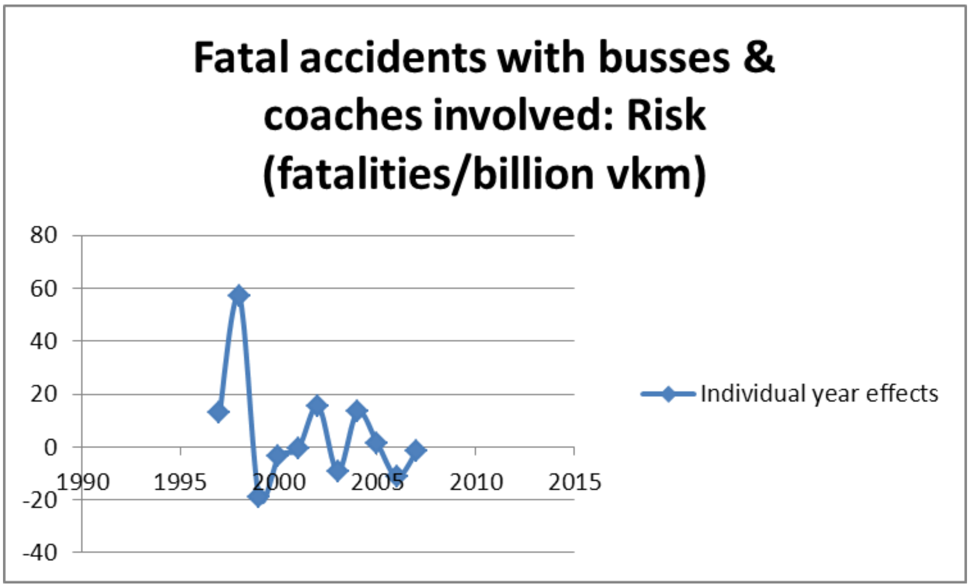

Fatal accidents with HGV involved:
Risk (fatalities/billion vkm)
Individual year effects
25
20
15
10
5
0
-5
-10
-15
-20
-25
1990
1995
2000
2005
2010
2015

Buses and coaches



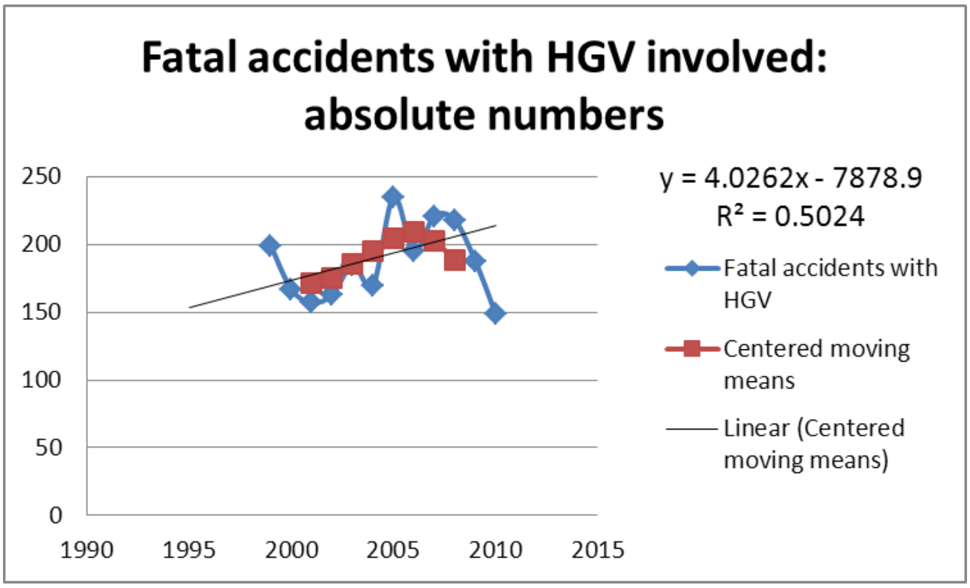


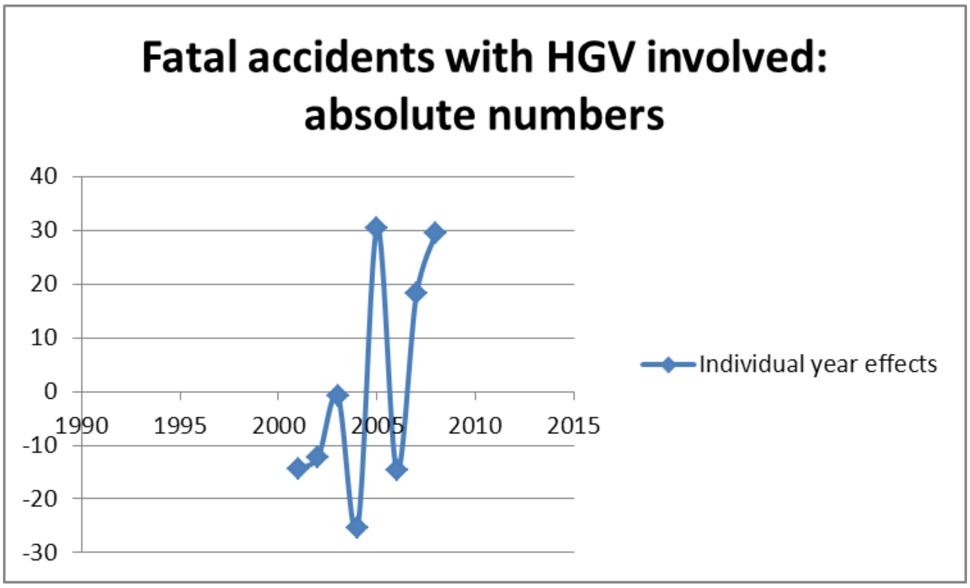

Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
160
140
120
100
80
60
40
20
0
-20
-40
1990
1995
2000
2005
2010
2015
y = -7.566x + 15198
R² = 0.9589
Fatal accidents with busses & coaches involved risk
Centered moving means
Linear (Centered moving means)

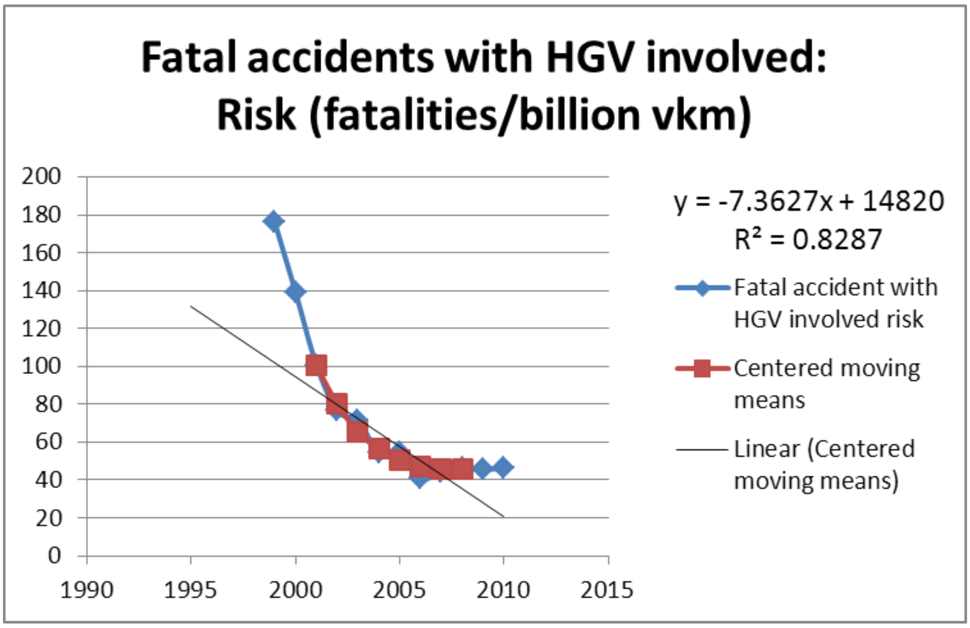

Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
80
60
40
20
0
-20
-40
1990
1995
2000
2005
2010
2015
Individual year effects

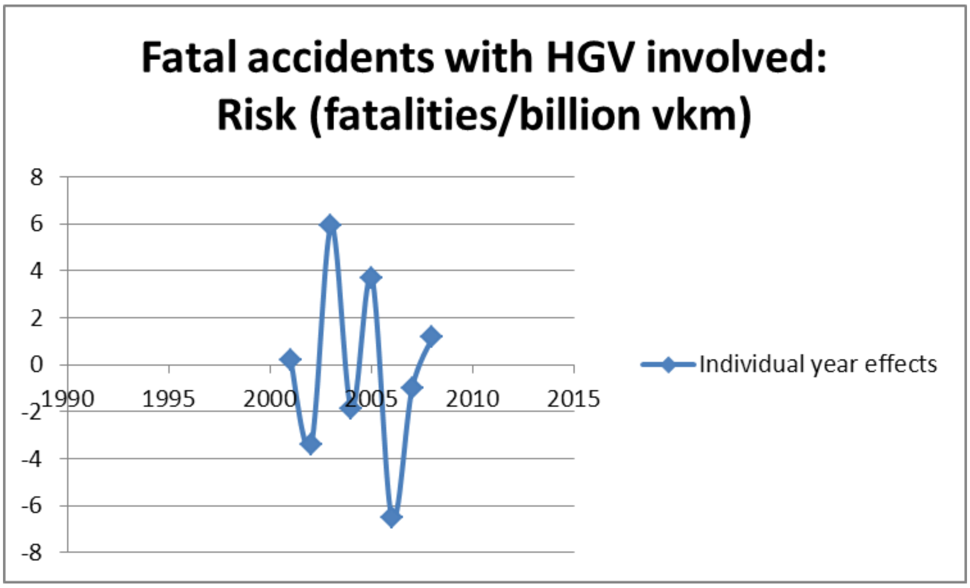
Romania

Heavy goods vehicles

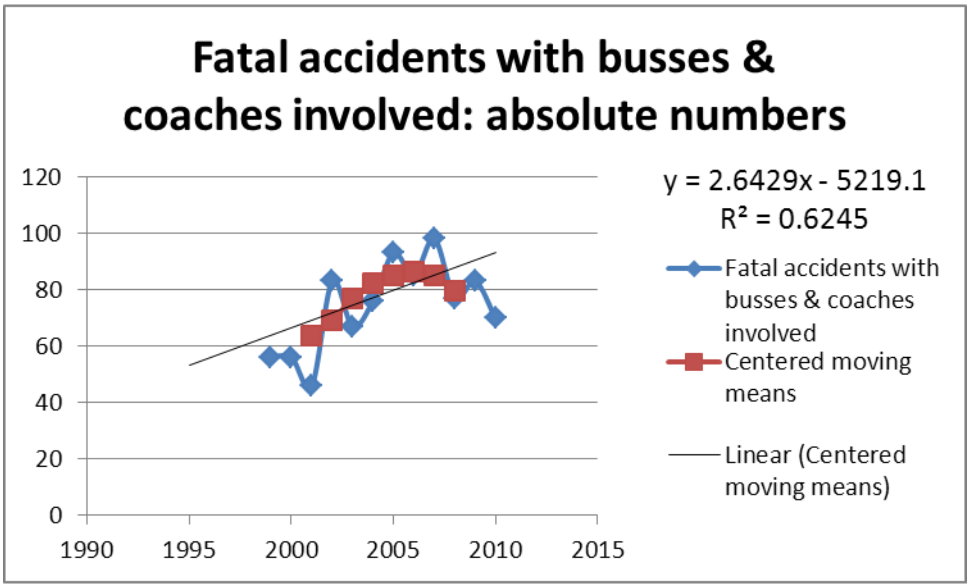


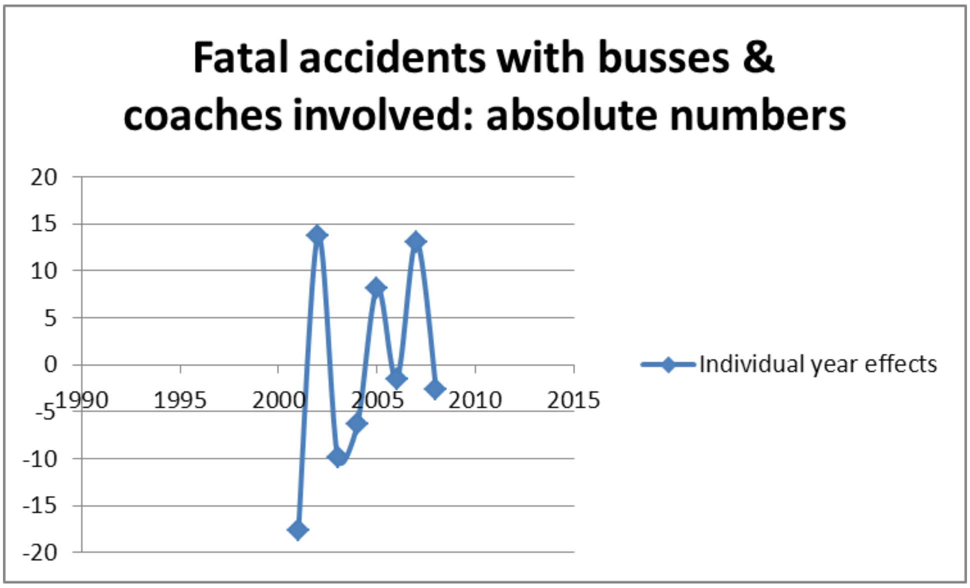


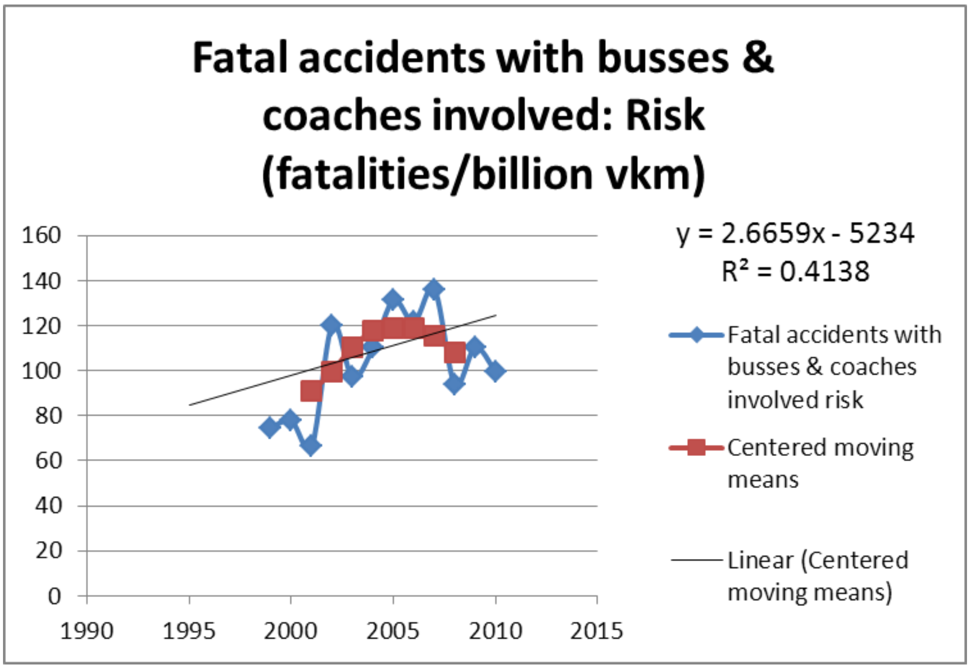

Fatal accidents with HGV involved:
Risk (fatalities/billion vkm)
y = -7.3627x + 14820
R² = 0.8287
Fatal accident with HGV involved risk
Centered moving means
Linear (Centered moving means)
200
180
160
140
120
100
80
60
40
20
0
1990
1995
2000
2005
2010
2015

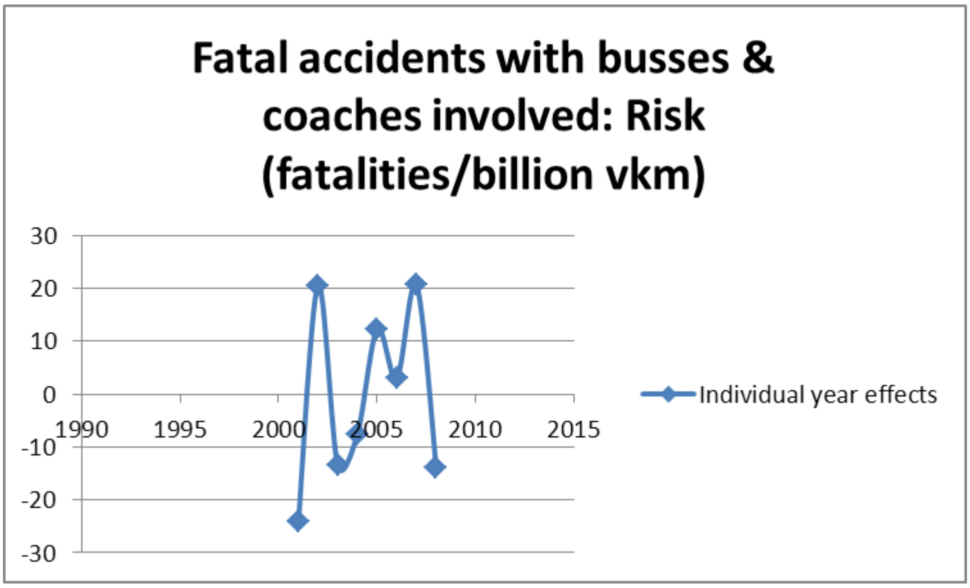

Fatal accidents with HGV involved:
Risk (fatalities/billion vkm)
Individual year effects
8
6
4
2
0
-2
-4
-6
-8
1990
1995
2000
2005
2010
2015

Buses and coaches



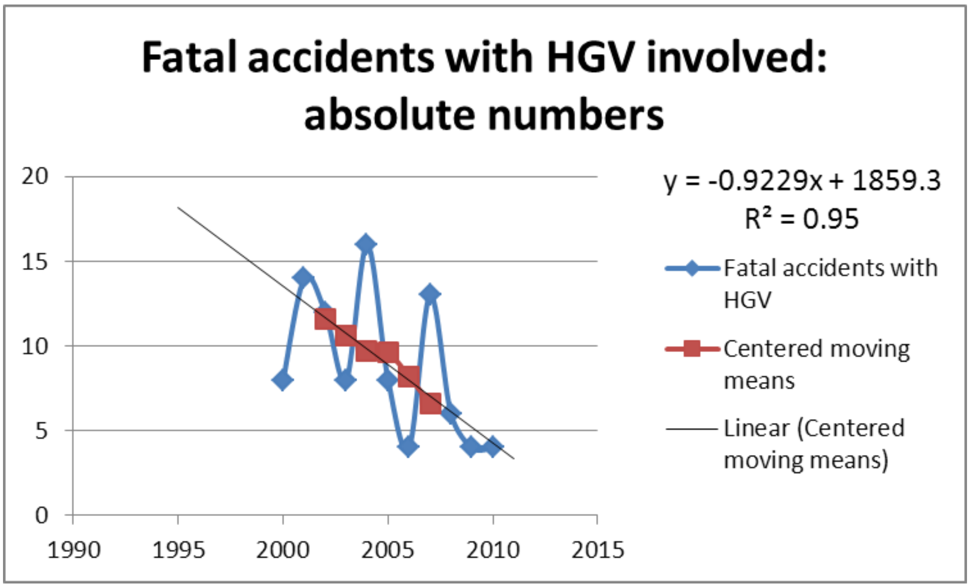


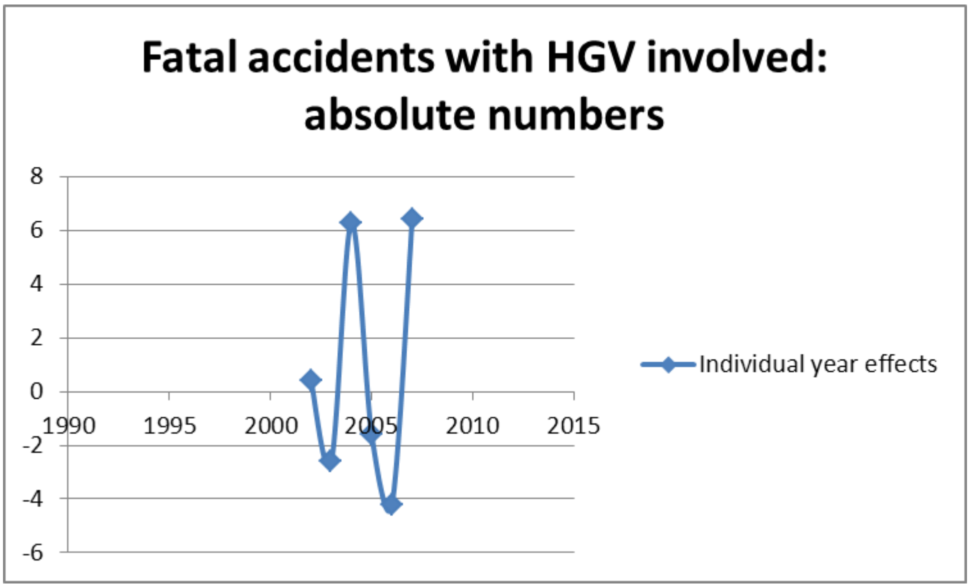

Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
160
140
120
100
80
60
40
20
0
1990
1995
2000
2005
2010
2015
y = 2.6659x - 5234
R² = 0.4138
Fatal accidents with busses & coaches involved risk
Centered moving means
Linear (Centered moving means)

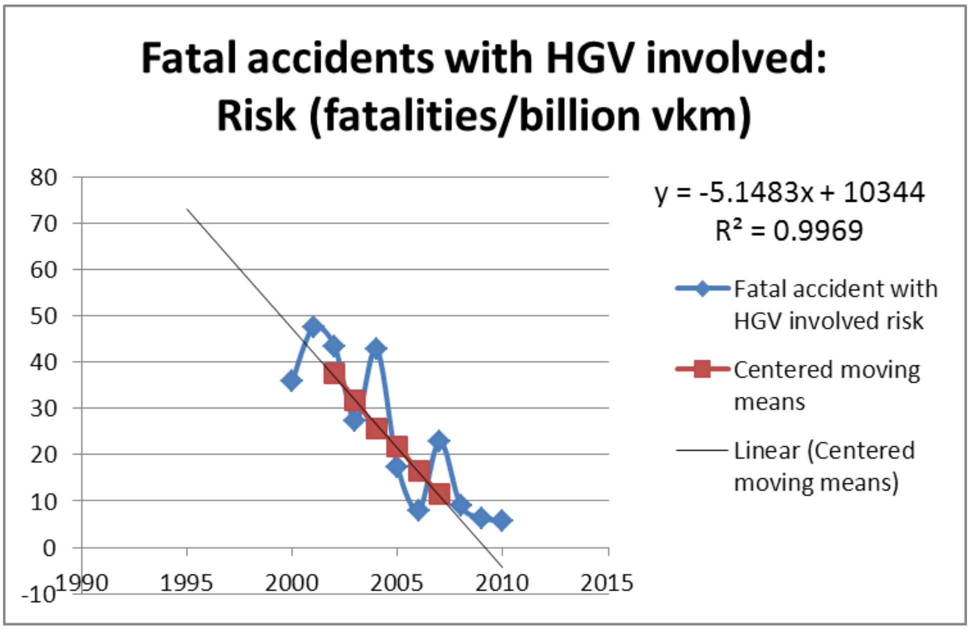

Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
30
20
10
0
-10
-20
-30
1990
1995
2000
2005
2010
2015
Individual year effects

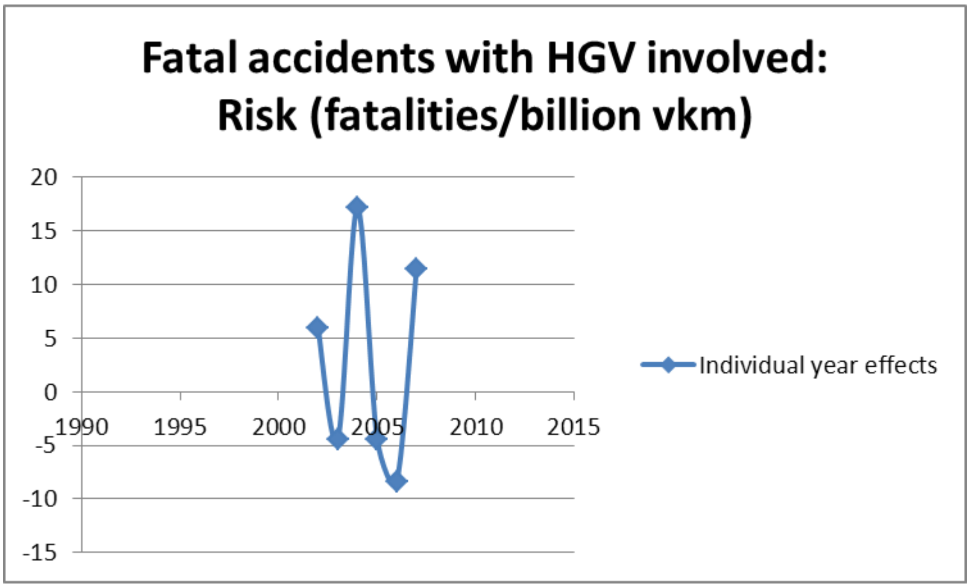
Slovakia

Heavy goods vehicles

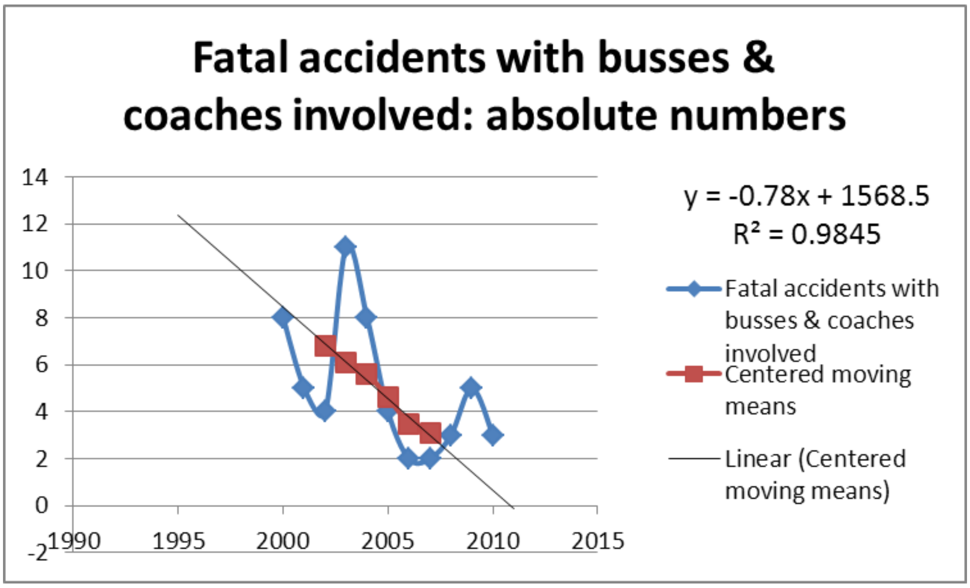


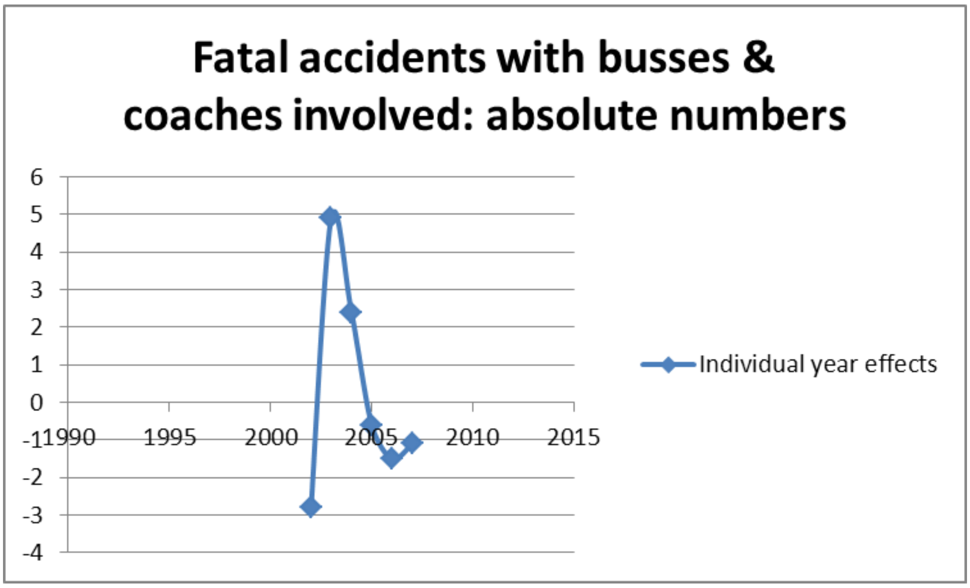


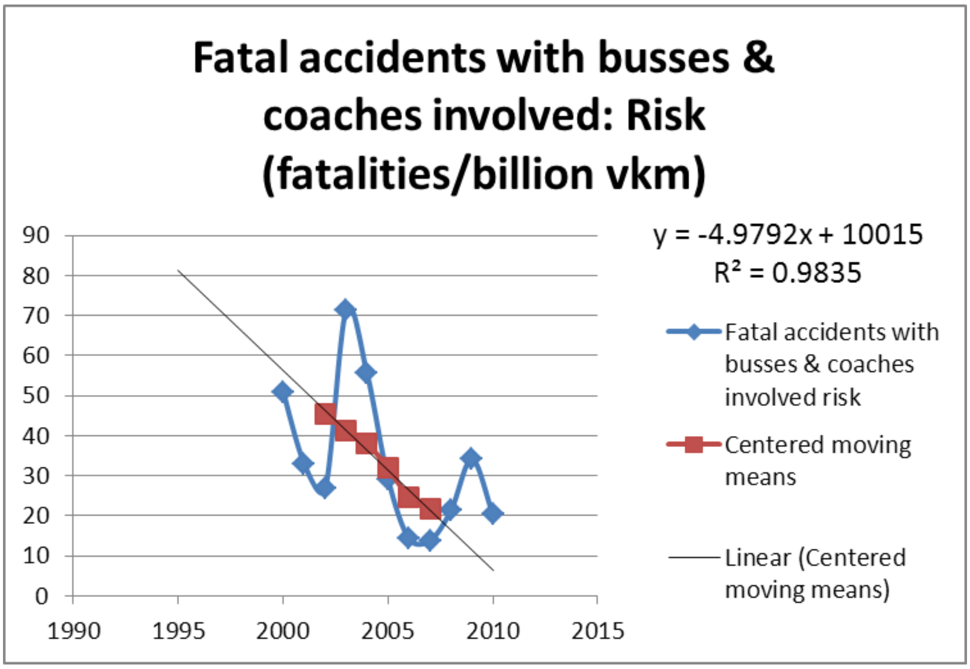

Fatal accidents with HGV involved:
Risk (fatalities/billion vkm)
y = -5.1483x + 10344
R² = 0.9969
Fatal accident with HGV involved risk
Centered moving means
Linear (Centered moving means)
80
70
60
50
40
30
20
10
0
-10
1990
1995
2000
2005
2010
2015

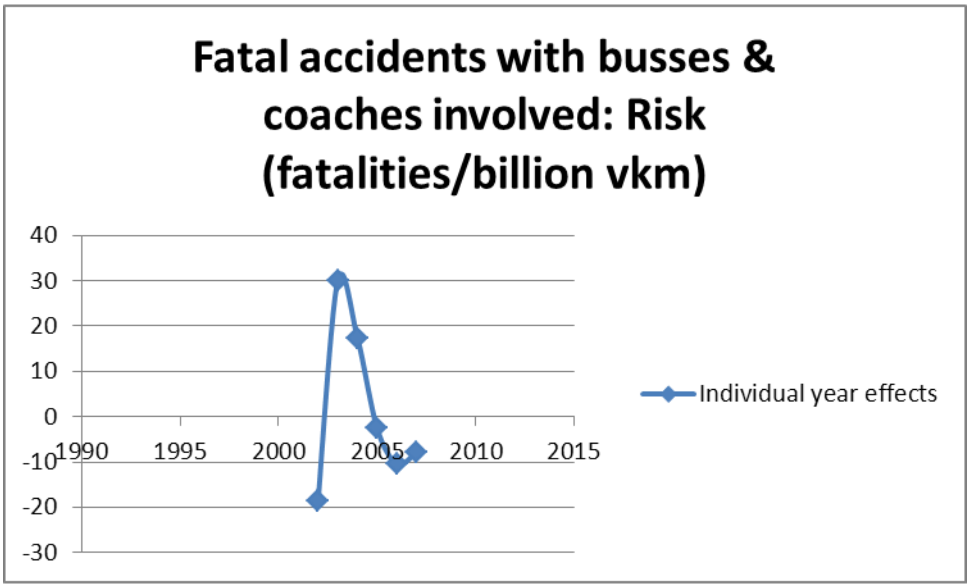

Fatal accidents with HGV involved:
Risk (fatalities/billion vkm)
Individual year effects
20
15
10
5
0
-5
-10
-15
1990
1995
2000
2005
2010
2015

Buses and coaches



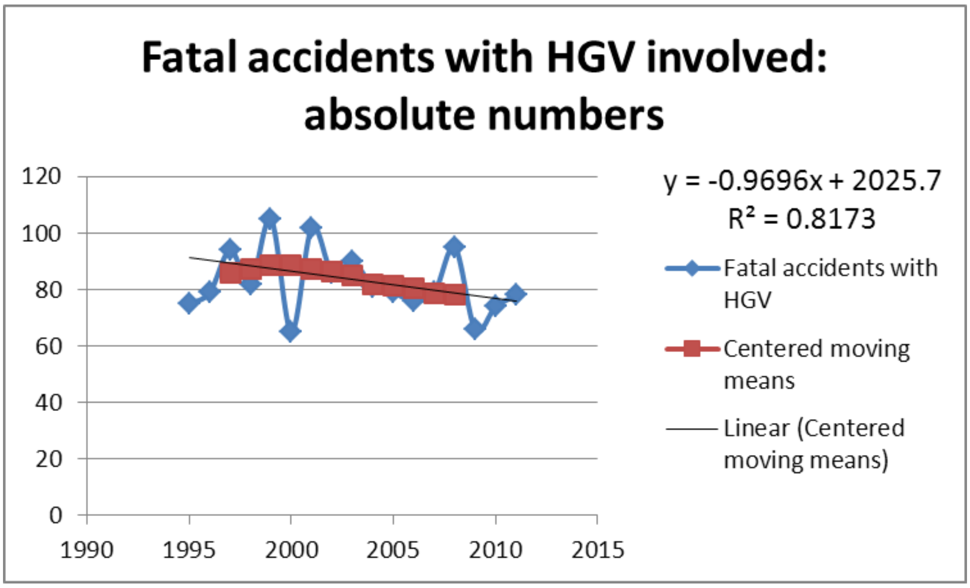


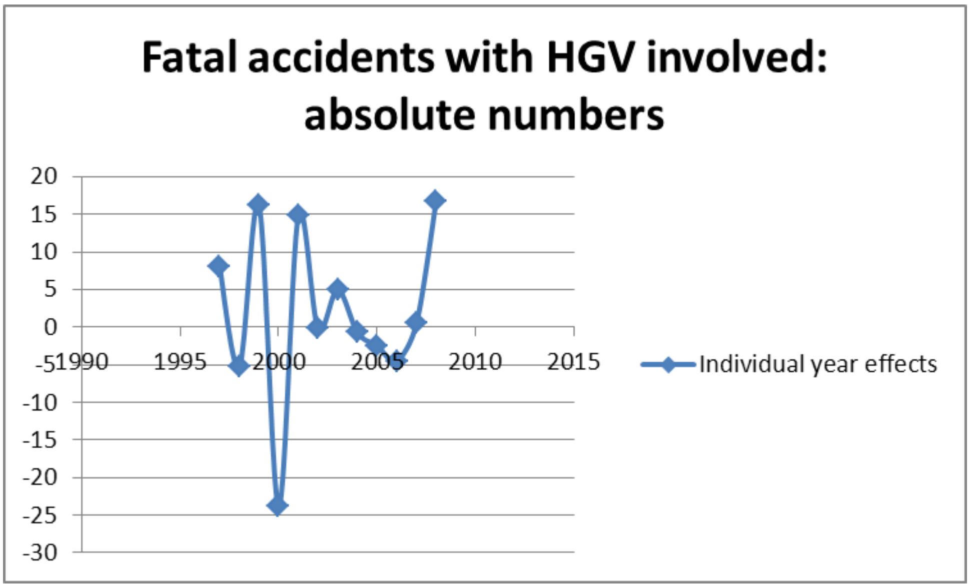

Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
y = -4.9792x + 10015
R² = 0.9835
90
80
70
60
50
40
30
20
10
0
1990
1995
2000
2005
2010
2015
Fatal accidents with busses & coaches involved risk
Centered moving means
Linear (Centered moving means)

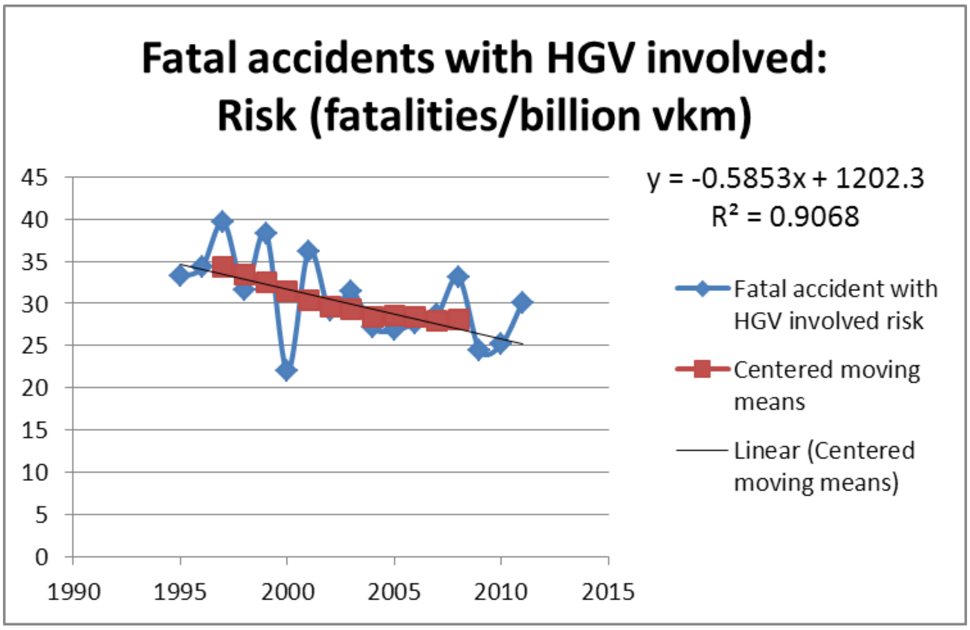

Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
40
30
20
10
0
-10
-20
-30
1990
1995
2000
2005
2010
2015
Individual year effects

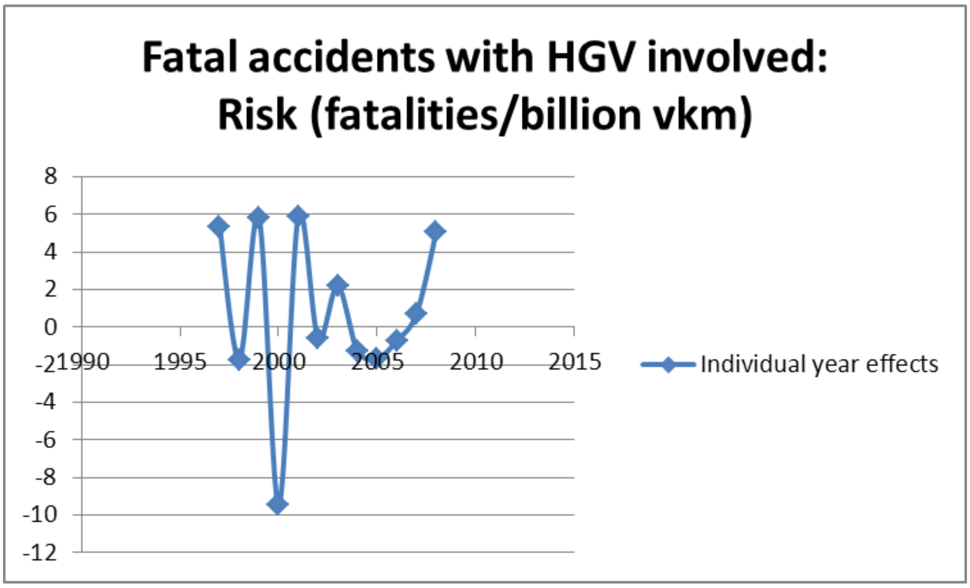
Finland

Heavy goods vehicles

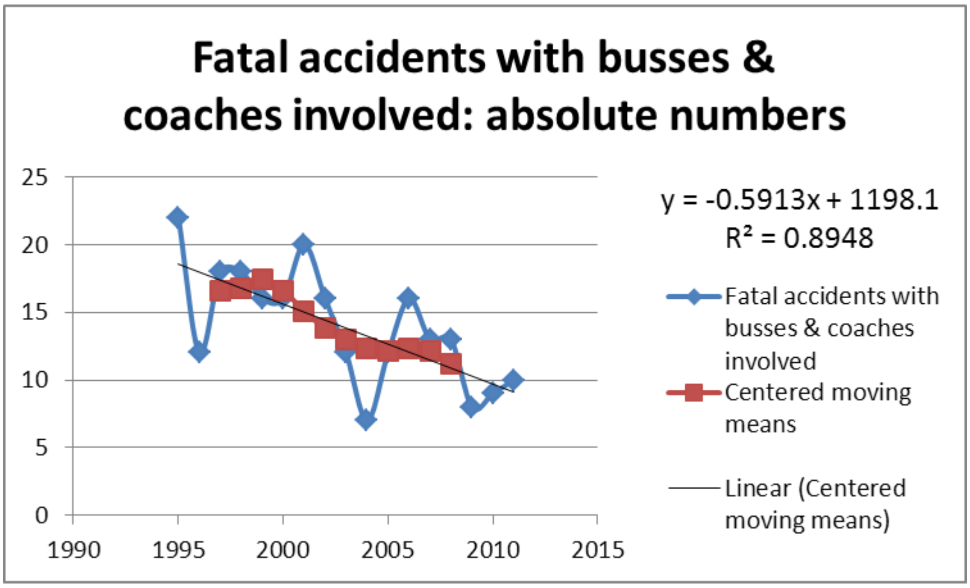


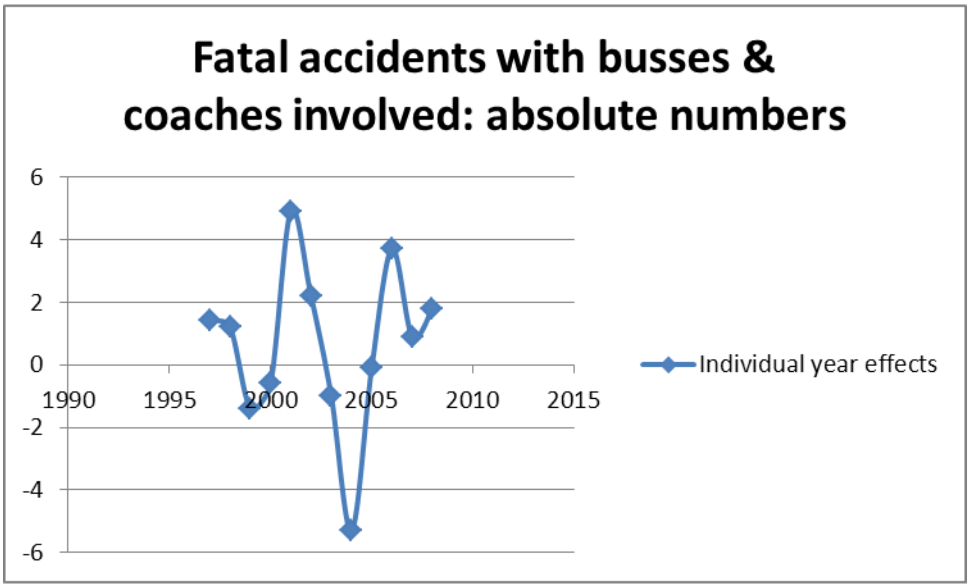


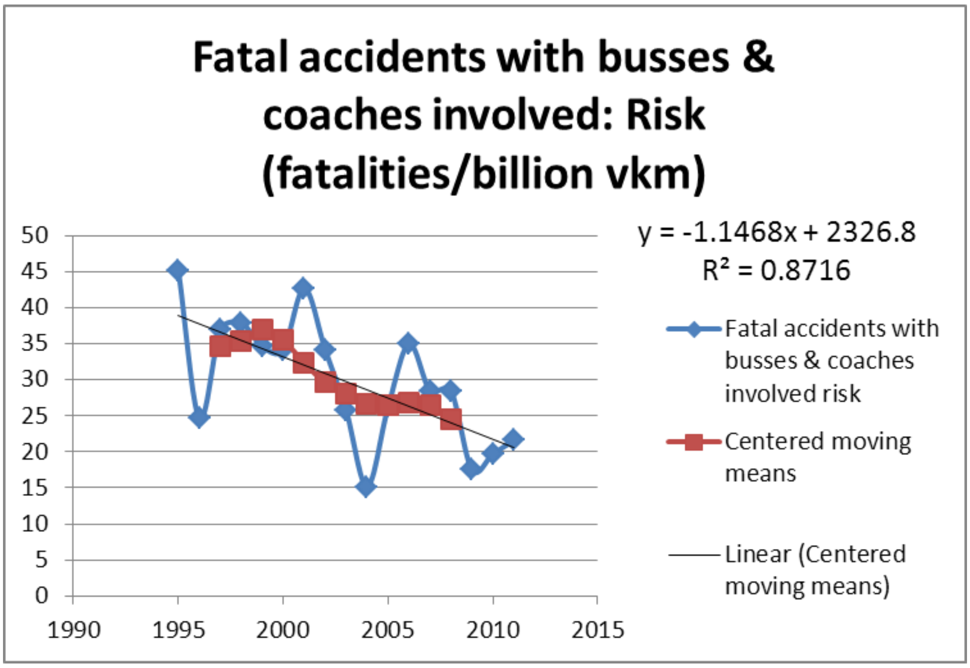

Fatal accidents with HGV involved:
Risk (fatalities/billion vkm)
y = -0.5853x + 1202.3
R² = 0.9068
Fatal accident with HGV involved risk
Centered moving means
Linear (Centered moving means)
45
40
35
30
25
20
15
10
5
0
1990
1995
2000
2005
2010
2015

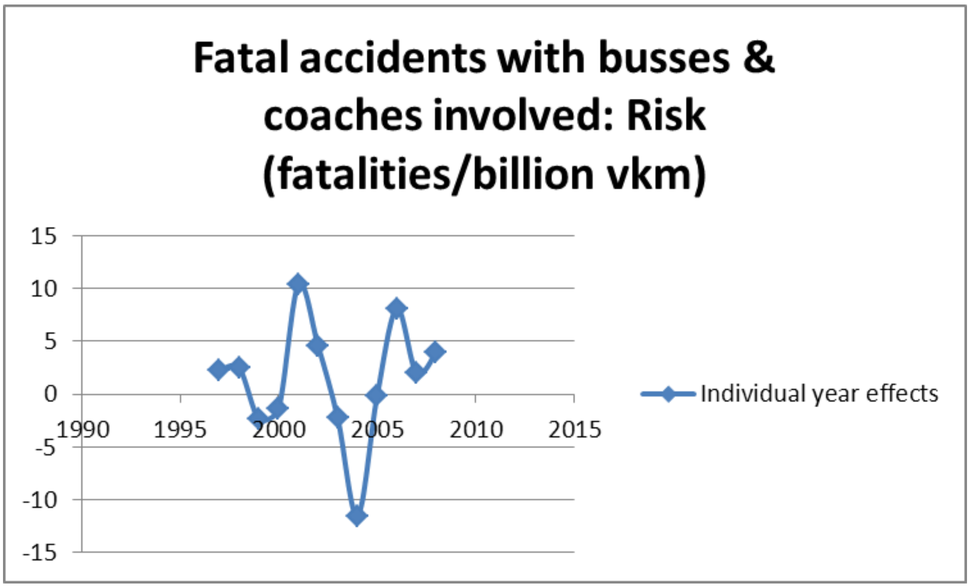

Fatal accidents with HGV involved:
Risk (fatalities/billion vkm)
Individual year effects
8
6
4
2
0
-2
-4
-6
-8
-10
-12
1990
1995
2000
2005
2010
2015

Buses and coaches



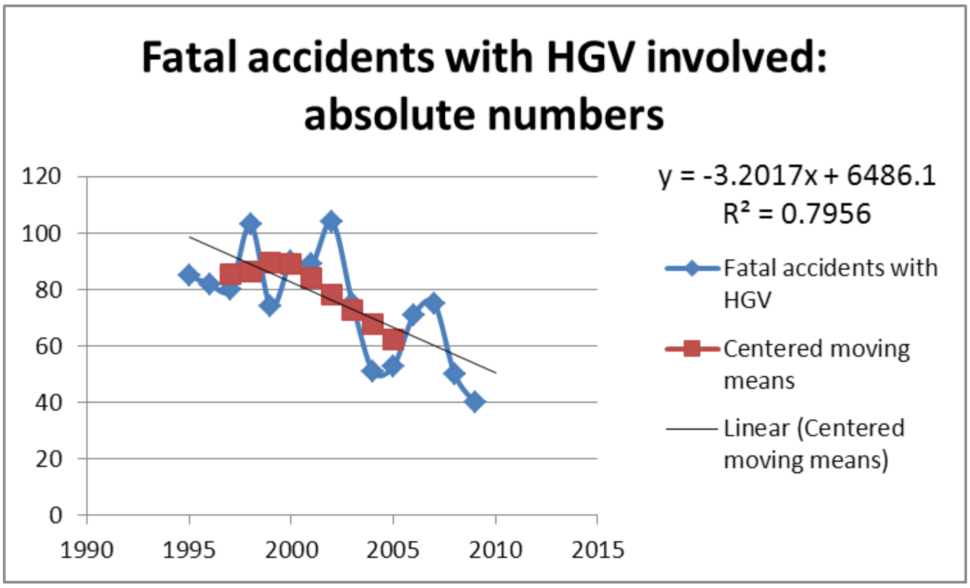


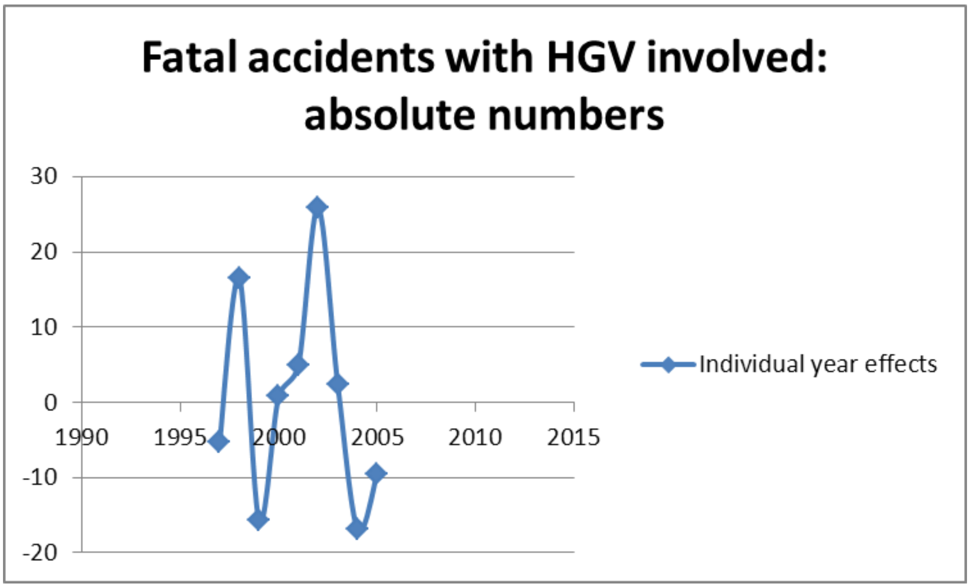

Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
y = -1.1468x + 2326.8
R² = 0.8716
50
45
40
35
30
25
20
15
10
5
0
1990
1995
2000
2005
2010
2015
Fatal accidents with busses & coaches involved risk
Centered moving means
Linear (Centered moving means)

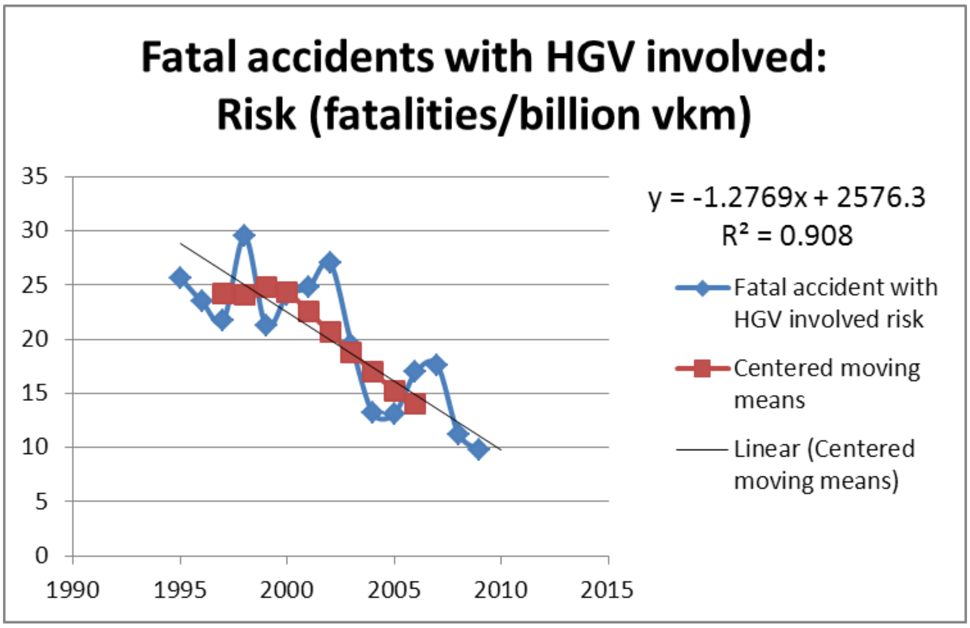

Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
15
10
5
0
-5
-10
-15
1990
1995
2000
2005
2010
2015
Individual year effects

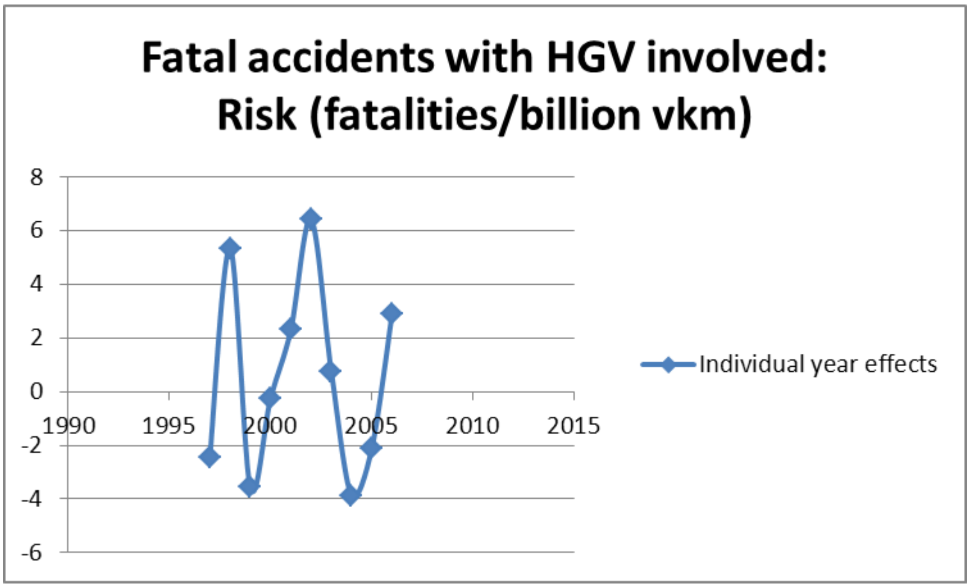
Sweden

Heavy goods vehicles

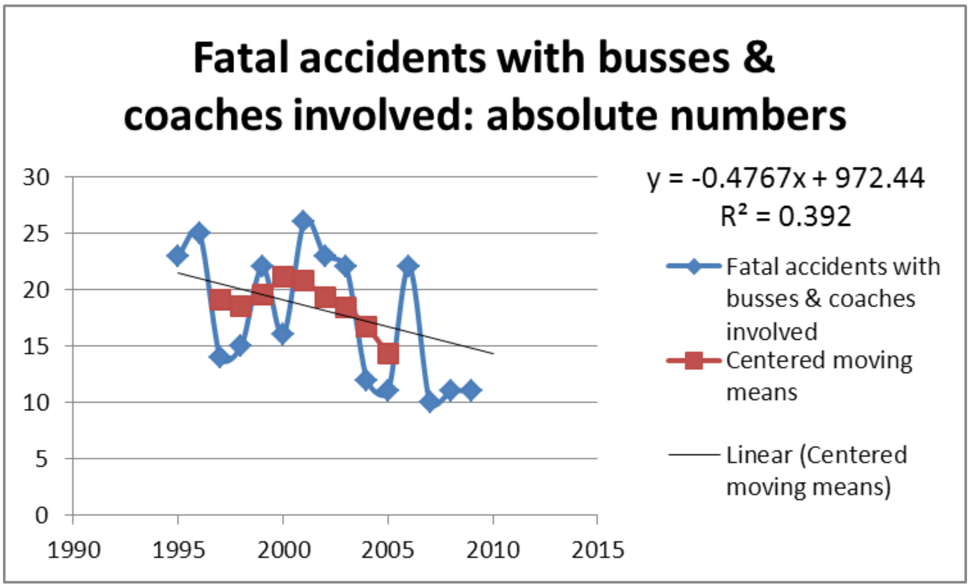


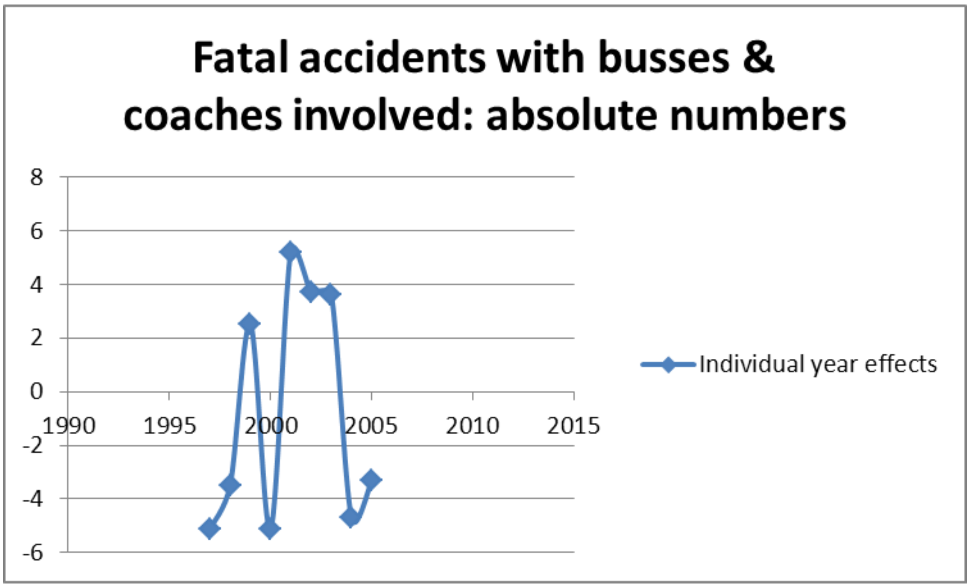


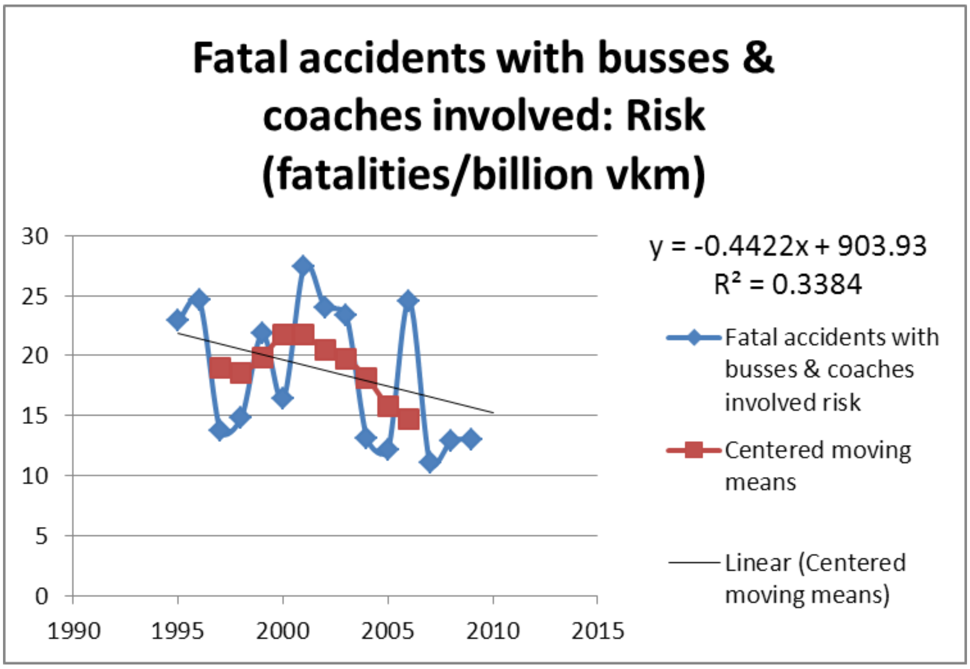

Fatal accidents with HGV involved:
Risk (fatalities/billion vkm)
y = -1.2769x + 2576.3
R² = 0.908
Fatal accident with HGV involved risk
Centered moving means
Linear (Centered moving means)
35
30
25
20
15
10
5
0
1990
1995
2000
2005
2010
2015

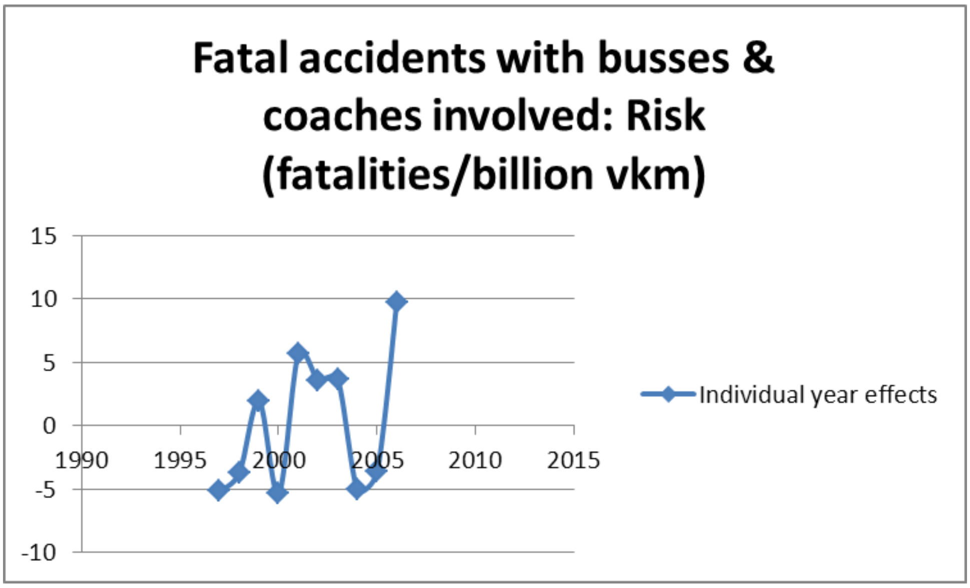

Fatal accidents with HGV involved:
Risk (fatalities/billion vkm)
Individual year effects
8
6
4
2
0
-2
-4
-6
1990
1995
2000
2005
2010
2015

Buses and coaches



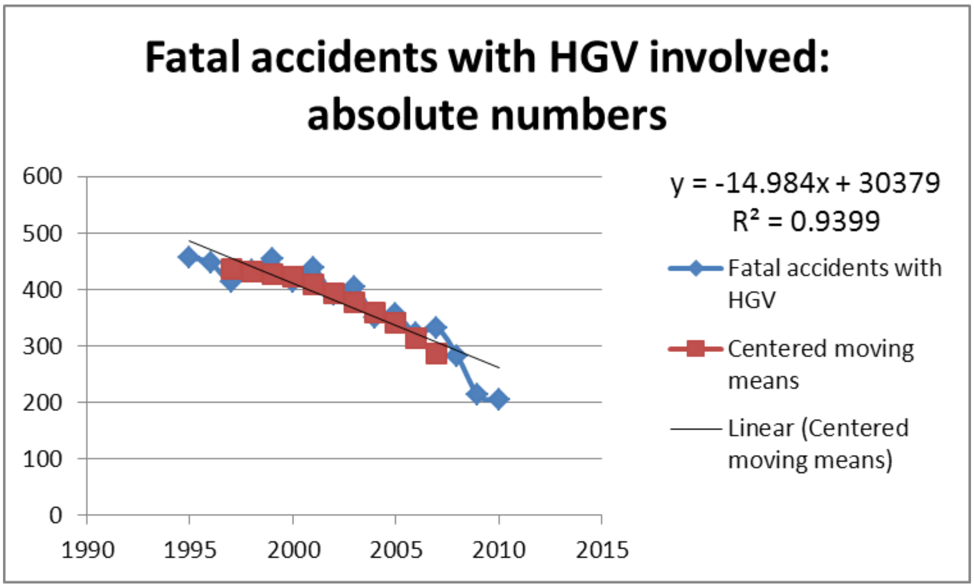


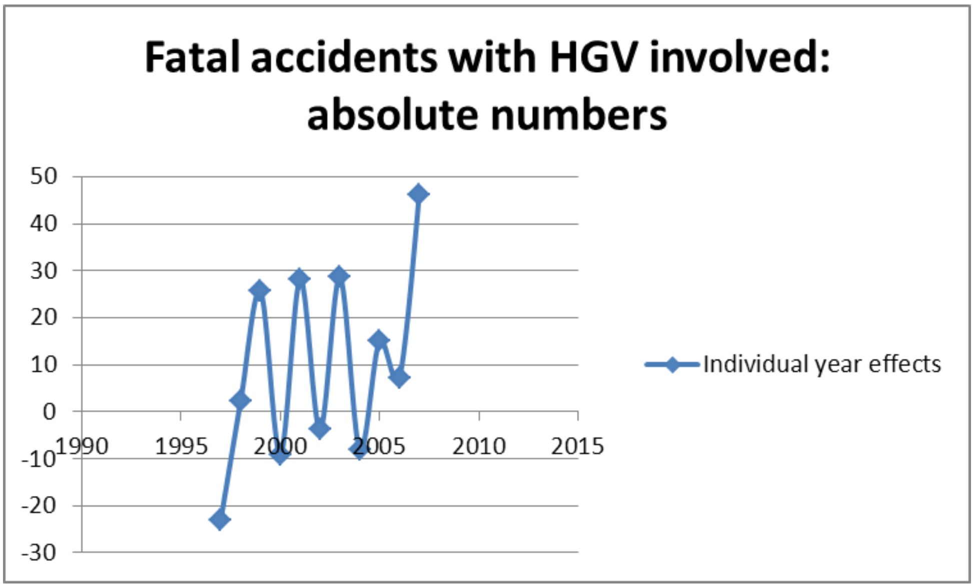

Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
y = -0.4422x + 903.93
R^2 = 0.3384
Fatal accidents with busses & coaches involved risk
Centered moving means
Linear (Centered moving means)
30
25
20
15
10
5
0
1990
1995
2000
2005
2010
2015

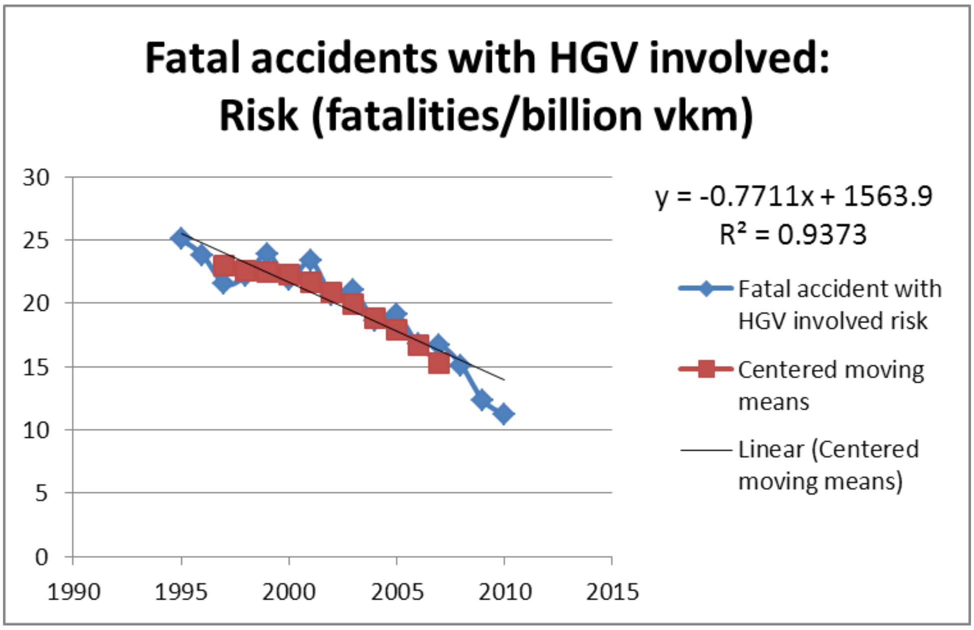

Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
Individual year effects
15
10
5
0
-5
-10
1990
1995
2000
2005
2010
2015

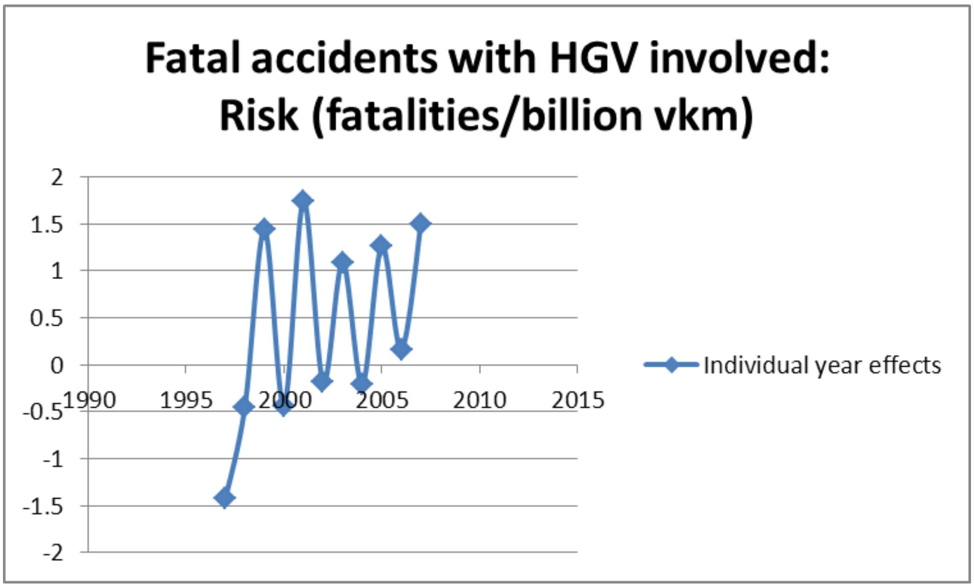
United Kingdom

Heavy goods vehicles

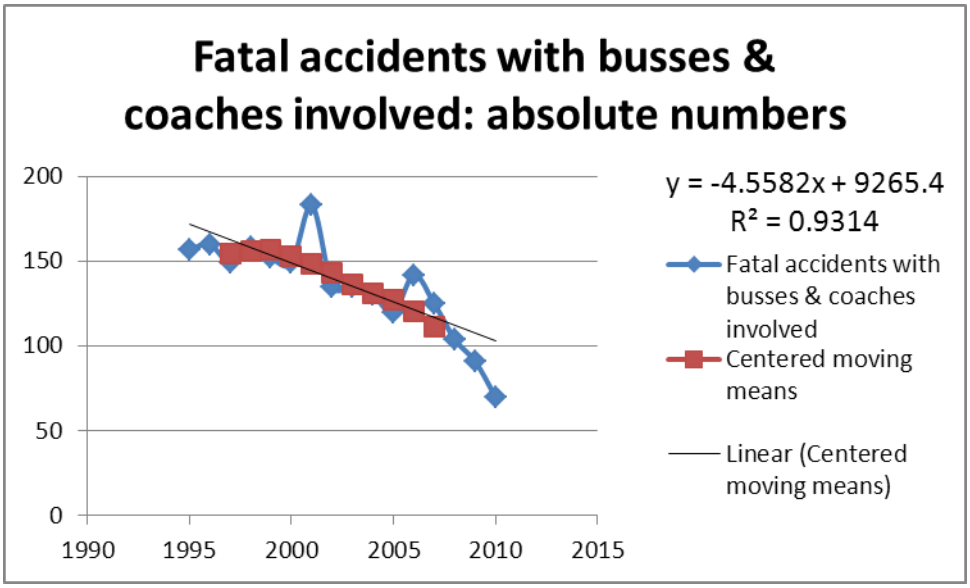


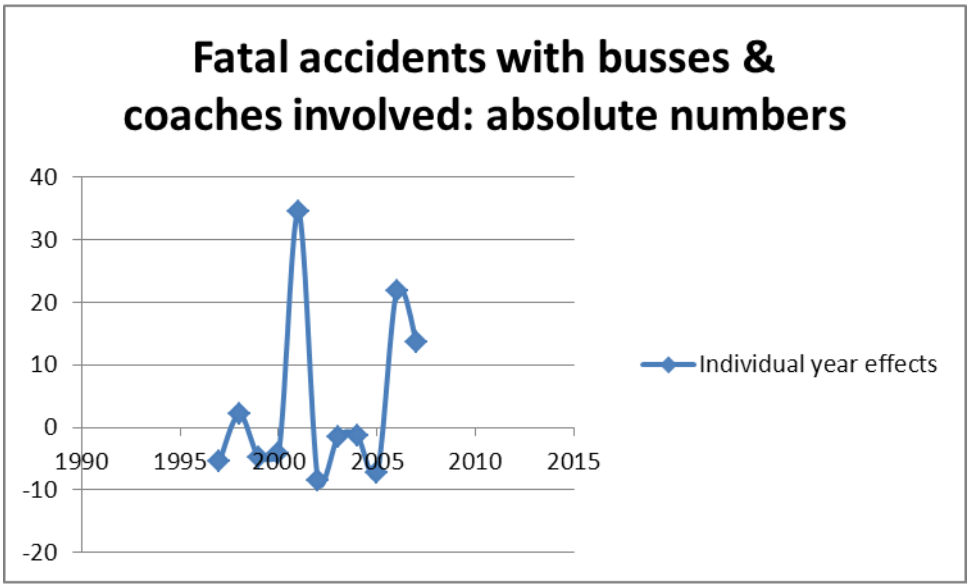


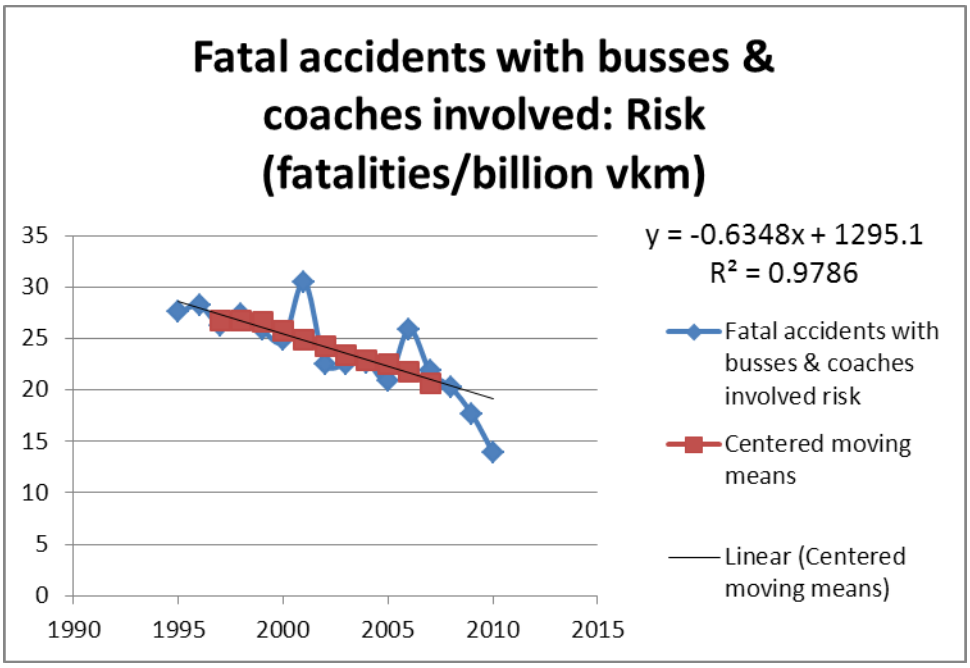

Fatal accidents with HGV involved:
Risk (fatalities/billion vkm)
y = -0.7711x + 1563.9
R² = 0.9373
Fatal accident with HGV involved risk
Centered moving means
Linear (Centered moving means)
30
25
20
15
10
5
0
1990
1995
2000
2005
2010
2015


Fatal accidents with HGV involved:
Risk (fatalities/billion vkm)
Individual year effects
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
1990
1995
2000
2005
2010
2015

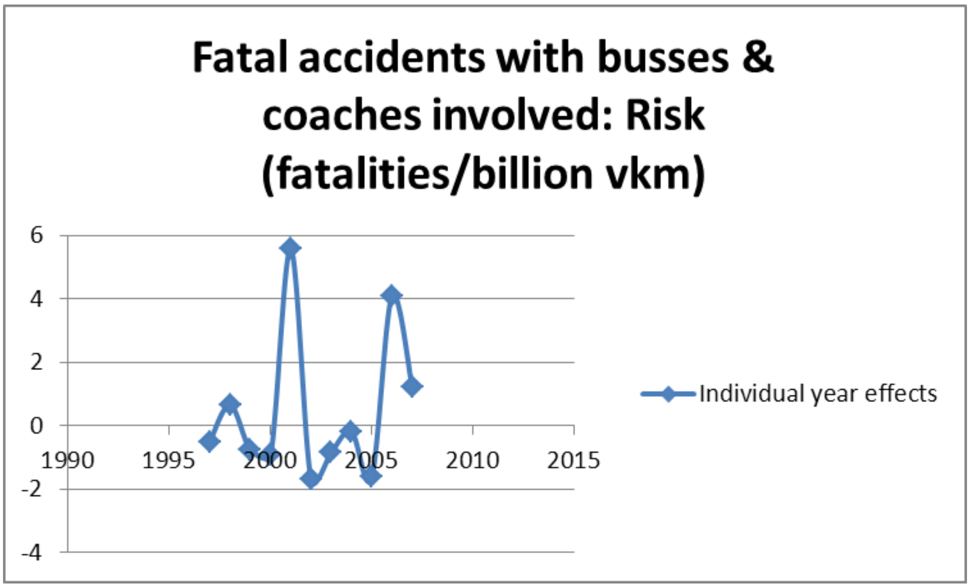
Buses and coaches







Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
y = -0.6348x + 1295.1
R² = 0.9786
35
30
25
20
15
10
5
0
1990
1995
2000
2005
2010
2015
Fatal accidents with busses & coaches involved risk
Centered moving means
Linear (Centered moving means)



Fatal accidents with busses & coaches involved: Risk (fatalities/billion vkm)
6
4
2
0
-2
-4
1990
1995
2000
2005
2010
2015
Individual year effects

ANNEX 12: Methodology for road safety calculations

Literature and selection of approach

To find a good approach to assess the road safety impacts of speed limiters, an assessment has been made of the available literature. In short: It is clear that higher speeds lead to higher crash risks, but it is difficult to estimate the exact increase in crash risk. It also depends on the initial speed level and the road environment. Higher speeds will also lead to more severe accidents.

Furthermore not only the average speed of the traffic counts but also the speed differences between various (types of) vehicles. Large speed differences at a road also increase the likelihood of a crash. In addition, drivers driving much faster than the average driver have a higher crash risk.

These different effects have been researched and described in the literature. In this section we will give an overview.

Absolute speed and accident risk

This section describes the relationship between the absolute speed and accident risk. With absolute speed we mean the speed of an individual vehicle or the average speed of traffic. Absolute speed is used to distinguish it from the other aspect of speed: the dispersion in the speed distribution or the deviation of the individual speed compared to the average speed (see section 2.6.2). The next section describes the relationship between the distribution of the speed and the probability of an accident.

Several speed-crash studies looked at absolute speed, either at individual vehicle level or at road section level. All of them conclude that there is an increase of the accident rate with an increase in speed (ERSO, 2006). On any road, an increase in speed will lead to the increased likelihood of a crash. Very strong relationships have been established between speed and crash risk.

High speeds reduce the possibility to respond in time in critical situations. People need time to process information, to decide whether or not to react and, finally to react. At high speed the distance covered in this period is longer. At higher speeds the distance between starting to brake and a complete standstill is longer as well. The driver needs to have more control over the vehicle in order to drive safely at higher speeds. Also for other drivers it is harder to assess the behaviour of a fast driving vehicle. Finally, the drivers vision is narrowed at higher speed so that less of the environment is observed.

Relatively many studies have examined the relation between absolute speed and crash rate. Irrespective of the research method used, practically all the studies concluded that the relation between speed and crash rate can best be described as a power function: the crash rate increases more rapidly when the speed increases and vice versa (SWOV, 2012).

Nilsson (1982) and Elvik (2009)

Very well-known Scandinavian studies that are still often quoted in this context are those carried out by Nilsson (1982; 2004), Elvik, Christensen & Amundsen (2004) and Elvik (2009). These studies examined the effects on the number of crashes of the increases and decreases of average speeds on a road section mostly due to changes in speed limit.

Nilsson (1982) developed the following formula to describe the effects of a speed change on the number of injury accidents:

$$A_2 = A_1 \left(\frac{v_2}{v_1}\right)^2$$

with A2 as the number of injury crashes after a speed change; A1 as the number of injury crashes before the speed change; v1 as the average speed before the change, and v2 as the average speed after.

He derived this relation based on the notion that when speed increases, the kinetic energy increases, Because kinetic energy is determined by the square of the vehicles speed, the probability of injury and the severity of injuries increase exponentially with vehicle speed.

Speed and injury severity

The absolute speed also has an impact on injury severity. For any given road, there is a relationship between increased injury severity and increased speed. When the collision speed increases, the amount of kinetic energy that is released increases as well. Part of this energy will need to be absorbed by the vulnerable human body. This is particularly true for occupants of light vehicles when colliding with more heavy vehicles, and for unprotected road users, such as pedestrians and cyclists when colliding with motorized vehicles. Generally, the more kinetic energy to be dissipated in a collision, the greater the potential for injury to vehicle occupants.

Power functions updated by Elvik (2009)

Nilsson reasoned that the severe injury crash rate would be affected more by a change in speed than the overall crash rate. Based on empirical data of the effects on crashes after a speed limit change on Swedish roads, he increased the power of the function to calculate the number of severe injury (I) and fatal crashes (F) to respectively 3 and 4:

$$I_2 = I_1 \left(\frac{v_2}{v_1}\right)^3$$

$$F_2 = F_1 \left(\frac{v_2}{v_1}\right)^4$$

With I_1 and I_2 as the number of severe injuries before and after the speed change and F_1 and F_2 the number of fatalities before and after the speed change.

The recent study by Elvik (2009) made it possible to refine this quantitative relationship. He defined the general power function as shown below and specified different exponents relating to the type of accident. The general function is:

$$\frac{Accidents_{after}}{Accidents_{before}} = \frac{Speed_{after}}{Speed_{before}}^{Exponent}$$

The exponent depends on the severity of accident that is considered. In general, the exponent is higher for more severe accidents. He also made a distinction between urban and rural roads. This showed that the effect of an increase or decrease of speed on rural roads is relatively greater than the effect on urban roads. The exponent is higher for motorways in comparison to urban roads. Table A- 1 shows the exponents for different accident severities for rural roads/motorways and for urban/residential roads, based on the latest empirical data (Elvik, 2009).

Table A- 1: The exponents of the power functions for the relationship between speed and crashes/casualties with different injury severity (Elvik, 2009)

Crash/injury severity	Rural roads/motorways		Urban/ residential roads	
	Best estimate	95% Confidence interval	Best estimate	95% confidence interval
Fatal crashes	4.1	(2.9-5.3)	2.6	(0.3-4.9)
Fatalities	4.6	(4.0-5.2)	3.0	(-0.5-6.5)
Serious injury crashes	2.6	(-2.7-7.9)	1.5	(0.9-2.1)
Serious injuries	3.5	(0.5-5.5)	2.0	(0.8-3.2)
Slight injury crashes	1.1	(0.0-2.2)	1.0	(0.6-1.4)
Slight injuries	1.4	(0.5-2.3)	1.1	(0.9-1.3)

As the power functions of Nilsson were extensively evaluated (Nilsson, 2004; Elvik et al., 2004) and fitted the speed and crash data of very different road types, Aarts and van Schagen (2006) consider that these functions describe this relationship best. They are based on a fairly sound before–after study design and describe the effect of changes in average speed on different crash severities levels.

Speed dispersion and accident risk

The speed-crash-rate-relation is further complicated by the fact that the crash-rate is not only related to the absolute speed, but also to the speed dispersion. If on a particular road, the vehicles travel at different speeds, the probability of an encounter is higher than if they drive at similar speeds (Hauer, 1971; Elvik et al., 2004). Faster traffic will be catching up with and passing slower vehicles. Higher speed variance this will result in less predictability, more encounters, more overtaking manoeuvres, etc. Many studies emphasized speed variance, rather than absolute speed, as the primary culprit in the incidence of crashes (ERSO, 2006).

The effect that speed differences between vehicles have on the crash-rate is studied in two ways. The first type of studies (e.g. Taylor et al., 2000) are those that compare the crash rates between roads that have a large speed variance (large differences in vehicle speeds during a 24 hour period) and roads that have a small speed variance. These studies mostly conclude that roads with a large speed variance are less safe (Aarts & Van Schagen, 2006).

The second type of studies are those that concentrate on the speed differences between the individual vehicles that were involved in a crash and all the other vehicles. The first studies of this type were conducted in the United States in the 1950s and 1960s, e.g. Solomon (1964). These studies always found a U-curve: the slower or faster a car drives compared with most of the vehicles on that road, the more the risk of being involved in a crash increased. However, more recent studies, especially those carried out in Australia (e.g. Kloeden et al., 1997; 2001; 2002) that used more modern measuring instruments and used a more accurate research design, reached a different conclusion. They still indicate that vehicles that drive faster than average on that road have a higher crash rate; vehicles that drive slower, however, were found not to have an increased risk.

Both the older and the more recent studies provide evidence that driving faster than the surrounding traffic increases the risk of a crash. With regard to driving slower than average, the evidence is less conclusive.

Concluding, when speed differences increase, the crash risk increases as well. Hence, a measure that results in lower average speed, but in larger speed differences may not have the expected positive effect on road safety.

Kloeden et al. (2001)

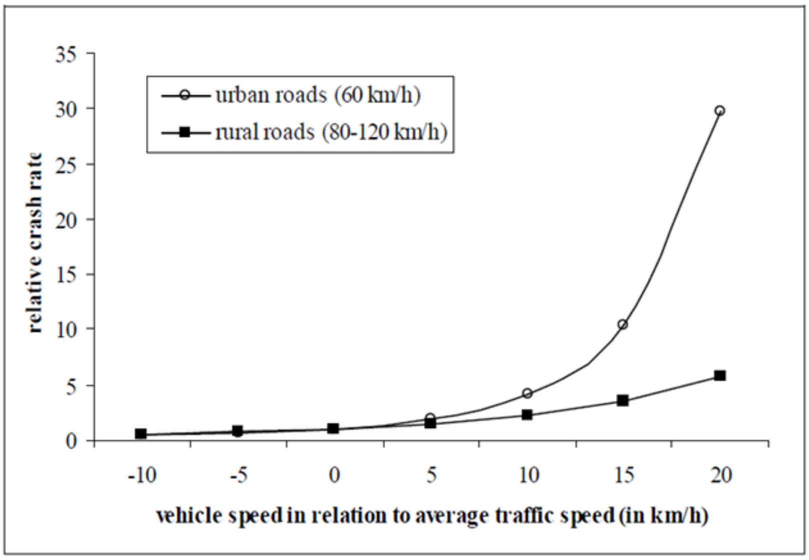
A more recent case–control study that examined the crash involvement risk of slow and fast driving vehicles more accurately, are the Australian studies of Kloeden et al. (1997, 2001). These studies found an increased risk for vehicles moving faster than the others, but not for vehicles moving slower.

Kloeden et al. (2001) conducted a number of case-control studies. In these studies, the speed of a vehicle just before a serious injury accident was estimated on the basis of computer modelling. These cases were then linked to control vehicles. At the accident site, the speed of a number of vehicles was measured under similar circumstances. This way, the impact of vehicle speed examined on crash. Kloeden et al. (2001) examined the speed–crash rate relationship on rural roads with speed limits between 80 and 120 km/h. In this study, each of the 83 cases was linked to 10 control vehicles (n = 830). They found the following formula to describe this relationship. See also Figure A - 1.

$$relative\ risk_{rural\ roads}(D) = e^{0{,}7039 \cdot D + 0{,}0008617 \cdot D^2}$$

with D as the difference of the speed of an individual vehicle with the average speed

Figure A - 1 Relative risk on urban and rural roads for vehicles driving faster or slower than the average speed on the road



The model has a good fit between -10 and +30 km / h and a reasonable fit over the range -20 to +40 km / h.

It should be said that these formulas are based on Australian data, and that it is not clear to what extent they also describe the situation well in other countries. It should also be noted that the relative crash risk describes the probability of an accident with at least an injury in which a hospital was consulted.

According to Aarts and van Schagen (2004) each type of study has drawbacks, but they consider case-control studies as superior for the examination of the relationship between speed and crash rate since they can control for many confounding factors. Therefore, they conclude that the results of Kloeden et al. (2001) best describe the relationship between individual vehicle speed and crash rate. This means that crash rate rises exponentially for individual vehicles that increase their speed.

Taylor et al. (2000)

As mentioned before, Taylor et al. examined speed variance at road section level. They performed a cross-sectional study, by comparing the crash rates (hospital admission or more) between roads that have a large speed variance and roads that have a small speed variance. They use both the speed deviation and the average speed at the same time as explanatory variables for the accident rates.

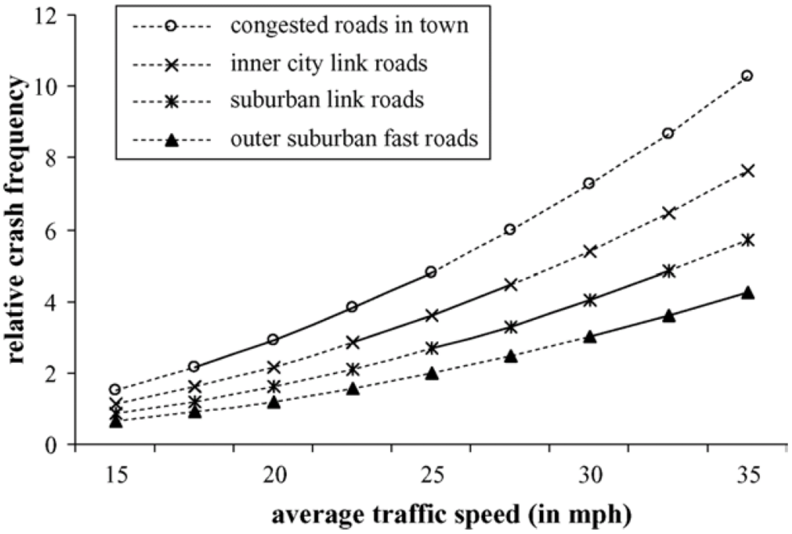
Taylor et al. (2000) found that traffic speed variance is related to the crash frequency. They collected aggregated 24 h spot speed data of 300 urban single carriageway roads in the UK and linked this to 1590 injury crashes at these roads. The researchers distinguished four road types: congested roads in town, inner city link roads, suburban link roads, and outer suburban fast roads. The results show that the crash frequency increased more with increasing average speed. At a more detailed level, congested roads both had a higher absolute crash frequency and a larger increase in crash frequency with higher average speeds than fast roads (Figure A - 1). Lower average speeds coincide with a larger speed variance and both were found to be related to crash frequency.

Taylor et al states that road safety is both related to the average speed and to the speed dispersion on the road section. Taylor developed the following formula for the relationship between accident rate and average speed and speed variance:

$$Accident\ rate(V, SD) = 0{,}000435 \cdot V^{2{,}252} \cdot e^{5{,}893 \cdot \frac{SD}{V}}$$

with v as the average speed (km/h) and SD as s the standard deviation of the speed distribution (km/h)

Figure A - 2: The relationship between average speed and crash frequency on four urban road types (Taylor et al., 2000). The dotted lines reflect the extrapolation of the observed data, based on the speed–crash rate according to Taylors formula



The study of Taylor et al. is useful because opposed to most other studies, who indicate either a relationship between average speed and crash rate or a relationship between speed dispersion, Taylor et al (2000) use both the standard deviation and the average speed at the same time as explanatory variables for the crash.

It should be noted that Taylor et al have studied urban roads. Earlier we saw that the effect of speed on the accident is higher on roads where the speeds are lower (Elvik, 2009; Kloeden (2000, 2001). Therefore the formula of Taylor et al. probably overestimate the crash reduction on motorways and rural roads.

Most other studies indicate either a relationship between average speed and accident rate or just the relationship between speed dispersion and accident rate. Only Taylor et al (2000) and Baruya and Finch (1994), use both the speed deviation and the average speed at the same time as explanatory variables for the accident rates. The type of study that was used to derive the relationships are cross-sectional, and less suitable to estimate the effect. Because the formulas of Taylor et al (2000) include both the average speed and speed dispersion, they will be used in the calculations for the current project on speed limiters (following the study of SVV, 2005).

External factors

The exact relationship between speed and accidents on a particular road is very complex and will depend on a range of road and traffic characteristics that interact with speed and also on the characteristics and behaviour of the drivers using the road, such as age, driving experience, drink-driving and seatbelt wearing. This means that the road safety impacts should be considered as uncertain and a best estimate instead of exact impacts. Recent studies shed some light on these factors as well as on the direction of the effects, but it is difficult to give specific quantifications. Researchers must be aware of the influence of external factors on the relationship between speed and crash-rate (Aarts and van Schagen, 2006).

Conclusion on the most relevant approaches

Even though the exact relationship between speed and crash rate depends on a large number of different factors, clear relationships between road safety and absolute speed and speed dispersion have been established. The literature is inconclusive on which one is more important.

Absolute speed relates to the accident risk, but also to the injury severity. This is best described by the Nilsson formulas, updated by Elvik. The accident risk is also affected by speed dispersion. The studies of Kloeden best describe this relationship. Taylor et al. both included absolute speed and speed dispersion in their formula. The table summarizes these three studies with respect to the relationship that they describe and the type of effect that is calculated.

Table A- 2: Summary of the studies that were chosen from the literature

	Formula includes		
Study	**Absolute speed**	**Speed dispersion**	**Calculates estimate of effect on:**
Nilsson/Elvik	Yes	No	i.a. all injury accidents, serious injuries, fatalities
Kloeden et al	No	Yes	Number of vehicles involved in crashes (at least hospital)
Taylor et al	Yes	Yes	All injury crashes

Choosing a method for assessing the impacts of speed limiters on vans and HGVs

To determine which approach methodology is appropriate for the current project we will first describe the expected effects. The application of speed limiters to one or a few vehicle categories (not to all passenger cars) will only affect a limited part of the total traffic flow. For the vehicle category with speed limiters the average speed will decrease and speed deviation will also decrease. The average speed of the total traffic flow will also decrease, but an additional consequence is that the differences between speeds of vehicles might increase. The application of speed limiters results in a change in the average speed and in the speed dispersion, which can be different for parts of the traffic flow and the total traffic flow. The methodology must be able to take all these effects into account.

By use of the formulas of Nilsson, Kloeden and Taylor, absolute speed, speed dispersion and a combination of these are integrated in the approach. However, the studies of Nilsson, Taylor and

Kloeden only looked at the total traffic flow. In this project only the speeds of a part of the traffic flow will be affected and the formulas of Nilsson, Kloeden and Taylor cannot be applied so easily. Several other studies have already dealt with this challenge.

In the study by Hohnscheid et al. (2006) the effect of speed limiters on vans was analysed, by use of the Nilsson formula's. The implementation of speed limiters for vans was modelled in a simulation to retrieve the reduction of average speeds of the total traffic flow. The power functions were then applied to all accidents.

The study by CE Delft (2010), chose a different approach, by applying the power functions only to the speeds of vans and then the results only to accidents with vans involved (unilateral and multilateral). However, this approach leads to an overestimation of the effects of multilateral accidents, because the Nilsson formula's also take into account speed reduction of the other road users (e.g. passenger cars), while in case of application of speed limiter on vans, the speed of passenger cars is unchanged. To account for this, the study by CE Delft (2010) on speed limiters for vans used the allocation principle of potential damage perspective, a principle that is used for calculation of social costs of transport modes. Victims from multilateral accidents with vans involved were only partly allocated to vans.

The studies of SWOV (1991) and SVV (2005) also chose the approach of applying the power functions only to the accidents that are likely to be affected, i.e. accidents with HGVs involved. The speeds of the involved vehicles were used for estimating the effects. In case of a multilateral accident, with two or more vehicles involved, the average speed reduction of both vehicle categories was weighed to the share in vehicle kilometres and then used to calculate the safety impacts. This leads to a very small reduction for multilateral accidents, because the share of kilometres for HGVs is small relative to the car. Therefore in this study the approach of CE Delft (2010) was followed, using the damage potential principle.

Methodology

In this section the methodology for estimating road safety impacts of speed limiters using the changes in speeds as applied in the current project is described in 5 steps. For each step the most important aspects will be explained.

Step 1: Effect on speed

As was said in the introduction, the calculation for effect of the speed limiters is based on a model that simulates the changes in the speed distribution. In the simulation model it is assumed that the desired speed distribution is normally distributed with parameters that are linked to the posted speed limit. The speed distribution for different vehicle categories were defined based on data that was collected from the member states and additional assumptions to fill in the gaps. This is described in section 2.6.

We use the distributions to capture the effect of the speed limiters on driver behaviour. The installation of speed limiters changes the shape of the distribution, since in each case all vehicles with speed limiters that that would otherwise have a desired speed that is higher than the limiter set speed, will be constrained to the limiter speed. This is shown in Figure A - 3. The figure shows the percentage of vehicles driving at the different speeds and the speed limit, for an example.

Figure A - 3: Re-distribution of the speed distribution due to the speed limiter

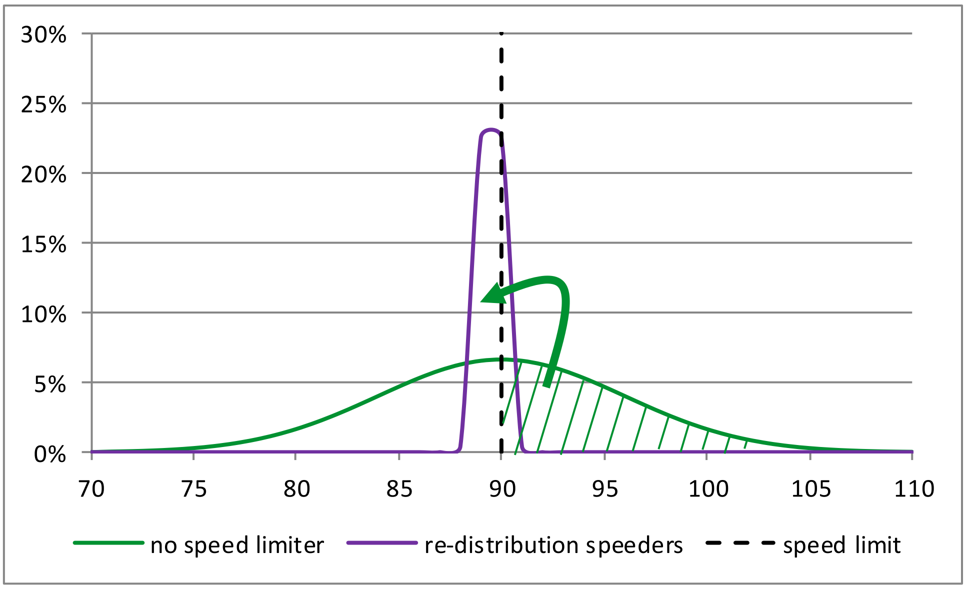
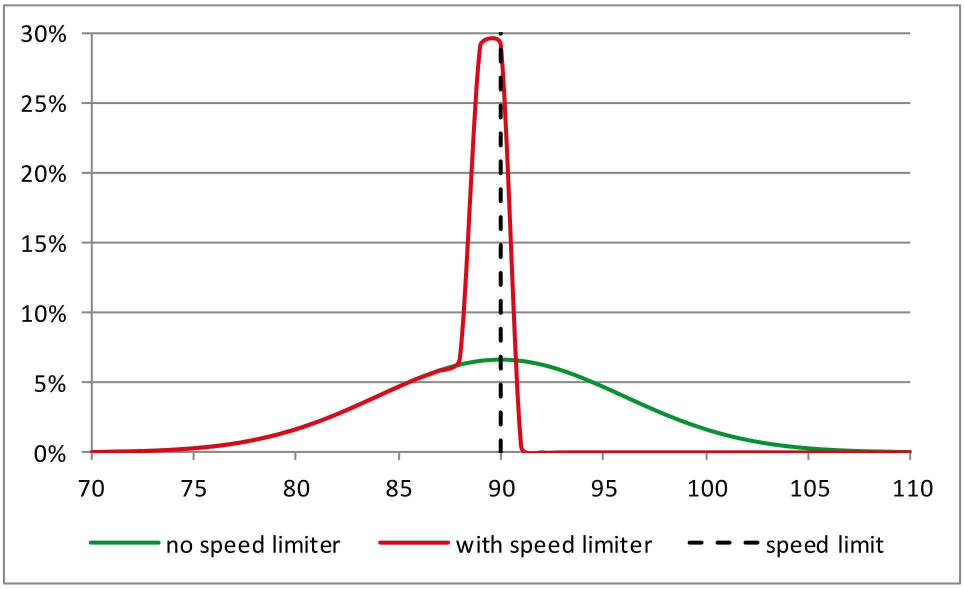


Figure A - 4 shows the new speed distribution due to the speed limiter.

Figure A - 4: Changed speed distribution due to the speed limiter



Step 2: Scenario calculations

The calculation that was explained in step 1 was performed for every scenario (for ex-post, ex-ante HCV, ex-ante LCV). The scenarios for speed limiters are compared to the reference scenario to determine the change in speed distribution (average speed and speed deviation) for every scenario. The effects on speeds are different per country, because the posted speed limit is different per country. Therefore the analysis was done for every Member State separately, based on the posted speed limits. The calculation was also performed for an average Member State with either high or low posted speed limits. This makes it easier to present the results of the calculations later on in this report. The posted speed limits for all Member States are included in Annex 3. The low and high posted speed limits for an average Member State are presented in Table A- 3.

Table A- 3: Low and high posted speed limits for an average Member State

		Posted speed limits	
Road type	**Vehicle**	Low	High
Motorway	N1	115	130
	N2/N3	80	90
	M2/M3	90	100
Rural roads	N1	90	100
	N2/N3	80	90
	M2/M3	80	90

Step 3: Applying the power functions

The road safety effect is estimated based on the change in average speed. The power functions are used to make the calculations. The effect of a change in speed dispersion is also calculated from the speed distributions, using the formulas by Taylor (2000) and Kloeden (2001) but reported in a qualitative way.

The general power function is:

$$\frac{Accidents_{after}}{Accidents_{before}} = \frac{Speed_{after}}{Speed_{before}}^{Exponent}$$

The exponent depends on the severity of accident that is considered. The exponents that were used are presented in Table A- 4.

Table A- 4: Exponents for the revised Power Model for rural roads/motorways (Elvik 2009)

	Best estimate
Fatal accidents	4,1
Serious injury accidents	2,6
All injury accidents	1,6

This way, for every scenario, every road type, every vehicle type and every Member State, the accident reduction percentage was calculated for fatal accidents, serious injury accidents and all injury accidents.

In the literature the relationship between speed dispersion and road safety is described by Taylor (2000) and Kloeden (2001). For the calculations with Taylor the speed deviation and average speed of the total traffic flow were calculated using the distribution per vehicle type and the share in vehicle km. The share in vehicle km was retrieved from TREMOVE. Combining them results in the distribution for the total traffic flow. From this the speed deviation and the average speed could be calculated. The literature and formula of Taylor is described in Annex 12. The calculation for Kloeden is slightly more difficult. The relative risk of every individual vehicle depends on the speed of that vehicle compared to the average speed. Therefore for every speed the relative risk is calculated and weighed by the share of vehicles driving that speed. This results in the cumulative risk factor. The change in the cumulative risk factor in the reference situation and the scenario determines the relative change in accidents for that scenario. Based on these calculations, a qualitative evaluation was made. The effect is presented on a 5-point scale, varying from – – to ++, and explained in text.

Step 4: Effect at EU level

In the next step the reduction percentages for accidents (fatal, serious injury, or all injury accidents) are applied to accident data for the EU Member States (source: CARE). The accident data that was used is the average for 2008-2011, to minimize the influence of variation in the dataset. If there was not sufficient data available, the Member State was left out of the analysis. This was the case for Bulgaria, Estonia, Italy, Cyprus, Latvia, Lithuania, Malta, Finland (applied to EU27). The data that was used for the evaluation is presented in Table A- 5.

Table A- 5: Average number of accidents in the EU for the period 2008-2011 per road type, accident severity and for different vehicle types involved that were used for the evaluation

		No HCV or LCV involved	HGV involved	Bus involved	LCV involved	Total
motorway	Fatal accidents	873	507	38	249	1.667
	Serious injury accidents	5.923	2.159	97	1.211	9.390
	All injury accidents	35.126	9.714	489	7.041	52.370
rural	Fatal accidents	9.451	2.050	243	1.275	13.019
	Serious injury accidents	49.893	4.186	591	4.750	59.420
	All injury accidents	197.152	17.455	2.631	21.915	239.154
urban	Fatal accidents	7.636	1.079	360	813	9.888
	Serious injury accidents	89.787	3.454	2.987	6.339	102.567
	All injury accidents	542.839	18.832	21.170	45.333	628.173
all roads	Fatal accidents	17.959	3.636	641	2.337	24.573
	Serious injury accidents	145.603	9.799	3.674	12.300	171.376
	All injury accidents	775.117	46.001	24.290	74.289	919.697

With this data and the accident reduction percentages from the previous steps, the road safety effect was calculated.

For accidents with only HGVs involved, only the speeds of HGVs have an impact (not the speeds of other vehicle categories). For accidents with only vans involved, only the speeds of vans have an impact. This is also shown in Table A- 6.

Table A- 6: Accident type and used speed distributions

Conflict type	Vehicle category speeds used to estimate the impact
Accidents without LCV or HCV	-
Accidents involving HCVs	HCVs
Accidents involving LCVs	N1-vehicles

There are unilateral and multilateral accidents. Unilateral accidents involve only one vehicle, while multilateral accidents involve several vehicles.

Step 5: Damage potential perspective

An important limitation of the power formulas is that they were estimated based on a reduction in average speed for the total traffic flow. For multilateral accidents, involving multiple vehicles, this means that both victim and opponent have reduced their average speed.

In this evaluation study however, only the HCVs (or LCVs) reduce their average speed due to the speed limiter. This means that in a multilateral accidents with other vehicles, only one of the involved vehicles is driving slower. Therefore the effect of the reduction in average speed for all accidents involving HCVs is overestimated by the power functions.

Because HCVs have a relative high accident risk and the crash opponent fatality rate is high, due to the great mass of the vehicle, the reduction in accidents is expected to be higher than 50% of the effect calculated by the power functions.

The measure that we use to estimate the relative effect is the damage potential perspective, as was used in the study External costs of transport in Europe (2011). This measure accounts for the damage potential of HCVs (or LCVs) compared to other vehicles. The relative effect of a speed reduction of those vehicles is proportional to the damage potential. The conclusion is that the reduction of multilateral accidents involving HCVs is lower than estimated by the power functions. For the total reduction in accidents, the other involved vehicles would have to slow down too. The effect is expected to be higher than 50% of the effect calculated by the power functions, because heavy vehicles have a relative high accident risk and the crash opponent fatality rate is high.

Method:

For fatalities in the Netherlands in the period 2006-2012, 91% of the casualties in accidents involving HCVs were in the other vehicle (source BRON Dutch Ministry of Transport). According to the damage potential perspective, these casualties are accounted to the HCVs. The other 9% are occupants of HCVs. Of those 9%, 18% were victim in an unilateral accident. The relative effect from a damage potential perspective is then (91% + 9%*18% =) 93%. The data for buses was too limited and aggregated with HGV data. Table A- 7 shows the result for fatalities and severe injuries for both HCVs and LCVs.

Table A- 7: Relative effect of a reduction in average speed for HCVs and LCVs (damage potential perspective)

	HCV	LCV
Fatalities	93%	63%
Severe injuries	84%	65%

Example:

A reduction in average speed for LCVs leads to a fatal accident reduction percentage of 10% according to the power formulas. The relative effect for all fatal accidents involving LCVs is 63% according to the damage potential perspective. The percentage of fatal accidents involving LCVs that are prevented due to the reduction of average speed is 6,3%.

ANNEX 13: Speed profiles for emission analysis

Table A- 8: characteristics of speed profiles used in ex-post analysis for HGVs and buses on motorways.

Input									Output	
							Without speed limiter		With speed limiter	
Profile Nr.	Reference Nr.	Scenario	Road type	Vehicle type	Posted speed limit	Speed limiter speed	Average speed	STD on speed	Average speed	STD on speed
					km/h	km/h	km/h	km/h	km/h	km/h
1	1	Ex post	motorway	N2/N3	80	0	85	6	85	6
2	2	Ex post	motorway	N2/N3	90	0	90	6	90	6
3	3	Ex post	motorway	M2/M3	90	0	95	6	95	6
4	4	Ex post	motorway	M2/M3	100	0	100	6	100	6
5	1	Ex post	motorway	N2/N3	80	90	85	6	85	6
6	2	Ex post	motorway	N2/N3	90	90	90	6	88	5
7	3	Ex post	motorway	M2/M3	90	100	95	6	95	6
8	4	Ex post	motorway	M2/M3	100	100	100	6	98	5

Table A- 9: characteristics of analysed speed profiles for HGVs and buses on motorways, in case of a higher assumed average speed before the introduction of the speed limiter (ex-post sensitivity analysis).

Input									Output	
							Without speed limiter		With speed limiter	
Profile Nr.	Reference Nr.	Scenario	Road type	Vehicle type	Posted speed limit	Speed limiter speed	Average speed	STD on speed	Average speed	STD on speed
					km/h	km/h	km/h	km/h	km/h	km/h
9	9	Sensitivity	motorway	N2/N3	80	0	90	6	90	6
10	10	Sensitivity	motorway	N2/N3	90	0	95	6	95	6
11	11	Sensitivity	motorway	M2/M3	90	0	100	6	100	6
12	12	Sensitivity	motorway	M2/M3	100	0	105	6	105	6
13	9	Sensitivity	motorway	N2/N3	80	90	90	6	88	5
14	10	Sensitivity	motorway	N2/N3	90	90	95	6	89	4
15	11	Sensitivity	motorway	M2/M3	90	100	100	6	98	5
16	12	Sensitivity	motorway	M2/M3	100	100	105	6	99	4

Table A- 10: characteristics of analysed speed profiles for HGVs and buses on motorways, in case of lower speed limiter speeds (ex-ante analysis, scenario 1).

Input									Output	
							Without speed limiter		With speed limiter	
Profile Nr.	Reference Nr.	Scenario	Road type	Vehicle type	Posted speed limit	Speed limiter speed	Average speed	STD on speed	Average speed	STD on speed
					km/h	km/h	km/h	km/h	km/h	km/h
17	17	HCV1	motorway	N2/N3	80	90	85	6	85	6
18	18	HCV1	motorway	N2/N3	90	90	90	6	88	5
19	19	HCV1	motorway	M2/M3	90	100	95	6	95	6
20	20	HCV1	motorway	M2/M3	100	100	100	6	98	5
21	17	HCV1	motorway	N2/N3	80	80	85	6	79	4
22	18	HCV1	motorway	N2/N3	90	80	90	6	80	3
23	19	HCV1	motorway	M2/M3	90	90	95	6	89	4
24	20	HCV1	motorway	M2/M3	100	90	100	6	90	3

Table A- 11: characteristics of analysed speed profiles for HGVs and buses on rural roads (ex-ante analysis, scenario 1).

Input									Output	
							Without speed limiter		With speed limiter	
Profile Nr.	Reference Nr.	Scenario	Road type	Vehicle type	Posted speed limit	Speed limiter speed	Average speed	STD on speed	Average speed	STD on speed
					km/h	km/h	km/h	km/h	km/h	km/h
25	25	HCV1	rural road	N2/N3	80	90	70	10	70	10
26	26	HCV1	rural road	N2/N3	90	90	80	10	80	10
27	27	HCV1	rural road	M2/M3	80	100	70	10	70	10
28	28	HCV1	rural road	M2/M3	90	100	80	10	80	10
29	25	HCV1	rural road	N2/N3	80	80	70	10	70	10
30	26	HCV1	rural road	N2/N3	90	80	80	10	76	7
31	27	HCV1	rural road	M2/M3	80	90	70	10	70	10
32	28	HCV1	rural road	M2/M3	90	90	80	10	80	10

Table A- 12: characteristics of analysed speed profiles for HGVs and buses on motorways and rural roads (ex-ante analysis, scenario 2).

Input									Output	
							Without speed limiter		With speed limiter	
Profile Nr.	Reference Nr.	Scenario	Road type	Vehicle type	Posted speed limit	Speed limiter speed	Average speed	STD on speed	Average speed	STD on speed
					km/h	km/h	km/h	km/h	km/h	km/h
33	33	HCV2	motorway	N2/N3	80	90	85	6	85	6
34	34	HCV2	motorway	N2/N3	90	90	90	6	88	5
35	33	HCV2	motorway	N2/N3	80	100	85	6	85	6
36	34	HCV2	motorway	N2/N3	90	100	90	6	90	6
37	37	HCV2	rural road	N2/N3	80	90	70	10	70	10
38	38	HCV2	rural road	N2/N3	90	90	80	10	80	10
39	37	HCV2	rural road	N2/N3	80	100	70	10	70	10
40	38	HCV2	rural road	N2/N3	90	100	80	10	80	10

Table A- 13: characteristics of analysed speed profiles for LCVs on motorways and rural roads (ex-ante analysis, scenario 1).

Input									Output	
							Without speed limiter		With speed limiter	
Profile Nr.	Reference Nr.	Scenario	Road type	Vehicle type	Posted speed limit	Speed limiter speed	Average speed	STD on speed	Average speed	STD on speed
					km/h	km/h	km/h	km/h	km/h	km/h
41	41	LCV1	motorway	N1	115	0	107.5	16	107.5	16
42	42	LCV1	motorway	N1	130	0	115	16	115	16
43	41	LCV1	motorway	N1	115	110	107.5	16	103	13
44	42	LCV1	motorway	N1	130	110	115	16	105	11
45	45	LCV1	rural road	N1	90	0	80	14	80	14
46	46	LCV1	rural road	N1	100	0	90	14	90	14
47	45	LCV1	rural road	N1	90	110	80	14	80	14
48	46	LCV1	rural road	N1	100	110	90	14	90	14

Table A- 14: characteristics of analysed speed profiles for LCVs on motorways and rural roads (ex-ante analysis, scenario 2).

Input									Output	
							Without speed limiter		With speed limiter	
Profile Nr.	Reference Nr.	Scenario	Road type	Vehicle type	Posted speed limit	Speed limiter speed	Average speed	STD on speed	Average speed	STD on speed
					km/h	km/h	km/h	km/h	km/h	km/h
49	49	LCV2	motorway	N1	115	0	107.5	16	107.5	16
50	50	LCV2	motorway	N1	130	0	115	16	115	16
51	49	LCV2	motorway	N1	115	100	107.5	16	96	10
52	50	LCV2	motorway	N1	130	100	115	16	98	8
53	53	LCV2	rural road	N1	90	0	80	14	80	14
54	54	LCV2	rural road	N1	100	0	90	14	90	14
55	53	LCV2	rural road	N1	90	100	80	14	80	14
56	54	LCV2	rural road	N1	100	100	90	14	90	14

Ex-post analysis

Central scenario

Figure A - 5: Profile number 1

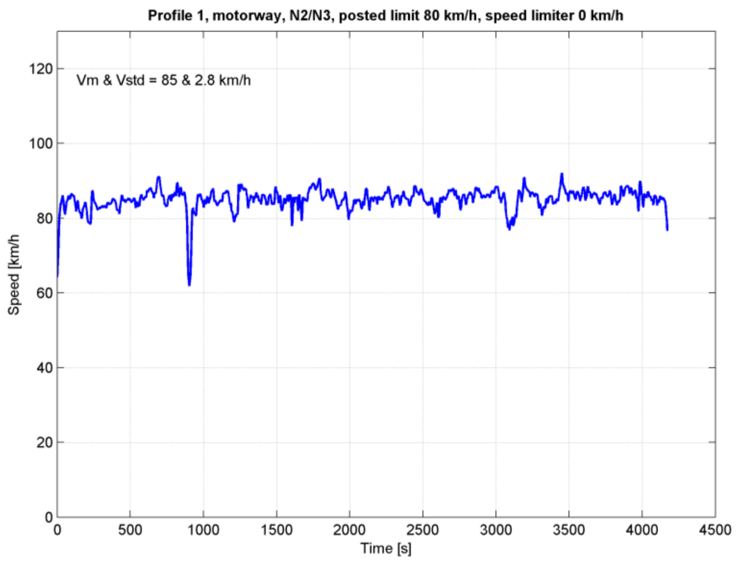


Figure A - 6: Profile number 2

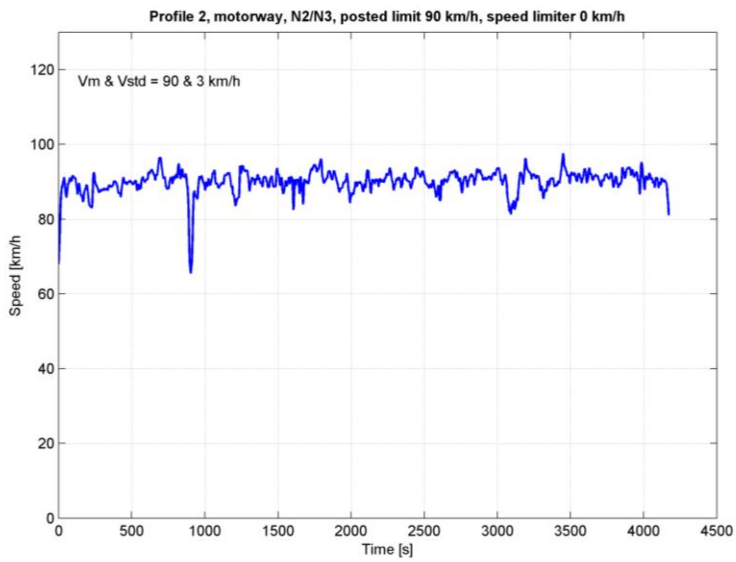


Figure A - 7: Profile number 3

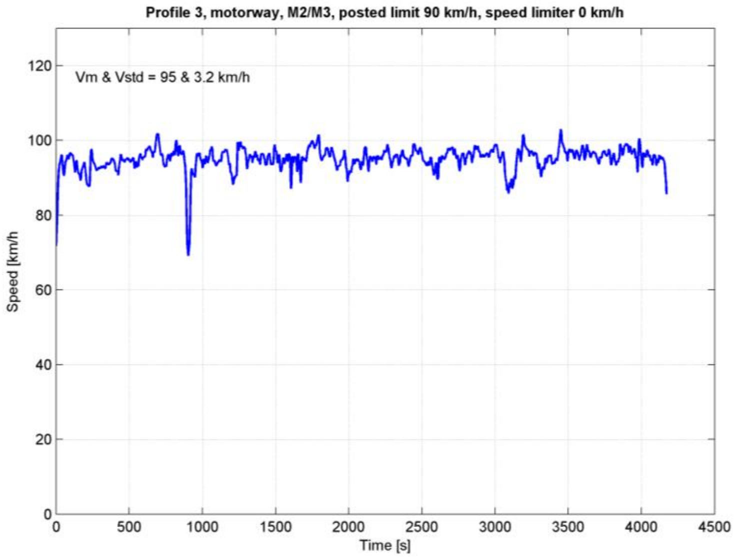


Figure A - 8: Profile number 4

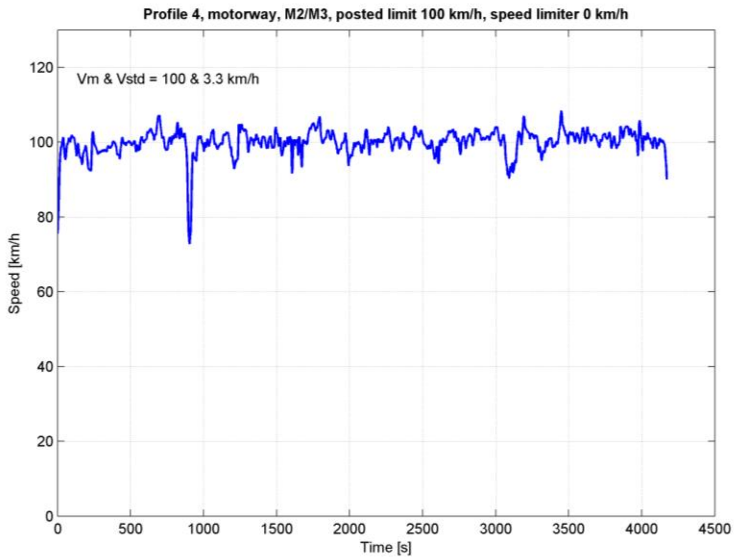


Figure A - 9: Profile number 5

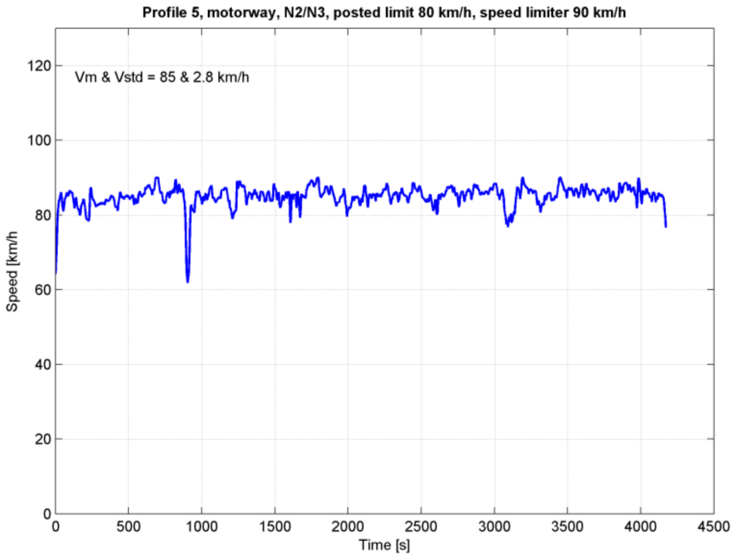


Figure A - 10: Profile number 6

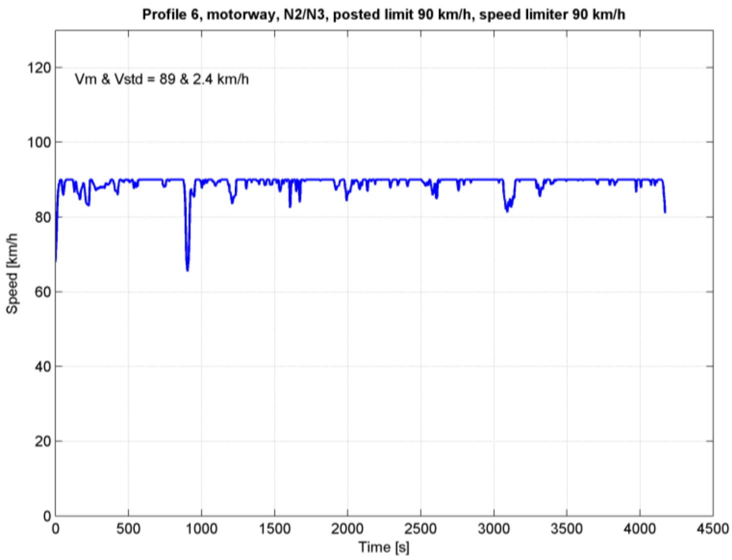


Figure A - 11: Profile number 7

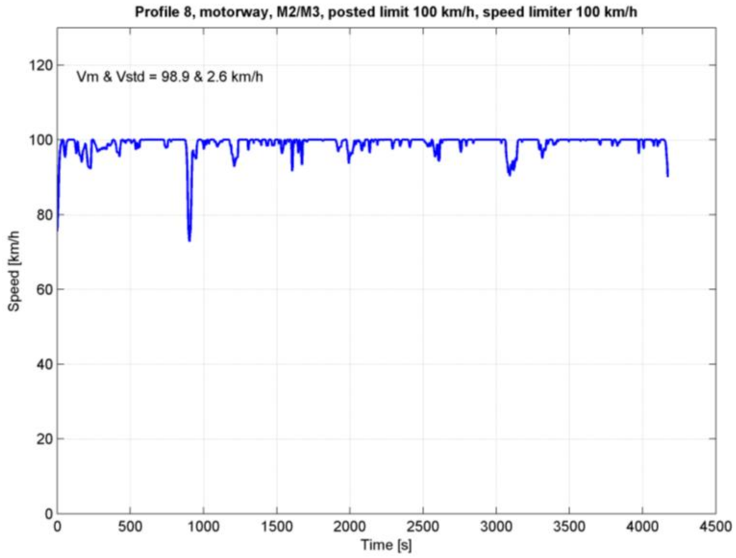
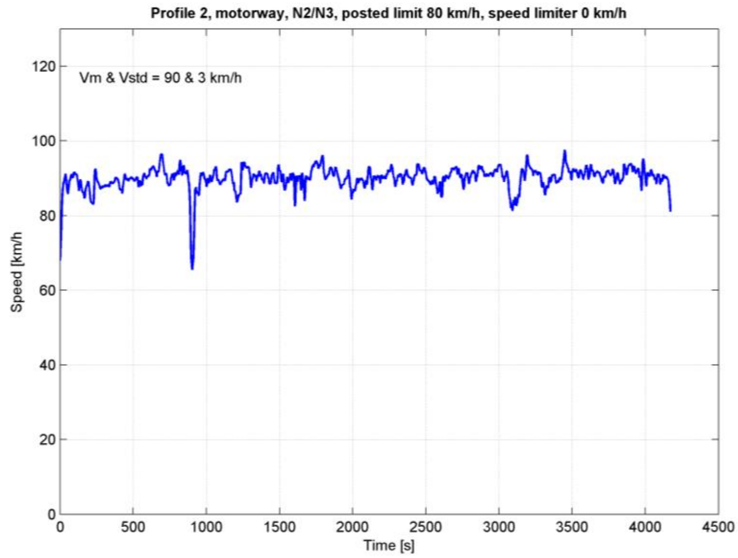


Figure A - 12: Profile number 8



Sensitivity analysis

Figure A - 13: Profile number 9

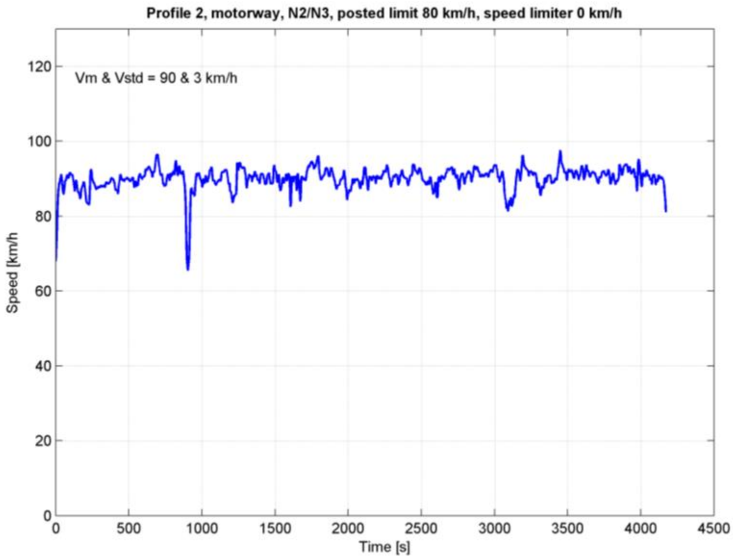


Figure A - 14: Profile number 10

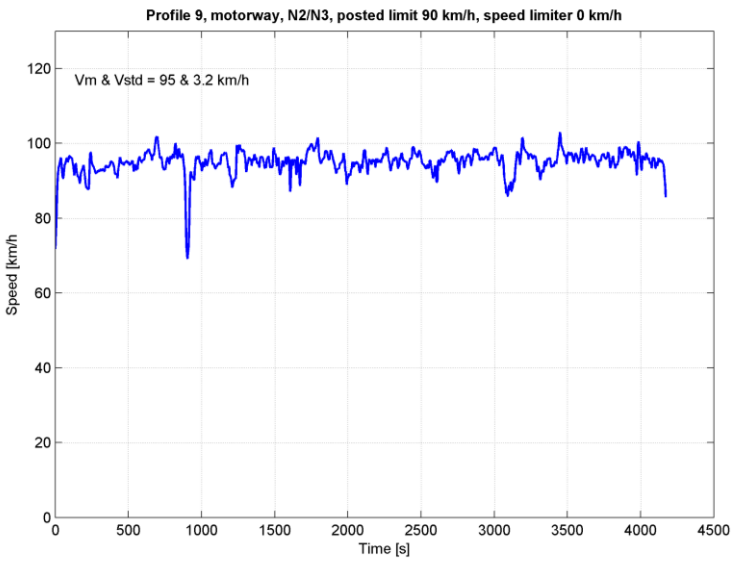


Figure A - 15: Profile number 11

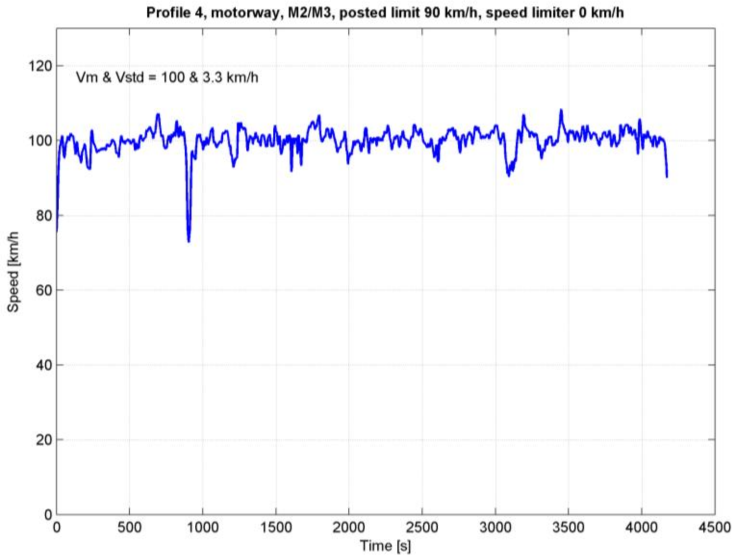


Figure A - 16: Profile number 12

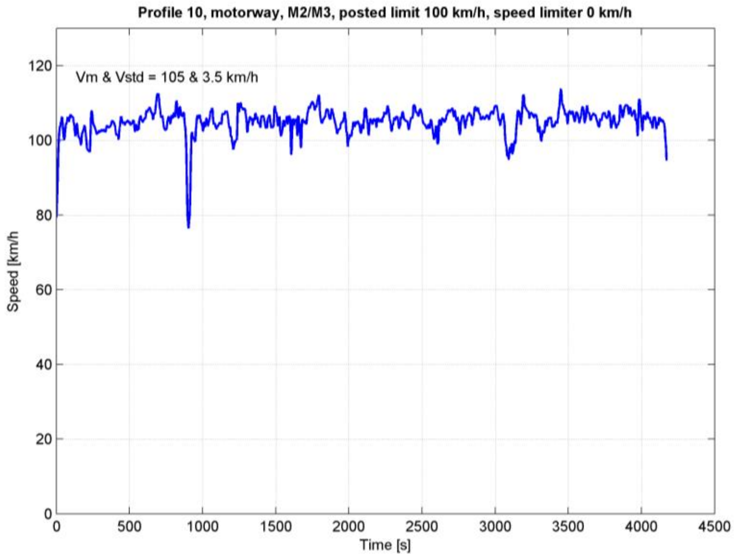


Figure A - 17: Profile number 13

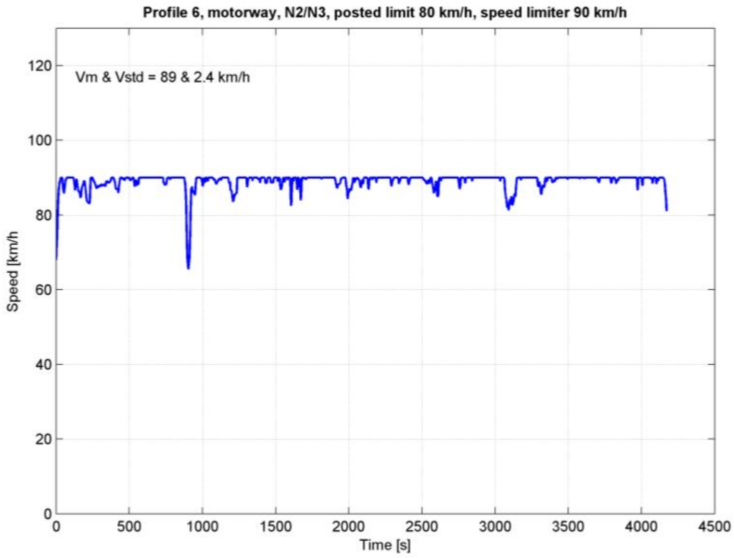


Figure A - 18: Profile number 14

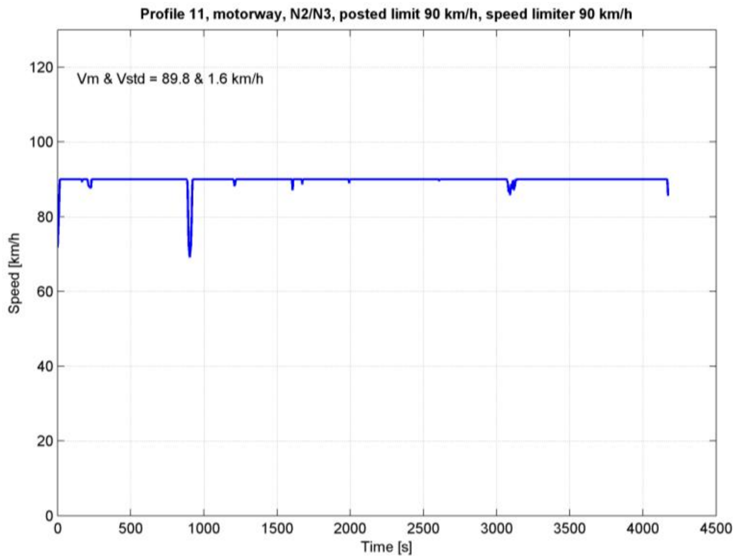


Figure A - 19: : Profile number 15

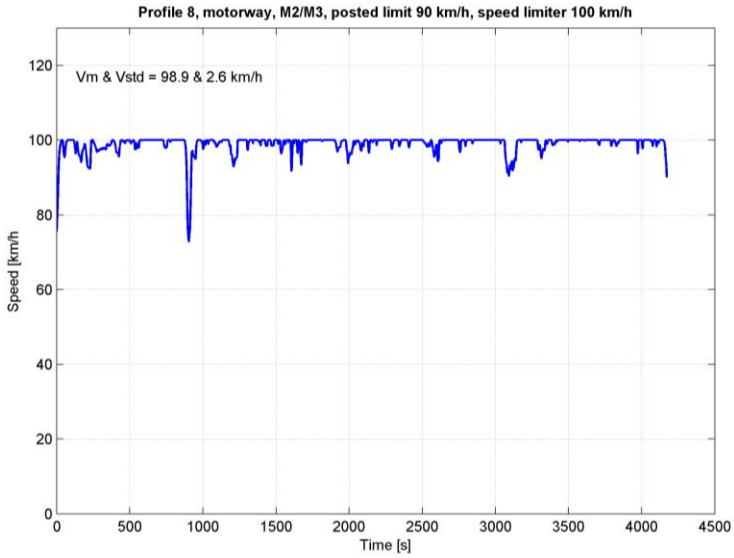
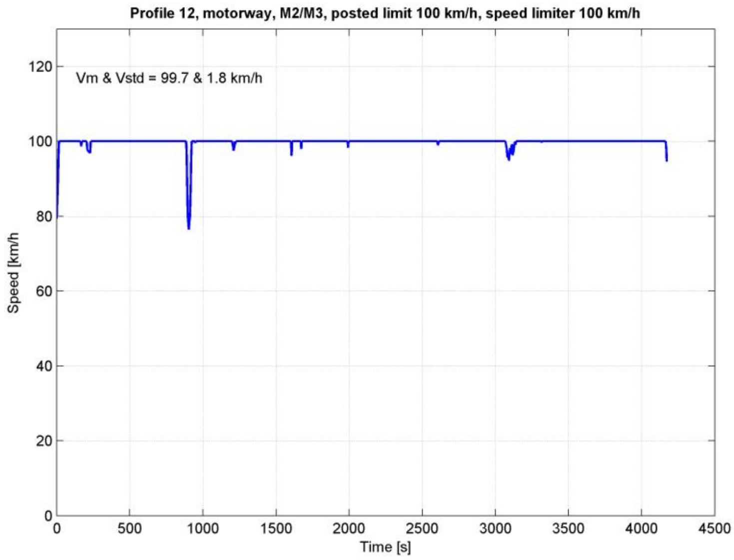


Figure A - 20: Profile number 16



Ex-ante analysis (HCVs)

Scenario 1

Motorway

Figure A - 21: Profile number 17

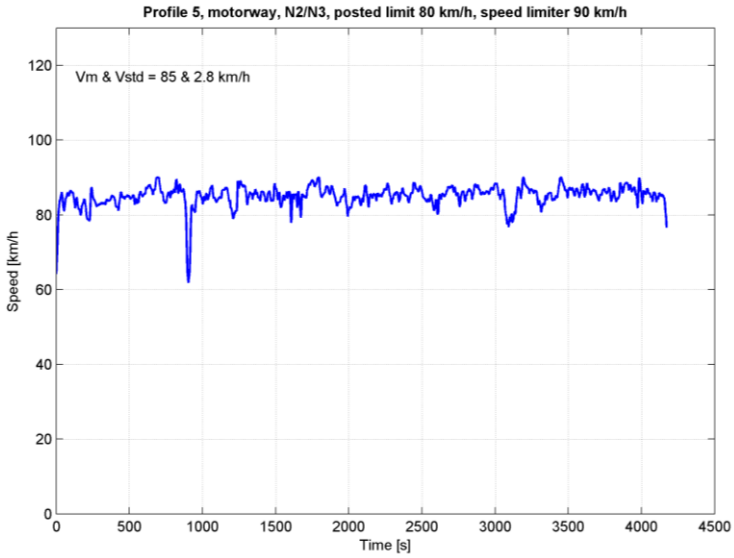


Figure A - 22: Profile number 18

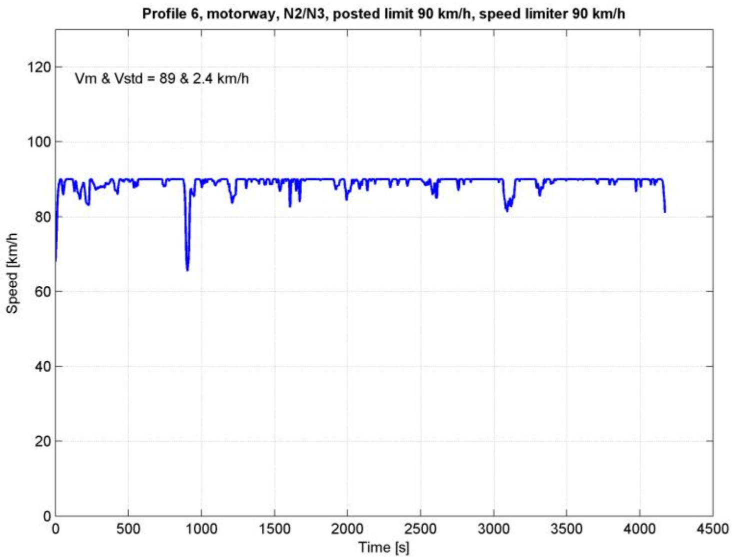


Figure A - 23: Profile number 19

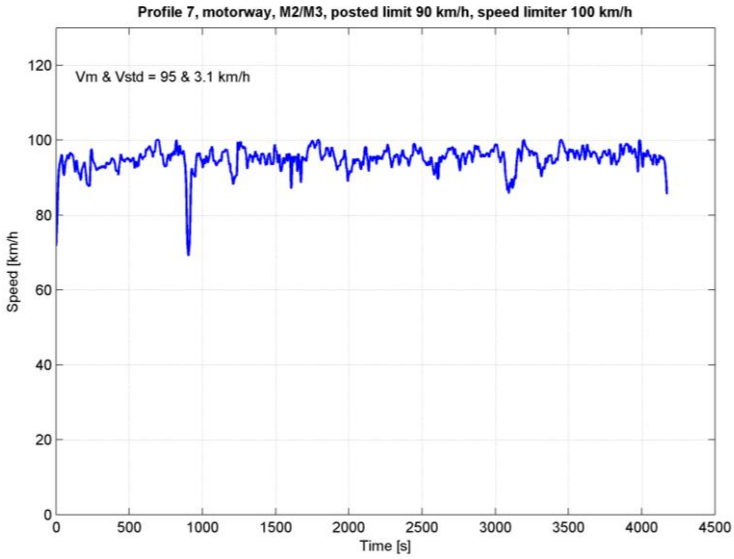


Figure A - 24: Profile number 20

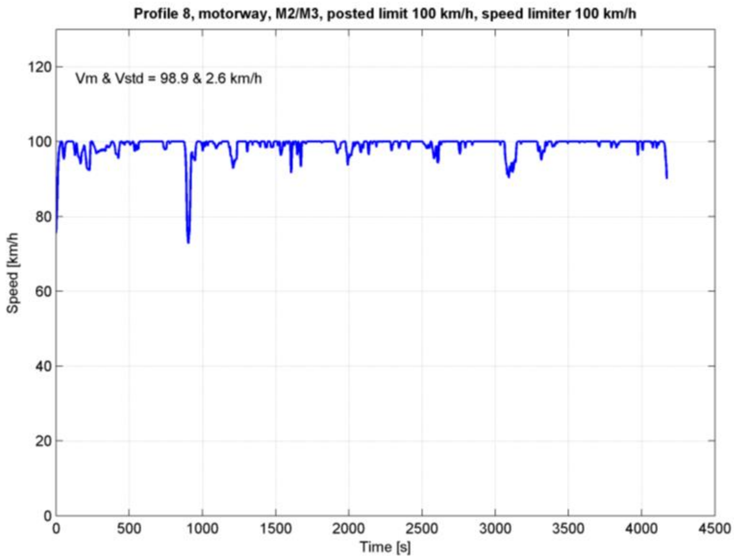


Figure A - 25: Profile number 21

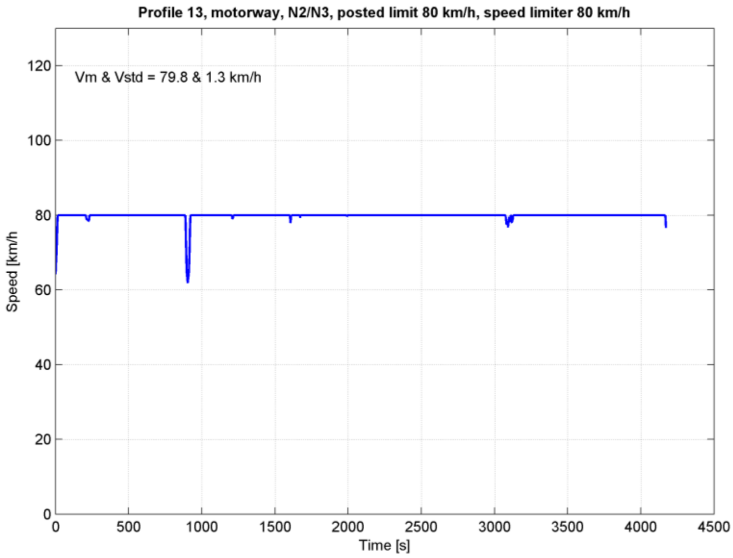


Figure A - 26: Profile number 22

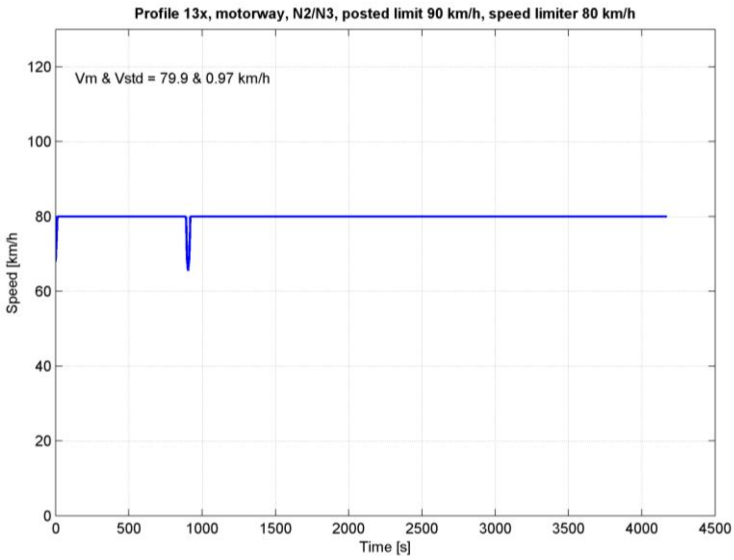


Figure A - 27: Profile number 23

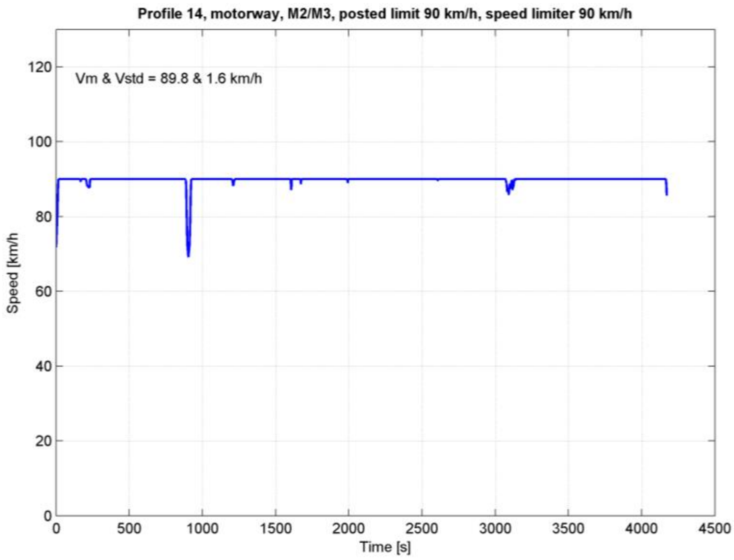
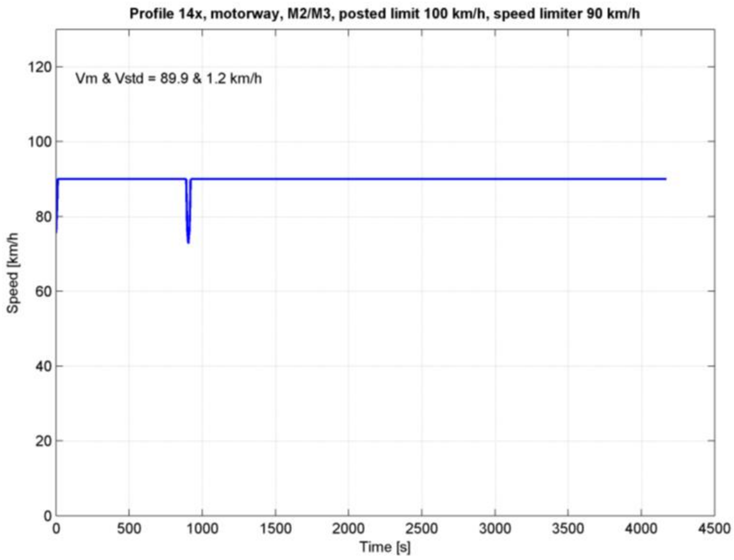


Figure A - 28: Profile number 24



Rural road

Figure A - 29: Profile number 25

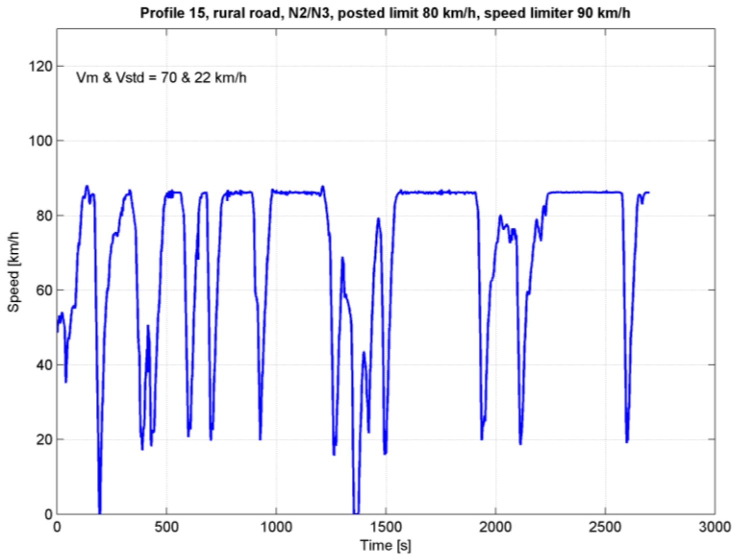


Figure A - 30: Profile number 26

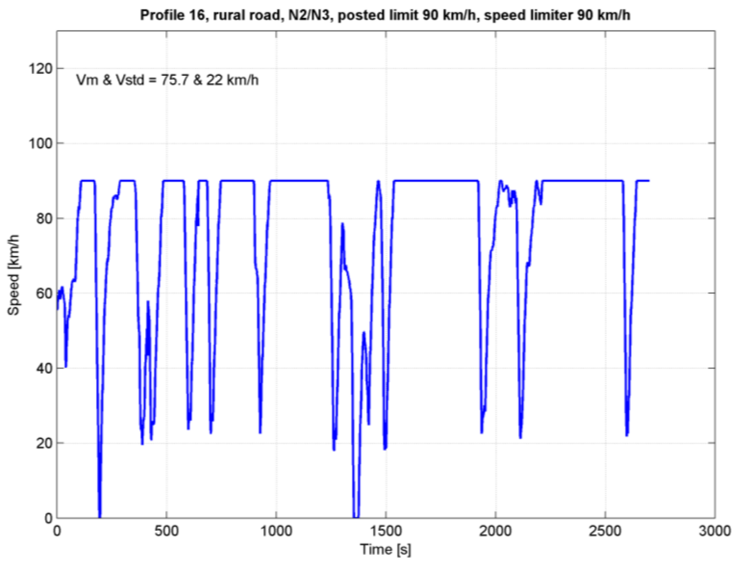


Figure A - 31: Profile number 27

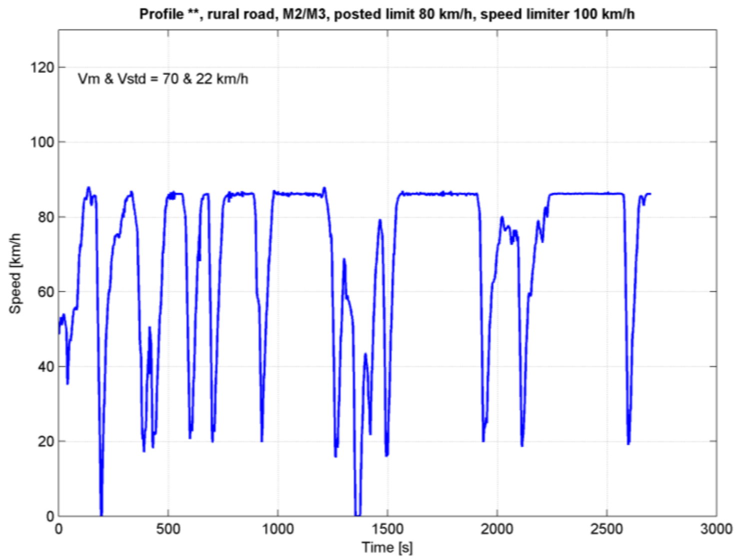


Figure A - 32: Profile number 28

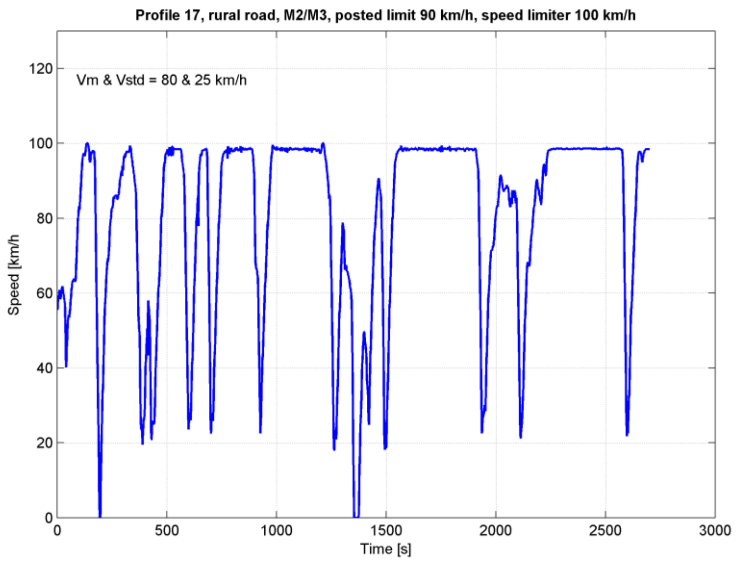


Figure A - 33: Profile number 29

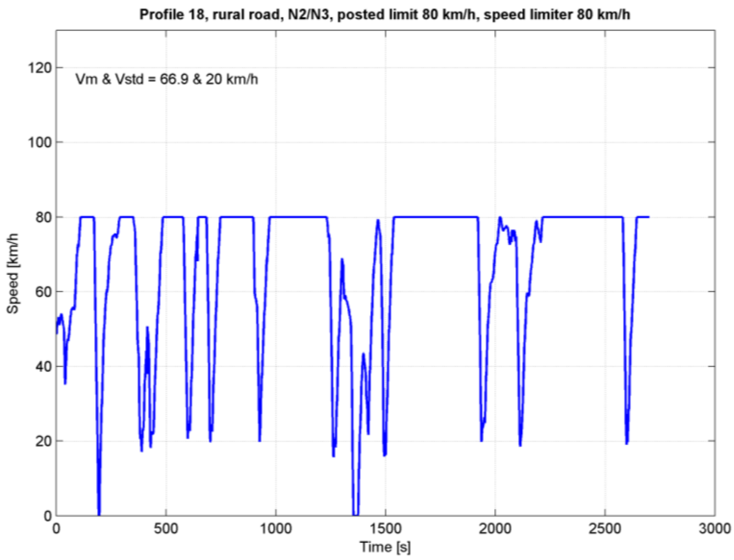


Figure A - 34: Profile number 30

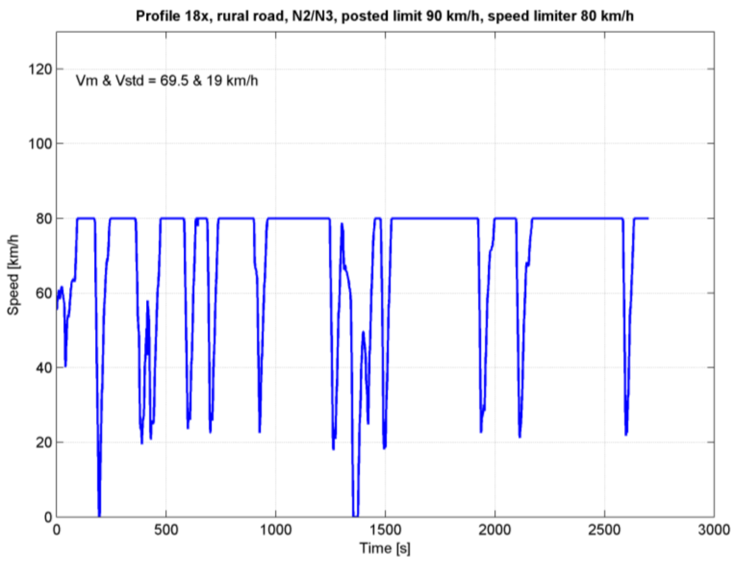


Figure A - 35: Profile number 31

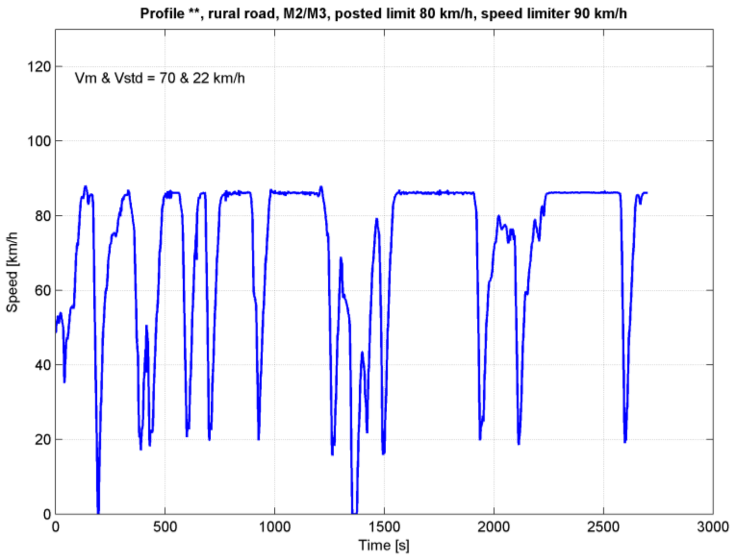
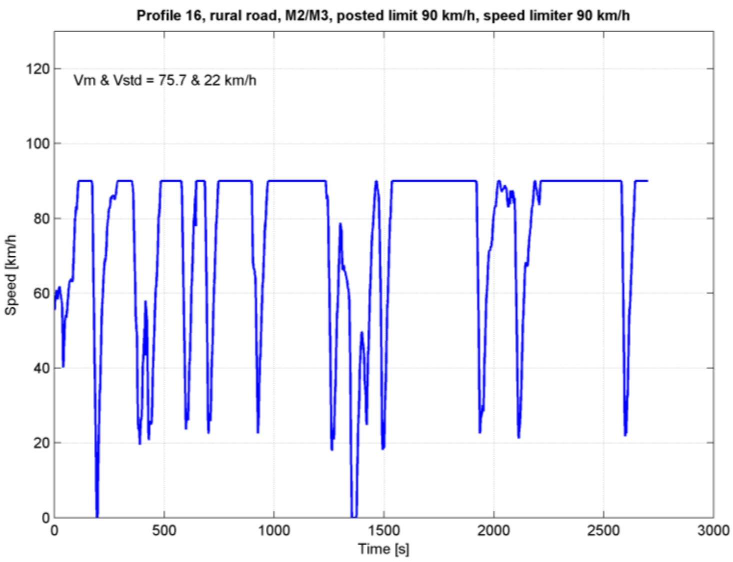


Figure A - 36: Profile number 32



Scenario 2

Motorway

Figure A - 37: : Profile number 33

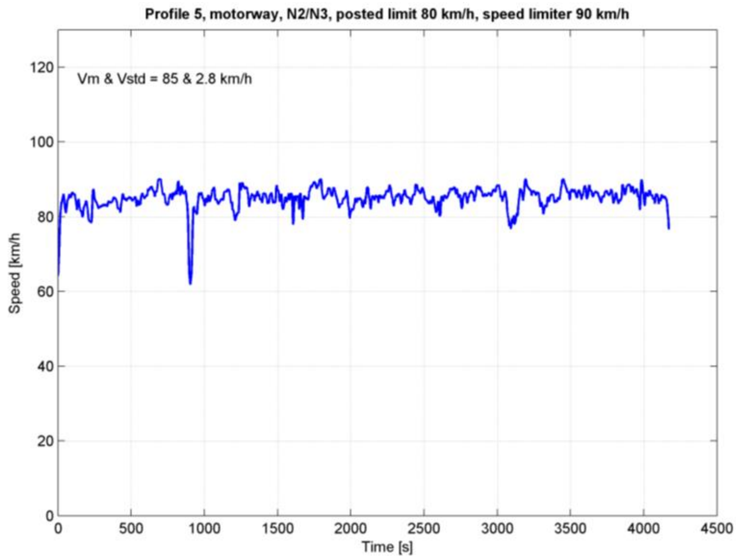


Figure A - 38: Profile number 34

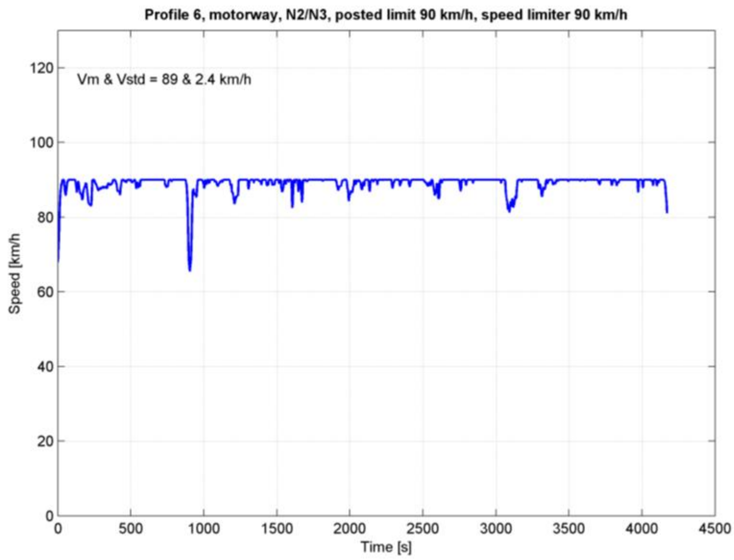


Figure A - 39: : Profile number 35

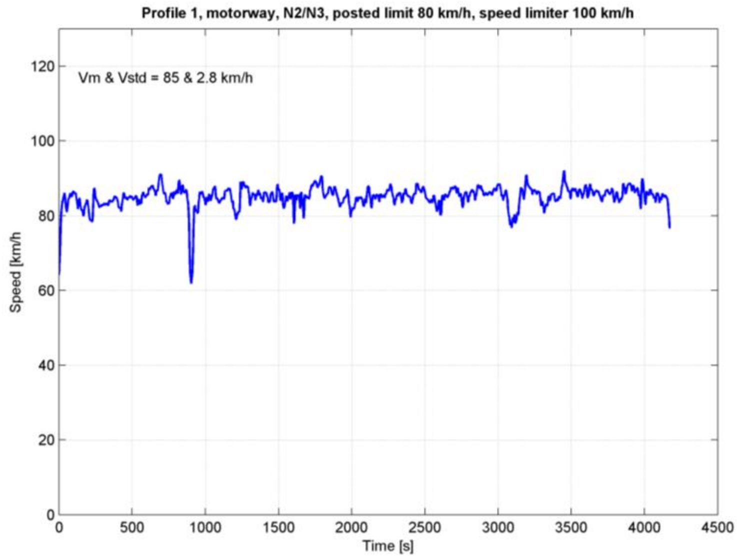
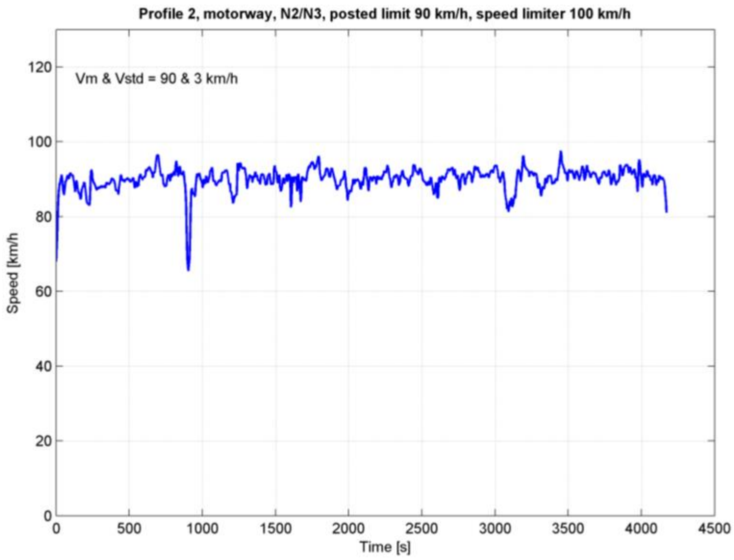


Figure A - 40: Profile number 36



Rural road

Figure A - 41: Profile number 37

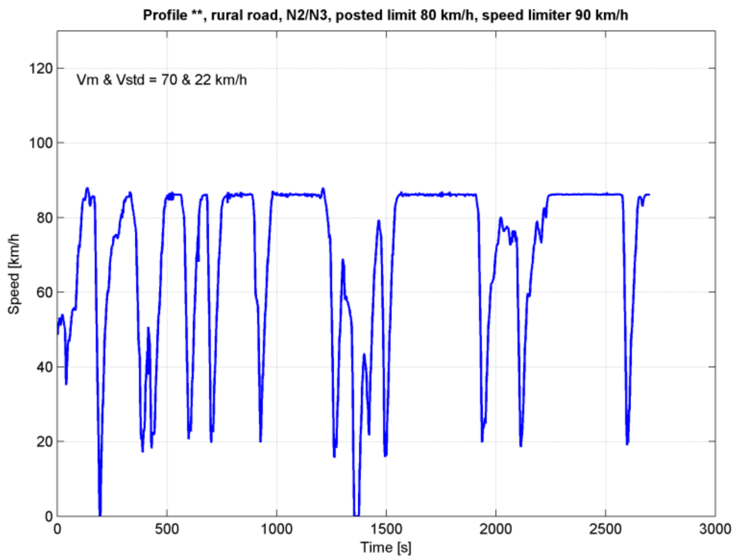


Figure A - 42: : Profile number 38

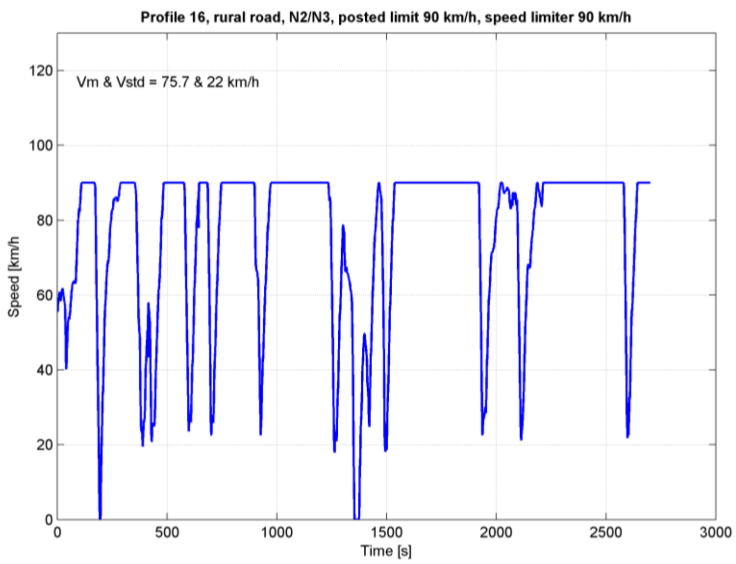


Figure A - 43: Profile number 39

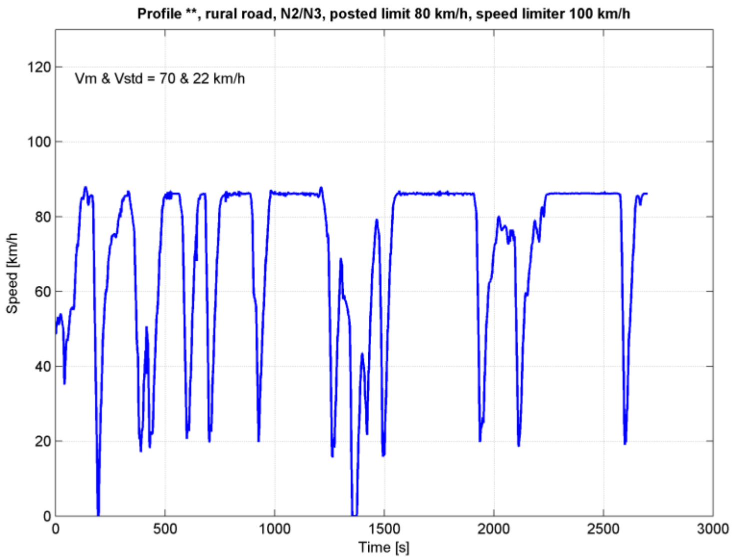
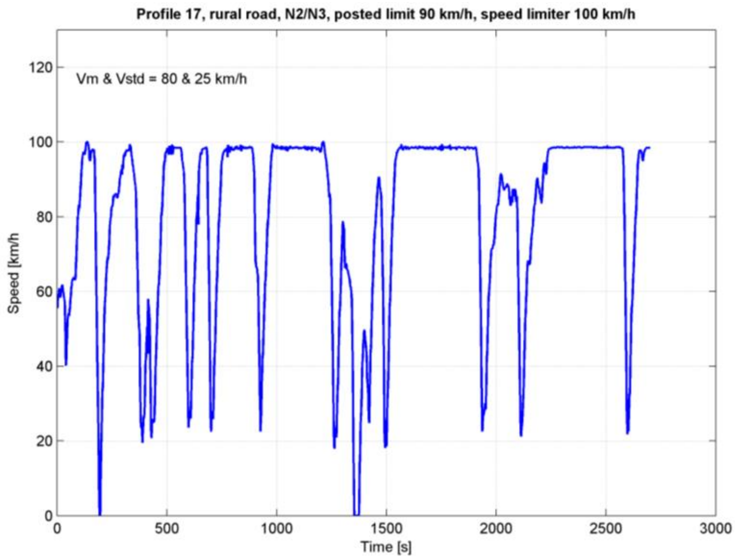


Figure A - 44: : Profile number 40



Ex-ante analysis (LCVs)

Scenario 1

Motorway

Figure A - 45: : Profile number 41

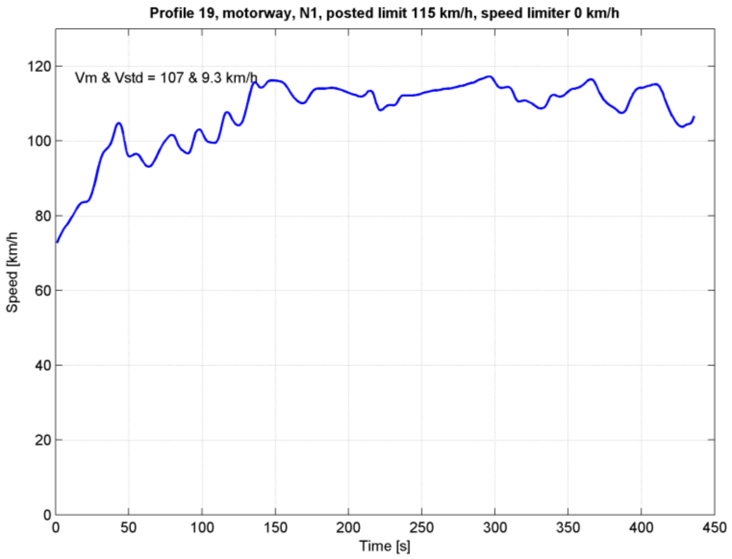


Figure A - 46: Profile number 42

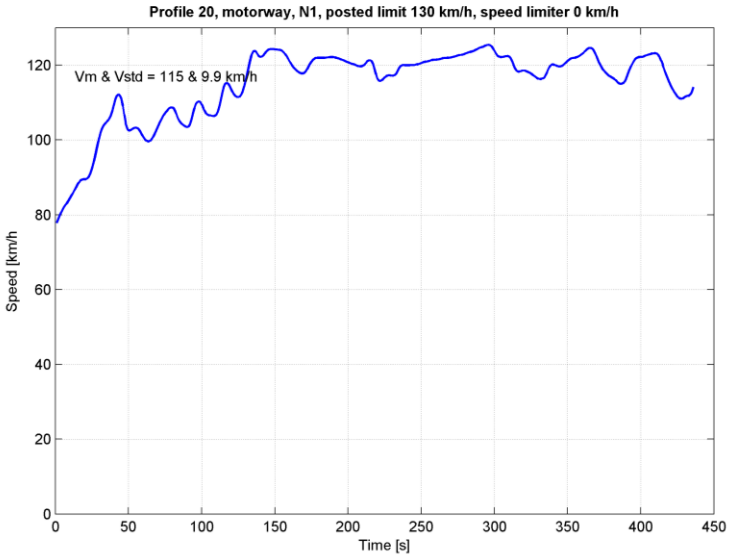


Figure A - 47: Profile number 43

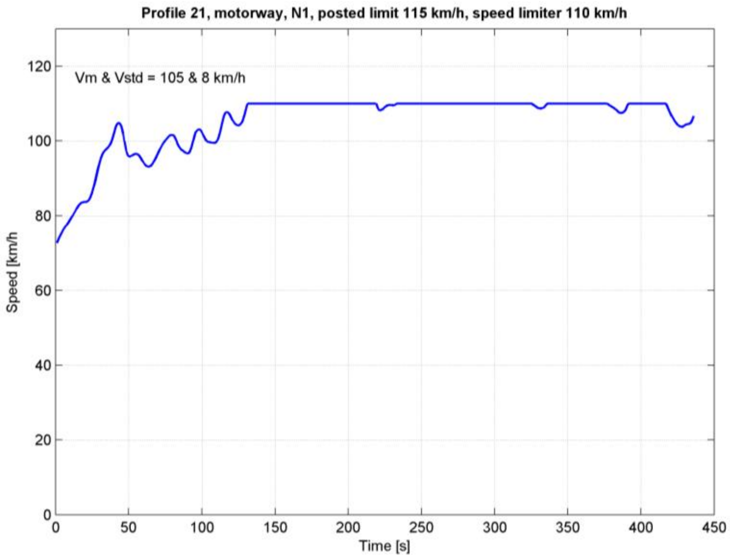
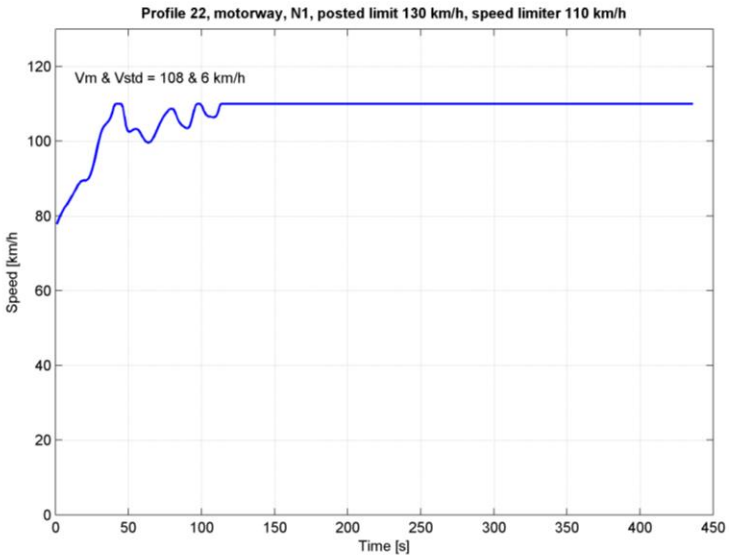


Figure A - 48: Profile number 44



Rural road

Figure A - 49: Profile number 45

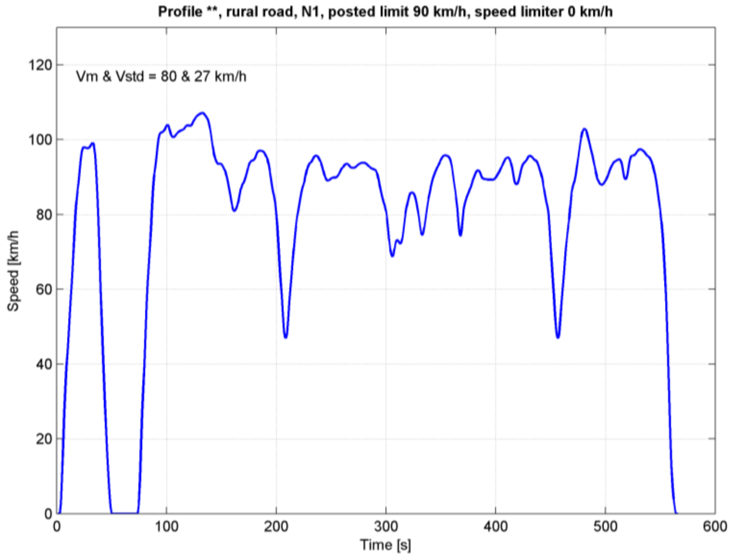


Figure A - 50: Profile number 46

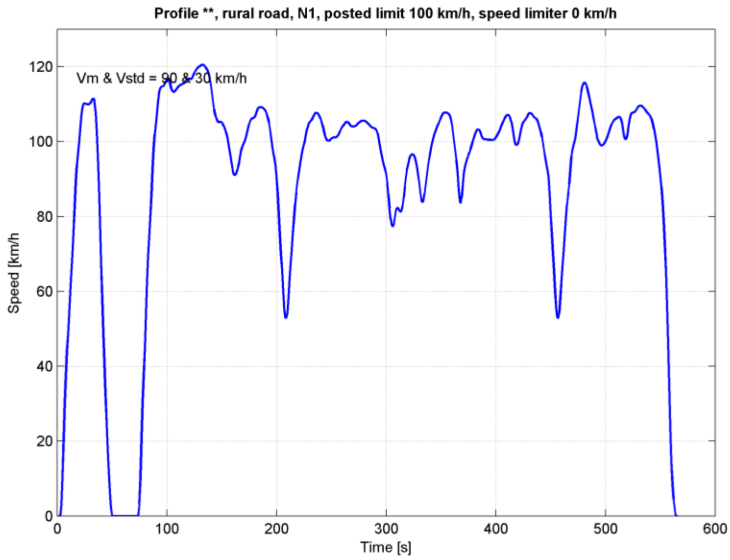


Figure A - 51: Profile number 47

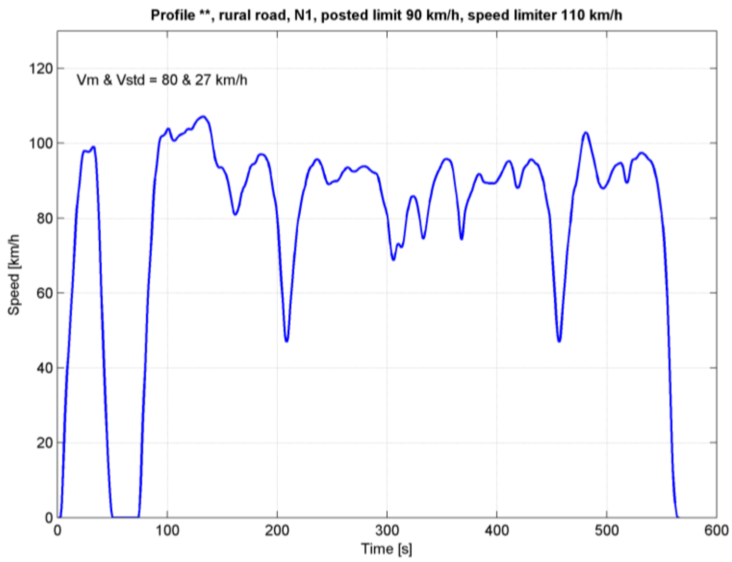
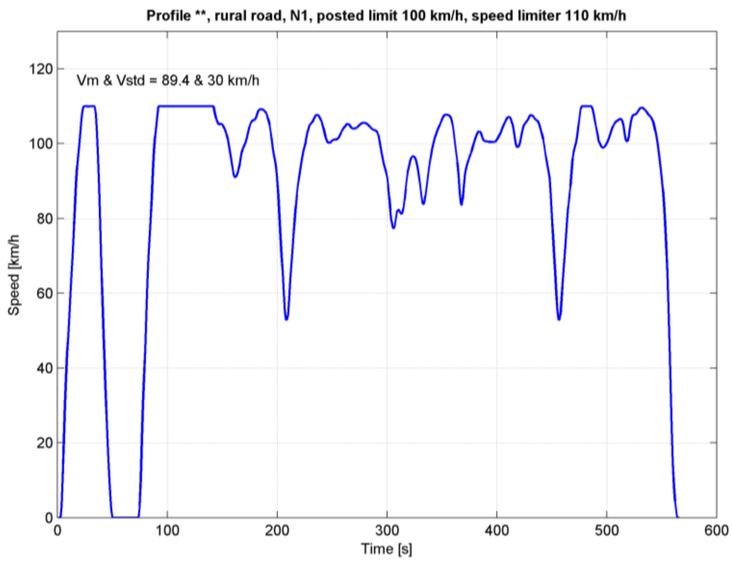


Figure A - 52: Profile number 48



Scenario 2

Motorway

Figure A - 53: Profile number 49

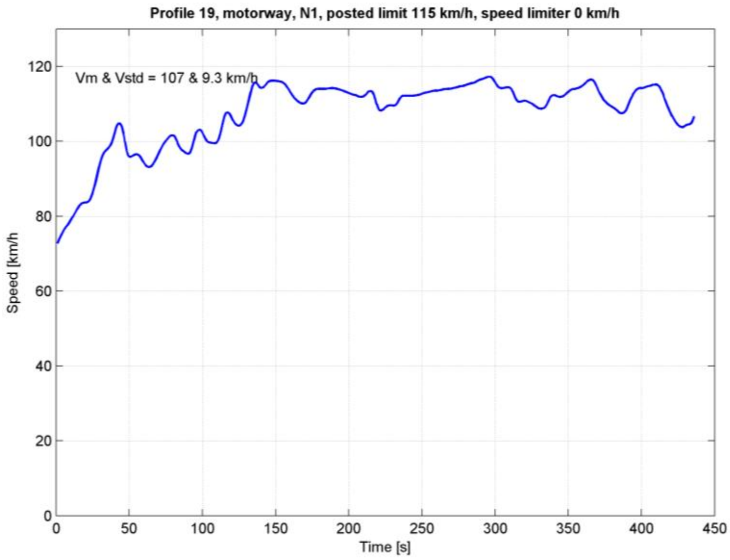


Figure A - 54: Profile number 50

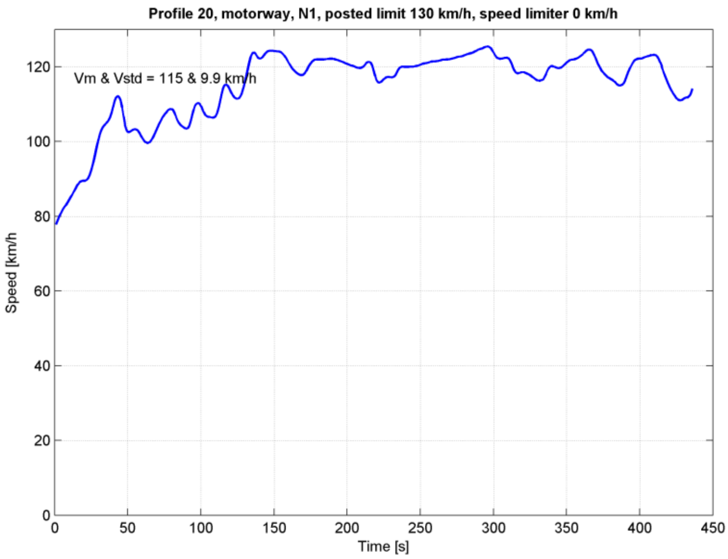


Figure A - 55: Profile number 51

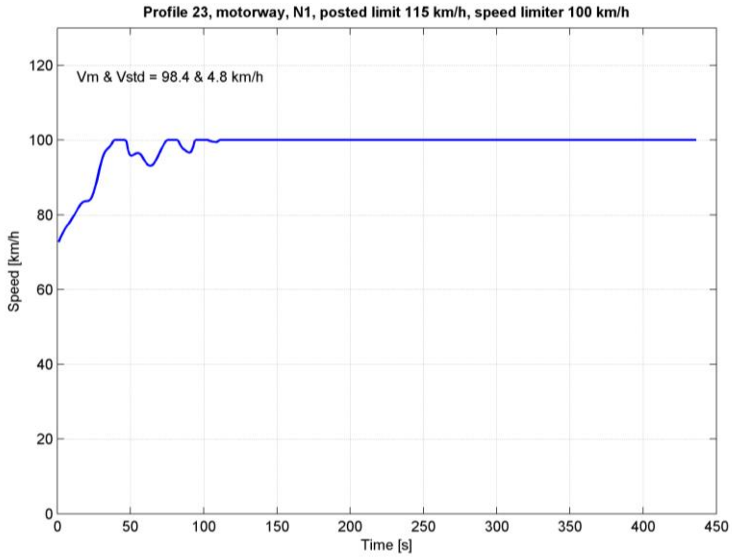
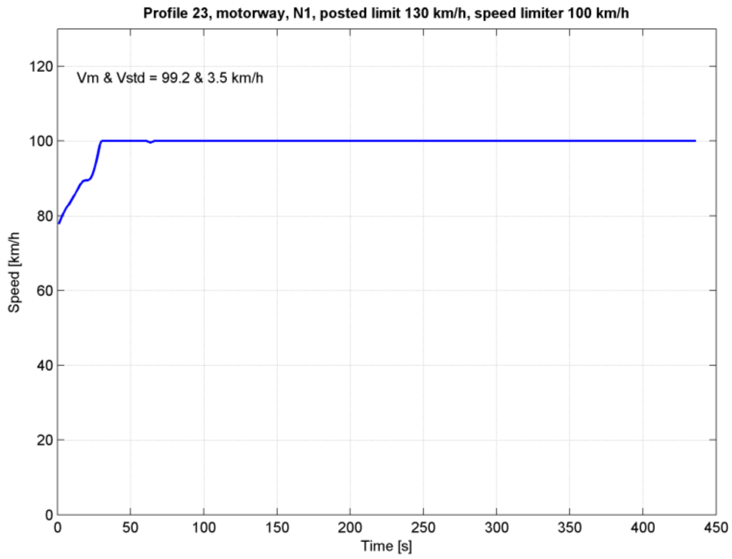


Figure A - 56: Profile number 52



Rural road

Figure A - 57: Profile number 53

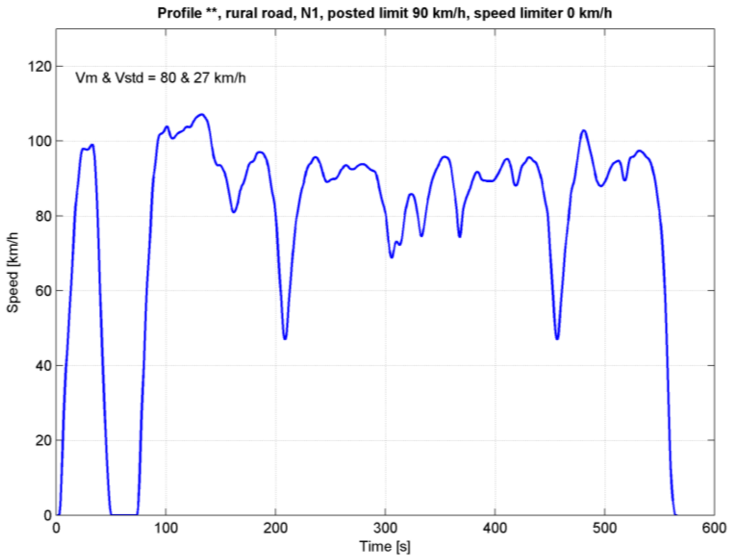


Figure A - 58: Profile number 54

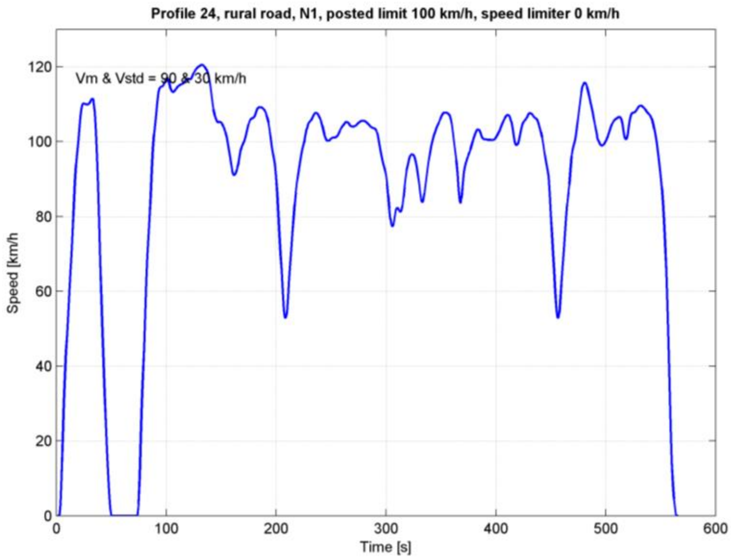


Figure A - 59: Profile number 55

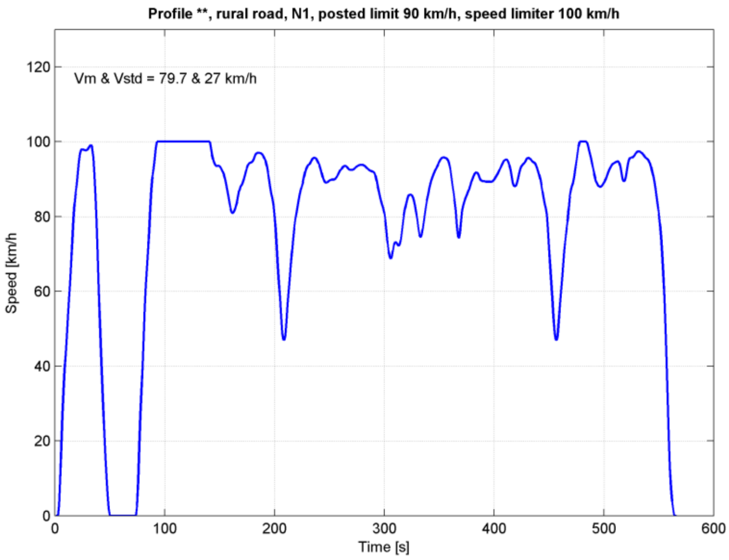
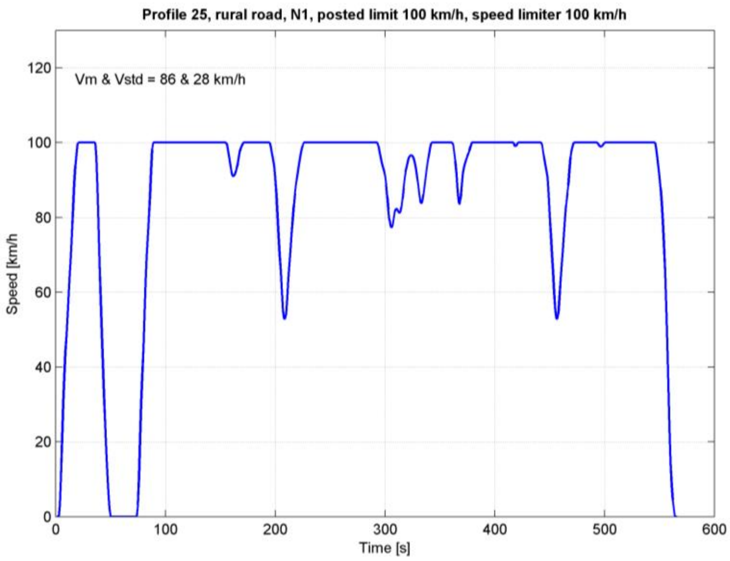


Figure A - 60: Profile number 56



ANNEX 14: Classification speed limits per country

	Rural		Motorway		Rural	Motorway
country	HGVs	Busses	HGVs	Busses	LCVs	LCVs
BE	high	no effect	high	low	low	low
BG	low	low	high	high	low	high
CZ	low	high	low	high	low	high
DK	no effect	low	low	no effect	no effect	high
DE	low	low	low	high	high	high
EE	high	high	high	low	low	no effect
IE	low	low	high	high	high	low
GR	low	low	low	high	low	high
ES	low	high	low	low	high	low
FR	low	high	high	high	low	high
IT	low	low	high	high	low	high
CY	no effect	low	low	high	no effect	low
LV	low	high	high	high	low	low
LT	low	low	high	high	low	high
LU	high	no effect	high	low	low	high
HU	no effect	no effect	low	no effect	low	high
MT	no effect	no effect	no effect	no effect	no effect	no effect
NL	low	low	low	high	no effect	high
AT	no effect	low	low	high	high	high
PL	no effect	no effect	low	high	low	high
PT	low	low	high	high	low	low
RO	high	high	high	high	high	high
SI	high	high	high	high	low	high
SK	high	high	high	high	low	high
FI	low	low	low	high	no effect	low
SE	no effect	no effect	high	low	no effect	low
UK	low	high	high	high	high	low

For the analysis of emission impacts 'high' and 'low' in the table above means that the impacts for 'high' or 'low' has been applied to that Member State, as shown in Table 2-13. In the cases that 'no effect' is indicated, the speed limit in a Member State is so low that the impacts on speeds and emission can assumed to be a negligible.

ANNEX 15: Emission models used

VERSIT+ model

The VERSIT+ model of TNO will be used to calculate the emissions for specific speed profiles. The VERSIT+ modal has been developed to estimate the emissions of specific driving patters and has been built upon a large amount of data from real world driving patterns.

Road traffic emission models serve a variety of purposes. They may be used in for instance emission inventory studies, to determine the total, annual and national emissions of all vehicles, and relate these numbers to the average emission of a fleet-average vehicle in a generic category, like a passenger car or a heavy-duty HGV. Another purpose is to test the compliance with emission regulations. Beyond this compliance lies a further goal to make the regulations fitting for the problems they are meant to solve.

A completely different purpose of emission models is to assist the development of new technology, by precise knowledge of the circumstances of the vehicle and the engine at which the unwanted emissions may occur. These emission models are meant to supply a direct, experimental link between vehicle operation and emissions.

Another application is the direct link between emissions and local air quality. In many urban areas where the air pollution exceeds the limit, there is a substantial traffic-related contribution. Therefore, the wish to monitor and to take effective measures has grown. The emission models are one part of the missing link between road traffic and the deterioration of air quality. The other part is the dispersion model; how the exhaust gases spread in the air.

The VERSIT+ emission model has been the Dutch road traffic emission model for many years for mainly the first goals: the average emissions in a variety of circumstances, for present and future fleet decomposition. The effects of planned government policies lead to changes in fleet composition, fleet usage and age, with corresponding effect in the gross emissions. These emission factors form part of the basis of the environment reports submitted by the local governments. A simple dispersion model links the daily traffic intensities with air-quality, which is for instance done in the Dutch CAR model.

The results produced by these models, are largely based on averages and they produce as many questions as answers if used to estimate the effect of traffic related measures. Many variations in the traffic situations, local road planning, or fleet composition will not be visible in these results.

Emission models

VERSIT+ is a statistical emission model able to calculate real-world HC, CO, NO_x, NO_2, PM10 and CO_2 emissions of road vehicles. It is best seen as an analysis tool of a large set of emission measurements of the Dutch fleet, mainly performed in the in-use compliance program. Over 20.000 measurements with warm and cold engines on over 3.200 different vehicles have been performed in a period over twenty years. The vehicles were randomly selected from the commonly sold models and were requested from their owners, to participate in the testing program. The average maintenance state of the vehicles should therefore correspond to the Dutch situation. Furthermore, new technology has always been included in the VERSIT+ model to be able to estimate their effects of their mass introduction.

The emission results themselves are already representative of the Dutch situation, since besides type approval tests like the NEDC and the FTP, in most cases real world driving cycles, like the CADC, OSCAR en Dutch F&E cycles, are used to characterize the driving behavior for which the emissions are determined. Every vehicle is tested typically on five different tests, but some on many more, as in the cases of durability testing.

To develop an emission model for a given driving behavior and vehicle type from the large set of vehicles, driving cycles and emission measurements a detailed statistical analysis is used. Two main ingredients are the distinction of relevant vehicle categories, with similar emission characteristics, and the characterization of driving behavior in relevant parameters on which the emission actually depend.

The vehicle categories are generally straightforwardly based on fuel, emission standard, injection technology, after-treatment technology, and transmission. The disadvantage of making such a detailed distinction is insufficient data in some of the categories, while on the other hand automatic transmission and older injection technology will strongly affect certain emissions, of these cars.

The characterization of driving behavior has evolved continuously. The average velocity was one of the first parameters to be used. Once it became clear that this was insufficient for an accurate emission prediction, a power variable, like average acceleration was added. More and more parameters, like trip fraction of idling, were added, and eventually there was a list of over fifty parameters for each trip, from which the relevant ones were selected, by checking for the dependencies. For every vehicle category and emission component this process was repeated. Therefore, generating the emission model VERSIT+ had become a cumbersome process.

Trip parameters versus instantaneous parameters

The trip parameters are only valid for a trip, which consist of at least several hundred meters of driving, from stop to stop. This is also closely tied to the measurement data, which yields a total emission in grams per test, for a particular driving cycle or trip. The actual time-dependence of the emissions, as the result of driving at that moment, or a few seconds before, has become available only in the last ten years with modal mass, or time-dependent, measurements. The quality of such data in the laboratory has increased in the last years. Hence it is possible to construct a second-by-second model from the data.

Velocity and acceleration dependence

A great part of VERSIT+ is to translate the bag results into velocity acceleration dependent results. The aggregated data per trip makes a full conversion impossible, and from velocities and accelerations combinations have be sought, to construct a robust emission model. Since for each vehicle category between fifteen and twenty five different drive cycles were used in the testing, the emission model can never have more than these fifteen to twenty five degrees of freedom.

Therefore, it is important to choose the degrees of freedom in the emission model appropriately. In a sense, instead of relying on a long list of variables, or models, to find the most appropriate ones, the basic model is selected in advance. Two criteria were used to select the model variables: First, the variables have to be independent to avoid the use of two variables which describe the same effect. Second, the variables have to be relevant to evenly divide the variables such that their share in the total emission is of the same magnitude.

Handling large variations in measurements

Especially for CO and HC emissions only a small fraction of the vehicles, in a small fraction of the traffic situations, produce the majority of the emissions. Only for CO2, and in lesser extent for PM10 in certain older diesel vehicle technologies, the variation is smaller than the average itself. In all other relevant emission components, the variation inside the same vehicle class is significant. Therefore, emission modeling for a fleet and a wide range of traffic situations requires statistical analysis. Only a few measurements on a few vehicles are insufficient produce a representative national emission model. Several dozens of vehicles are required to produce enough statistics to bring the model uncertainty down to an acceptable value, less than 10 % of the mean emissions.

Also, little less than half the emissions tests are type-approval tests such as the MVEG-A, MVEG-B, and FTP tests, which are less representative for real world driving. To ensure that these tests do not dominate the analysis, a weighted average of the type-approval tests and the real-world driving tests has been used during the model development. The weighting of type-approval test results is one fifth of the real-world test results.

History effects and modal mass data

The most important history effect is cold start. Most of the CO and HC emissions are produced just after the start. Also the CO2 emission is typically higher during the cold start. The retention of the cold start effects depend on the components, but in VERSIT+ the time-dependence is not taken into account, mainly because it is hard to determine the precise trip in average Dutch driving. It is simpler to assume that in the majority of the cases the engine is warm at the end of the trip, meaning that the full contribution of the cold start emissions were produced during the trip. Depending on the components this may be after less than hundred meters for HC and CO to four to five kilometers for CO2 emissions and emissions related to the higher fuel consumption.

Modal mass, or second-by-second, data can be treated in the similar manner in the VERSIT+ model as bag data. The prediction of the model depends on the ten parameters q0...q9, which are known for every second. In principle the measurement of every data point counts as a separate test. Some care must be taken, in this case unlike the bag data, to compensate for history effects. The emission may have a delay by some time with respect to the velocity and acceleration.

At TNO modal mass data has be measured intermittently from 1998, during the tests. Some of the older data exhibit misalignment: the CO2 signal does not coincide with the power demand as determined from velocity and acceleration, but is advanced or delayed with respect with the power demand. Likewise, all other signals are misaligned. Possibly, the delay may vary with exhaust gas velocity. Modal mass data must be analyzed both for history and misalignment effects.

Limitations of the VERSIT+ model

As all models VERSIT+ has some limitations, either due to the model data (as derived from measurements) or to the way the model is set up.

- The emission measurements for VERSIT+ are done on a sample of vehicles taken from the Dutch real-world fleet. This sample is for some vehicle categories small and may have insufficient data.
- The VERSIT+ model is primarily designed to model general average driving behavior, i.e. trip averages, for average vehicles belonging to certain vehicle categories. This implies that it is limited in the velocity dependent detail it can accurately model.

Not a direct limitation but rather a point not to forget in the European context is the following.

- The VERSIT+ database is based on measurements on a sample of vehicles taken from the Dutch vehicle fleet and not from the European vehicle fleet. Thus, for a certain vehicle category the VERSIT+ data will usually accurately model the average Dutch vehicle for that category. This need not be the case for the average European vehicle for that category. This can be overcome by using an adapted weighting over the measured vehicles within each category, which compensates for differences between the Dutch and European fleets.

TREMOVE model

TREMOVE (www.tremove.org) is a transport and emissions simulation model developed for the European Commission. It is designed to study the effects of different transport and environment policies on the emissions of the transport sector. The model estimates the transport demand, the modal split, the vehicle fleets, the emissions of air pollutants and the welfare level under different policy scenarios. All relevant transport modes are modelled, including air and maritime transport. The model covers the 1995-2030 period.

Context

TREMOVE is a policy assessment model to study the **effects of different transport and environment policies on the emissions of the transport sector**. The model estimates the transport demand, the modal shifts, the vehicle stock renewal, the emissions of air pollutants and the welfare level. The model can be applied for environmental and economic analysis of different policies such as road pricing, public transport pricing, emission standards, payments for public services for cleaner cars etc. TREMOVE models both passenger and freight transport in 31 European countries (EU 27 + Croatia, Norway, Switzerland, Turkey), and covers the period 1995-2030 with yearly intervals.

The TREMOVE II model has been further developed by Transport & Mobility Leuven in a service contract for the European Commission, DG Environment. The first version of the model dates 1997-1998. At that time, the model covered 9 countries and focussed on road transport. The K.U.Leuven and DRI developed the first model as an analytical underpinning for the European Auto-Oil II programme.

In 2002-2005, TREMOVE has been enhanced and extended. The new model also covers explicitly rail, air and shipping and deals with a larger set of pollutants. Moreover, it covers all EU15 countries, plus Switzerland, Norway, the Czech Republic, Hungary, Poland and Slovenia. The new model has been made consistent with other European transport and energy scenarios and takes on board the most recent emission computation methodology available at EU level.

Since March 2005, the TREMOVE II transport and emissions model has been available for policy runs. It has been instrumental for the Clean Air for Europe (CAFE) programme for air quality, the European Climate Change Programme (ECCP), as well as for other programmes like the update of the white paper for transport (ASSESS).

In 2006 TREMOVE was updated by improving the database for 1995-2000 (statistical data) and making some minor model additions (projections on hybrids, CNG, airco). Moreover, 10 new countries, improved emission modeling, and a more elaborate vehicle choice model are added.

Recent projects (f.e. TREMOVE SCP-CAR) contain the impact of environmental taxation and a scrappage subsidies on transport emissions and economy. TREMOVE was extended with a new module that covers the material flows (production and waste) of road transport. The most recent version TREMOVE v3.1 is available at the JRC of the European Commission.

In 2009-2010, TREMOVE was thoroughly updated with particular focus on updating the input data. This project resulted in the youngest TREMOVE versions: “v3.3.2” en “v3.3.2 alt”, corresponding to the version used in the i-TREN project (3.3.2: iTREN Reference, 3.3.2 alt: Integrated).

Modular Structure

TREMOVE consists of **31 parallel country models, and one maritime model**. Each country model consists of three inter-linked 'core' modules: a transport demand module, a vehicle turnover module and an emission and fuel consumption module, to which we add a welfare cost module and a life cycle emissions module.

The **transport demand module** describes transport flows and the users' decision making process when it comes to making their modal choice. The TREMOVE model represents the transport activities in a country as an aggregate of the activities in three types of zones: metropolitan, urban and non urban. For each zone, one represents all modes of passenger transport and freight transport. Passenger and freight users have the choice between some 240 different types of modes and vehicles (mode, vehicle, timing etc.). Road freight and passenger transport interact via congestion and a distinction is made between peak and off peak traffic. The preferences of passengers differ in function of the motive (professional, commuting, leisure) and choices are made taking into account preferences, money and time costs. For freight, different types of transport (unitized, bulk..) are distinguished and modal choice is a function of the time and money cost of the different alternatives. The private cost of transport consists of the price set by the suppliers (equal to the marginal resource cost if not subsidized) plus all the taxes, charges and tolls. Urban public transport supply is characterized by a Mohring effect: an increase in demand allows to improve frequencies and to reduce waiting times. The capacity of the road infrastructure is represented via area speed flow functions. Starting from the baseline level of demand for passenger and freight transport per mode, period, region etc., the module describes how the implementation of a policy measure will affect the user's and company's choice between these 240 different transport types. The key assumption here is that the transport users will select the volume of transport and their preferred mode, period, region etc. based on the generalized price for each mode: cost, tax or subsidy and time cost per km travelled and the price elasticity. The TREMOVE model incorporates a range of elasticity values, which are either exogenous or endogenous to the model. The household utility functions and the business production functions are nested CES functions – hence, assume constant elasticity of substitution at each level of the tree. This implies that at each branching of the utility and production trees an elasticity of substitution value must be specified. These elasticities of substitution are explicitly present in the utility and production functions and are determined outside the model. The elasticities of substitution (together with the demands and prices of the "goods', i..e. the transport modes) determine three endogenous elasticities: the income elasticities, the own price elasticity and the cross price elasticities.

The output of the demand module consists of **passenger kilometers (pkm) and tonne kilometers (tkm) that are demanded per transport type** for a given policy environment. The pkm and tkm are then converted into vehicle kilometers.

The **vehicle stock turnover module** describes how changes in demand for transport or changes in vehicle price structure influence the share of age and type of vehicles in the stock. The output of the vehicle stock module is twofold: we split both **the total fleet and the number of km for each year according to vehicle type and age**.

The **fuel consumption and emissions module** is used to calculate fuel consumption and emissions, based on the structure of the vehicle stock, the number of kilometers driven by each vehicle type and the driving conditions.

Outputs from the vehicle stock and fuel consumptions and emissions modules are fed back into the demand module. As fuel consumption, stock structure and usage influence usage costs, they are important determinants of transport demand and modal split.

In addition to the three core modules, the TREMOVE model includes a lifecycle emissions and a welfare cost module.

The **lifecycle emissions module** enables to calculate emissions during production of fuels and electricity. The **welfare cost module** has been developed to compute the cost to society associated with different transport policy measures. The welfare effect of a policy change is calculated as the discounted sum of changes in utility of households, production costs, external costs of congestion and pollution and benefits of tax recycling. These benefits of tax recycling represent the welfare effect of avoiding public funds to be collected from other sectors, when the transport sector generates more revenues.

In this study the model is used for counterfactual analysis: what is the effect on transport volumes, modal split, external costs and the welfare of modifying taxes and charges such that they better match the different external costs.

Limitations of the TREMOVE model

As all models TREMOVE has some limitations, either due to data or to the way the model is set up.

Data

- The volumes in the reference scenario are exogenously. They are determined outside TREMOVE (based on TRANS_TOOLS model runs in iTREN). Hence it is not possible to consistently change some of the main assumptions made in this reference scenario – for example a higher increase in fuel prices.
- TREMOVE makes mostly use of European wide statistical sources: EUROSTAT, UIC,... . Thus it might deviate from more recent or more detailed data that is available at national level. It is possible to include national data, however this is very time consuming and will make renewed calibration necessary. Vehicle stock data has been updated in 2009, but still only includes data up to 2008 for some parameters and 2005 for most

Model

- The TREMOVE model is a partial equilibrium model and hence only focuses on the transport market. The effect of policies on other markets is not directly taken into account.
- TREMOVE only has one user type, it does not differentiate according to income, etc. Hence an equity analysis of policies is not possible.
- Transaction costs of switching to another mode (in response to a policy) are not included explicitly (but are implicitly in the elasticities of substitution and the consumer surplus calculation) .
- Given that it uses constant substitution elasticities, the model is in principle only valid for moderate changes in demand & prices
- The model cannot be used for analysing short term effects of policies (1st 5 years) - as it is made to predict mid to long term effects of policies.

ANNEX 16: Real life distributions

The tables below show the real life average speed and standard deviation which were used to calculate the stylised average speed and standard deviation in the calculations.

Table A- 15: Average speed and standard deviation on motorways for HGV

Country	UK	UK	UK	UK	UK	Belgium	Ireland	Ireland	Finland	France	France
Motorway	Rigid- 2 axle	Rigid 3 axles	Rigid 4 axles	Articulated - 4 axles	Articulated - 5 axles	all HGV	Rigid	Articulated	N2/N3	all HGV	all hgv
average speed	98	86	86	86	86	89	86	85	86	97	86
STANDARD DEVIATION	16	6	6	6	4	4	0	6	10.4	6.5	6.3
speed limit	n/a	96	96	96	96	90	80	80	120 summer/100 winter	130	110

Table A- 16: Average speed and standard deviation on dual carriageways for HGV

Year	2011	2011	2011	2011	2011	2011	2012
Country	UK	UK	UK	UK	UK	France	Finland
dual carriage way	Rigid- 2 axle	Rigid 3 axles	Rigid 4 axles	Articulated - 4 axles	Articulated - 5 axles	HGV	N2/N3
average speed	94	85	85	85	85	82	84.5
STANDARD DEVIATION	11	9	8	9	6	7.69	9.3
speed limit	n/a	80	80	80	80	110	100

Table A- 17: Average speed and standard deviation on single carriageways for HGV

Year	2011	2011	2011	2011	2011	2011
Country	UK	UK	UK	UK	UK	France
single carriage way	Rigid- 2 axle	Rigid 3 axles	Rigid 4 axles	Articulated - 4 axles	Articulated - 5 axles	HGV
average speed	74	67	69	69	70	76
STANDARD DEVIATION	12	14	14	14	12	9.59
speed limit	n/a	64	64	64	64	90

Table A- 18: Average speed and standard deviation on urban roads for HGV

Year	2011	2011	2011	2011	2011	2011
Country	UK	UK	UK	UK	UK	France
urban roads	Rigid- 2 axle	Rigid 3 axles	Rigid 4 axles	Articulated - 4 axles	Articulated - 5 axles	HGV
average speed	48	46	48	48	48	49
STANDARD DEVIATION	10	11	11	12	10	11.04
speed limit	48	48	48	48	48	50

Table A- 19: Average speed and standard deviation for buses in the UK and Finland

	UK				Finland	
	Motorways	Dual carriageways	single carriageways	urban roads	Motorways	Dual carriageways
	2011	2011	2011	2011	2012	2012
average speed	99	96	72	43.2	92.7	96.3
STANDARD DEVIATION	13.95	13.94	14.01	8.93	10.5	10.2
speed limit	112	96	80	48	120 (summer)/100 (winter)	100

Table A- 20: Average speed and standard deviation on motorways for cars

Year	2011	2010	2011	2011	2011	2011
Country	UK	Belgium	Ireland	France	France	Finland
average speed	110	118	109	113	101	109
STANDARD DEVIATION	16	19	14			15
speed limit	112	120	120	130	110	1

Table A- 21: Average speed and standard deviation on dual carriage ways for cars

Year	2011	2010	2011	2011	2011	2011
Country	UK	Belgium	Ireland (NP)	Ireland (SP)	France	Finland
average speed	109	71	12	82	101	97
STANDARD DEVIATION	15		100	13		12
speed limit	112	70	0	100	110	100

Table A- 22: Average speed and standard deviation on single carriage ways for cars

Year	2011	2011	2011	2011
Country	UK	Ireland (regional road)	Ireland (local road)	France
average speed	77	77	64	80
STANDARD DEVIATION	15	13	27	
speed limit	96	80	80	90

Table A- 23: Average speed and standard deviation on urban roads for cars

Year	2011	2010	2011	2011	2011
Country	UK	Belgium	Ireland	France	Austria
average speed	48	54	61	51	51
STANDARD DEVIATION	10		13	52	8
speed limit	48	50	50	53	50

Table A- 24: Average speed and standard deviation for LDV in the UK, 2011

	motorway	dual carriageways	single carriageways	urban roads
average speed	112.0	108.8	76.8	48.0
STANDARD DEVIATION	113.0	15.2	15.5	10.2
speed limit	114.0	112.0	96.0	48.0